Cloud based Employee Timesheet Model Using Facial Recognition; in case of Oromia Occupational Competence Assurance Agency

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A Thesis Submitted to Department of Computer Science and Engineering

School of Electrical Engineering and Computing

Presented in Partial Fulfilment of the Requirement for the Degree of Masters of Science in Computer Science and Engineering

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Declaration

I hereby declare that this Master thesis entitled **Cloud-based Employee Timesheet Model using Facial Recognition: the case of Oromia Occupational Competence Assurance Agency (OOCAA)** is my original work. It has not been submitted to any other university as a partial requirement for a degree or certificate. I also confirm that all sources used in this thesis have been appropriately acknowledged.

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Name	Signature	Date

Recommendation of Advisor

I the advisor of this thesis, hereby certify that I have read the revised version of the thesis entitled "**Cloud based Employee Timesheet Model using Facial Recognition: the case of Oromia Occupational Competence Assurance Agency (OOCAA)**" prepared under my guidance by **Chala Wakshuma Wadajo** submitted in partial fulfillment of the requirements for the degree of Masters of Science in computer science and Engineering. Therefore, I recommend the submission of the revised version of the thesis to the department following the applicable procedures.

Dr. Biruk Yirga	_____	_____
Advisor	Signature	Date

Approval of Board of Examiners

I the advisors of the thesis entitled "**Cloud based Employee Timesheet Model using Facial Recognition: the case of Oromia Occupational Competence Assurance Agency (OOCAA)**" developed by **Chala Wakshuma** hereby certify that the recommendations and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

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Advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by **Chala Wakshuma Wadajo** have read and evaluated the thesis entitled "Cloud based Employee Timesheet Model using Facial Recognition: the case of OOCAA" and examined the candidate during the open defense. This is, therefore, to certify that the thesis is accepted for partial fulfillment of the requirement of the degree of Master of Science in Computer Science and Engineering.

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Abstract

This paper introduces a cloud-based employee timesheet model that utilizes facial recognition methods, specifically targeting the Oromia Occupation Competence Assurance Agency. The limitations of traditional paper-based timesheets are highlighted, and a facial recognition-based model is proposed as a solution. The motivation behind this work stems from the inefficiencies, time consumption, and inaccuracies of the traditional timesheet process, exacerbated by the need for touchless solutions during the COVID-19 pandemic. Leveraging facial recognition, a biometric technology that identifies individuals based on unique facial features, presents a promising alternative. The system incorporates the Haar Cascade Classifier for face alignment and detection, followed by a Convolutional Neural Network (CNN) for extracting high-level features and matching faces in a cloud-based database. By combining computer vision algorithms, facial recognition technology, and cloud-based storage, the proposed solution aims to streamline the timesheet process and enhance efficiency. The study collected datasets from publicly available face databases from Flicker database and supplemented them with suitable Ethiopian face datasets. A total of 2945 datasets were utilized, with 441 known faces and 2504 unknown faces. The data was split into training, validation, and testing sets, employing holdout classification to avoid overfitting while it helps in assessing how well the model generalizes to unseen data. The performance of algorithms such as CNN, ANN, and SVM was compared, with CNN achieving the highest training accuracy (97.83%) and validation accuracy (88.30%), along with the lowest training and validation losses. Consequently, CNN was identified as the most suitable model for the timesheet system.

The keywords: *timesheet, face recognition, face detection, real-time processing, biometrics, CNN, ANN, SVM.*

CONTENTS

Abbreviations and Acronyms

OOCAA	Oromia Occupational Competence Assurance Agency
HR	Human Resource
FRA	Face Recognition Algorithm
NN	Neural Network
CNN	Convolutional Neural Network
ICT	Information Communication technology
CSP	Cloud Service Provider
SW	Software
PCA	Principal Component Analysis,
KNN	K-Nearest Neighbor
SVM	Support Vector Machine
AAM	Active Appearance Models

CHAPTER 1

1. INTRODUCTION

This research is related to Timesheet the case of Oromia Occupational Competence Assurance Agency shortly abbreviated as (OOCAA). (Agency, 2021) OOCAA is a governmental organization established in Oromia Regional State having a responsibility of taking care of occupational Assessments in the region. Established 2015 (2007 E.C.) by the Oromia cabinet. To provide occupational competence assurance service in the region there are seven branches under this office in the region. These organizations have around 257 employees in both branches and head office inclusively. The author focuses on developing cloud-based timesheet model of facial recognition for OOCAA.

1.1 BACKGROUND OF THE STUDY

ICT has transformed the way we do things in our lives dramatically over the years. Without a question, computer assisted has had a huge influence on every aspect of human life. Tasks and processes will be completed inefficiently if computers are not used, and in certain cases will be impossible to complete. Every day, a large number of applications are created to meet the needs of many industries, such as education and other organizations by various sectors such as education institution or other organizations.

In the business world of today we all know one simple truth that Time Is Money! We work to keep the amount of time it takes to complete even the simplest tasks down to the minimum.

Figure 1 : Shows the Importance Time and Valued With Money.

A revered organizations has thousands of employees working in many departments, and each department has various teams divided according to the types of work they do (for instance, the IT department has a designing team, a development team, etc.). All of these employees keep track of their daily work in excel sheets, emails, laptops, notepads, etc.

It is convinced that machine learning and deep learning are now vital in today's computers environment which is everything are moving rapidly in a sense that every process are being done within split seconds. With the aid of computers, it is not only proven that organizations could

smoothen out their everyday-routines, but furthermore, organizations could achieve their corporation objectives effortlessly. Besides other than individuals could improve their productivity, and skills, they could also provide a better quality of service in terms of efficiency and effectiveness to their employers and country as a whole.

The success of an organization relies heavily on the management of its employees, who serve as its foundation. To accommodate changes, the positions of individual employees can be modified within the database. However, relying on the manual attendance process, which is both time-consuming and prone to mistakes, has been a practice of the past.

Timesheet system is a system that is use to track the time and attendance of a particular person and is apply in Industries, Schools, Universities and other working firms. The traditional way for taking attendance has drawbacks, which is the data of the attendance cannot be reuse and tracking is too difficult. A simple thing but very important to companies, Timesheet is (Shaheen, 2016) . It is a critical factor for organization that has Employees. Information gathered through timesheet system reporting style helps to determine whether an organization is on the right track as well as if it moving toward successful future. Many studies were done to boost the organization's productivity. Many elements have been identified as the useful primarily for increasing the efficiency and production of various companies. Those factors are human, technological, economic and environmental factors. The main causes of human factors are fraud and laziness. The important aspect of this interval is the records of attendance in terms of punctuality, regularity on duty, expected hours put to work are some. Due to inaccurate record keeping of their time and labor, many employees have been paid under or over in industries.

A timesheet helps to track the records of the amount of time an employee has spent at the office (time and attendance). It usually comes in terms of a simple table that both Employers and Employee can use to keep track of the number of hours worked. Be it on their job, project, or working for specific task. In the past, this information was record on paper. However, with the advancement of technology it is now a norm for timesheet to be digital and stored directly on Cloud services. With easy timesheets, not only will of company be able to reduce costs, it will also be able to increase the employees' time and attendance work records visibility and stay on budgeted and their performance.

Nowadays, most of the timesheets are paper based. Paper based timesheet could be a barrier for the companies which seek to reach a higher level of productivity. Paper timesheet occupy huge physical space in the office; this will cost more money, also it is time consuming because it requires time to process and submit the sheet. Furthermore, Paper timesheets are also likely to error because it could be hard to distinction time data from employees that hand write their time. This causes error in identifying the actual real data.

1.2 IMPORTANCE OF FACIAL RECOGNITION

Face recognition is a biometric technique that involves determining the identity of an individual by comparing a live image of their face with images stored in a database. The human face is considered a distinct representation of an individual's identity. Facial technology will be another important amplified world technology. It's one of the few biometric technologies that are shiny our mind quietly. Face recognition is another category of biometric system that maps an individual facial feature mathematically and stores the data as face print (Gillis, 2022). Face recognition systems can be used to identify people from images and videos in real-time. It is the process of identifying a person's identity using their face (THALES, 2021). Face is turning into the preferred measurement over current biometrics basically on the grounds that it is a characteristic attestation of personality, and its non-meddlesome nature gives more comfort and simplicity of confirmation. For instance, in a fingerprinting framework, the subject is needed to interface with the framework by setting a finger under a unique mark per-user, and the outcomes must be confirmed by a specialist. Interestingly, utilizing the subject's face as a measurement requires no mediation, and the outcomes can be checked by a non-master (P & M, 2001).

In the real-world application of face recognition there are some causes why we need the face recognition while the face recognition is currently being used to make the world safer, smarter and more convenient (Vidha).

- To retake crime
- To find the missing person
- To security identification
- To lever the attendance system
- To identify accounts on social media

- To identify drivers in car, etc. methods to perform facial recognition depending on the performance and the complexity.

As the application (truMe.in, 2021) developer says; in the aftermath of the pandemic, the benefits of face recognition attendance systems have garnered considerable interest among application developers. In today's contactless era, where everything from financial transactions to education has been revolutionized, automated attendance systems have significantly evolved. The latest iteration, the face recognition system, has simplified the process of marking attendance, offering enhanced convenience and time-saving advantages.

The face recognition attendance system has attracted the attention of businesses, both small and large, owing to its wide range of advantages for employers and employees. It comes as no surprise that these systems are being adopted more frequently in office spaces and business complexes. For those still relying on manual attendance systems, implementing a face recognition system can greatly enhance employee management. For instance, truMe's touchless, cloud-based face recognition attendance system is well-suited to current industry needs. By accurately tracking employee attendance and reducing costs, such a system also provides an additional layer of security. It is now the opportune time to upgrade your workplace's attendance system from manual methods to one based on facial recognition technology.

1.3 MOTIVATION

Many organizations, including government entities, continue to rely on outdated paper-based attendance systems. However, these methods are inefficient, insecure, and prone to loss or damage. They are also time-consuming and costly, with potential legal and financial impacts due to errors or unforeseen circumstances. Moreover, organizations with a large number of employees following similar work schedules face additional challenges with paper-based systems. To address these issues and ensure data security, efficiency, and easy access to attendance information and employee performance, transitioning to a cloud-based solution is necessary. This shift can save time, storage space, and offer a more reliable and secure attendance management system. In government-owned enterprises, where hundreds of employees may be involved, managing and tracking attendance manually becomes burdensome and problematic. As businesses expand, it becomes necessary to reevaluate the use of timesheets and other technologies to accommodate the growing workload and improve productivity.

Transitioning from paper-based timesheets to digital ones is crucial, particularly in the era of teleworking. Furthermore, the need for contactless attendance systems has become evident to prevent the spread of diseases through physical contact and contaminated surfaces. Given the current concerns around diseases transmitted through contact, such as the COVID-19 virus, non-contact entry methods have become essential for ensuring safety. Traditional biometric systems that rely on touch-based interactions are no longer considered safe. Consequently, there is a growing interest in leveraging computer-supported technologies, especially with the advancements in Computer Vision and image-related research. These developments have paved the way for identification, detection, and recognition systems. Facial recognition systems offer a touchless alternative that can be implemented to ensure employee safety and access their attendance.

1.4 STATEMENT OF THE PROBLEM

Currently, many organizations rely on a manual attendance system, which often leads to accidental loss of attendance sheets and delays in effectively monitoring the attendance of their Human Resources (HR). In Ethiopia, most government organizations use manual attendance, while some institutions utilize biometric attendance systems based on fingerprints. A study conducted within Oromia Occupational Competence Assurance Agency (abbreviated as OOCAA) Company revealed that their manual attendance system is time-consuming, prone to human error, and susceptible to loss. At OOCAA, employees use a pen and notebook to record their attendance by writing their names, arrival times, and signatures in designated columns. This data is used to calculate employee salaries, considering instances of lateness and absence. However, the problem with this system is that employees can manipulate entries, leading to potential falsification of attendance records.

The problem with old system is that, most of the timesheets are paper based. Paper based timesheet could be a barrier for the companies which aspire to reach a higher level of productivity. Paper timesheet occupy huge physical space in the office; this will cost more money, also it is time consuming because it requires time to process and submit the sheet. Furthermore, Paper timesheets are also likely to error because it could be hard to distinction time data from employees that hand write their time. This causes error in identifying the actual real data. Another issue with paper-based time sheet is allowing entering someone else’s time and nobody could know.

Figure.2 below shows the paper-based attendance system for Oromia Occupational Competence Assurance Agency having days in a month including Weekend and Holidays marked differently. It has twelve months, which means for every employee it was once prepared for one year for each of them in a single sheet separately and they put their signature twice a day, that is during morning When the Employee arrive for office until 8:30 o'clock and 1:30 during afternoon.

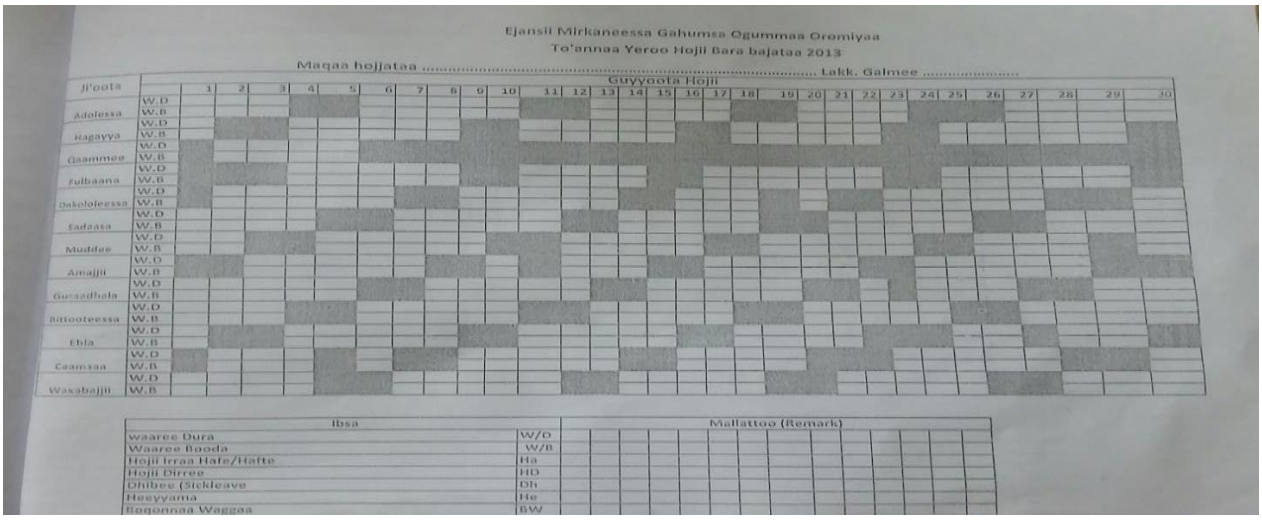


FIGURE 2 MANUAL TIMESHEET OF OOCAA

1.5 RESEARCH QUESTION

This research will set the following research question to examine the problem in modeling the cloud-based timesheet based on facial recognition.

1. What kinds of systems and methods are used for making the timesheet model system using facial recognition?
2. What kind of algorithm is suitable for making the timesheet management system using facial recognition?
3. How accurately does the new model perform according to the chosen performance metrics?

1.6 OBJECTIVES

1. 6.1. GENERAL OBJECTIVES

The general objective is to model Employee cloud-based timesheet using facial recognition by applying a deep learning approach to fill the gap of traditional tracking of employee for government organization in case of OOCAA.

1. 6.2. SPECIFIC OBJECTIVES

The specific objectives of the study are;

- ✓ To conduct literature review and related work that helps to understand the approach and usability of timesheet and find the gaps.
- ✓ To model the employee timesheet using FR that helps the government institutions by applying CNN.
- ✓ To model facial recognition database.
- ✓ To evaluate the model using performance metrics for achieving maximum accuracy.

1.7 SIGNIFICANCE OF THE STUDY

This paper focuses on the cloud-based employee timesheet system modeling using facial recognition. Its purpose is to accurately track and record the tasks performed by employees, along with the time spent on each task. The system serves to assess the efficiency of workers by comparing their working hours to their output. It helps identify underperforming employees who may be costing the company money, while also providing insights into the productivity of each employee. By streamlining the timesheet payroll process, the system ensures accurate payment for employees. Typically, timesheets are required from nonexempt employees to comply with government regulations and company policies. The paper explores a model that aims to increase employee efficiency through time tracking and documentation, improve the quality of the payroll system using a computerized approach, and maintain confidentiality. It also highlights the ability of the system to generate reports for company management and automate various employee-related functionalities.

1.8 RESEARCH METHODOLOGY

The research methodology describes the procedures and steps used to conduct the research along with description of the necessary tools. The specific research method we followed in this research was experimental type. Based on these methodologies, the proposed research could be classified as applied research or experimental research. Applied research involves solving practical problems and developing new technologies, while experimental research involves testing premises and evaluating theories. The proposed research involves developing a practical solution for employee attendance tracking using facial recognition technology. For the achievement of the objectives of this research, the following approaches are described as follows:

i. Literature Review

The identification and comprehension of theoretical concepts and related research are vital stages in this particular study. To gain a thorough understanding of the research area, an extensive literature review is conducted. Additionally, a significant factor in successfully completing the research lies in understanding the tools employed for experimentation. As a result, the literature review conducted in this study primarily targets key aspects related to these elements.

- Recognize the theoretical underpinnings of both human and machine face recognition systems in general and statistical approaches to face recognition in particular.
- Understanding what has been done before in the area of face recognition
- Identify the various tools, techniques, and algorithms for face recognition that are employed during the experiment.

ii. Data collection technique

The research focuses on a face recognition system that requires facial images of individuals as input. There are numerous datasets available for face detection, and face recognition. However, most of them are only for research purposes. Acquisition of these images is conducted in using both online dataset by checking research studies or academic papers such as IEEE, ACM, or Google Scholar if they were used Ethiopian face datasets for facial recognition tasks. Also, different face and the data of images captured of local face dataset. The images taken are made to be representative of Ethiopian faces. As part of the research, individuals' face images were captured and underwent manual processing. To augment the dataset used for the model, the researchers sought open-source datasets available online. Eventually, they chose the Flickr-Faces-HQ Dataset (FFHQ), which was originally designed for generative adversarial networks (GAN). This dataset comprises 70,000 high-resolution PNG images of human faces, featuring diverse characteristics such as age, ethnicity, image background, and accessories like eyeglasses and hats. A subset of these FFHQ images was incorporated into the research model (Frumkin, 2023). Finally, a Known face images and Unknown face dataset images was constructed.

iii. Algorithms Used

Various machine learning algorithms, including Neural Networks, Artificial Neural Networks (ANN), Support Vector Machines (SVM), Convolutional Neural Networks (CNN), and other image recognition-based algorithms, will be working to identify and classify face datasets. These algorithms will be evaluated and compared against each other to determine their performance.

Subsequently, the algorithm that yields the most accurate and efficient results will be chosen as the final algorithm for face detection and recognition.

iv. **Tools**

The success of the research depends heavily on the choice of the right tools, which can assist the researcher in designing and putting the architecture into practice.

- **Anaconda**: - is used for the implementation of the model and it is a free and open-source distribution of the python and R programing languages for computer vision and primarily used in data science and machine learning. It provides a comprehensive package management system and a collection of pre-built libraries and tools that are commonly used in scientific computing and data analysis. Anaconda simplifies the process of setting up and managing software environments for data-related tasks by allowing users to easily install, update, and switch between different packages and dependencies. Anaconda includes popular data science libraries such as NumPy, Pandas, Matplotlib, and SciPy, as well as development environments like Jupyter Notebook and others. It also offers a graphical user interface called Anaconda Navigator, which provides a convenient way to manage packages, launch applications, and create new environments.
- **Tensor Flow**: is an open-source machine learning framework and is widely used for building and deploying machine learning models, particularly in deep learning applications. It has the key feature ability to work with computation graphs. The architecture of Tensor flow works for pre-processing of the data, building the model, train the model, and estimate the model. All the Computation in Tensor Flow involves tensor (n-dimension array) that represents all kinds of data. Tensor Flow also uses graph framework for graphical representation of the series of computation during the training. It has two distributions for CPU and GPU. It supports a wide range of applications beyond deep learning, including traditional machine learning algorithms such as linear regression, support vector machines (SVMs), and decision trees. It also provides tools and libraries for data preprocessing, visualization, and model serving. TensorFlow offers a high-level API called Keras, which simplifies the process of building and training neural networks.
- **Keras:-** is a high-level neural network application programming interface (API) that runs on top of various deep learning frameworks, including TensorFlow. It provides a user-friendly and intuitive interface for building, training, and deploying deep learning models. It is very

simple to develop a model, user friendly, easily extensible with python, and most importantly it contains pre-trained CNN models. It provides a range of utilities and functionalities for model training, evaluation, and inference. It includes built-in methods for data preprocessing, data augmentation, and model visualization.

- **Visual Paradigm: -** is a software modeling and diagramming tool that supports various types of visual modeling techniques. It provides a comprehensive set of features and tools for creating professional-looking diagrams and models. It offers a user-friendly interface with drag-and-drop functionality, making it easy to build and edit diagrams. Users can create a wide range of diagrams, such as class diagrams, use case diagrams, activity diagrams, flowcharts, and more.

1.9 LITERATURE REVIEW

Is a thorough and critical examination of existing literature, scholarly articles, books, and relevant sources pertaining to a specific research topic. Its purpose is to identify, analyze, and combine the available literature to develop a comprehensive understanding of the current knowledge in a particular field or subject area. It serves as a vital and essential component of research, involving the investigation and analysis of various references and journals related to the research topic.

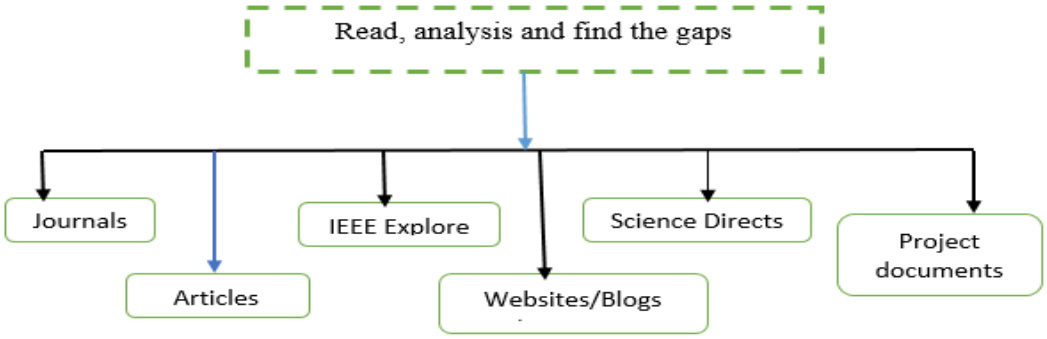


FIGURE 3: Digital Library for Proposed Research (*Adapted From* (GUTEMA, 2018))

1.10 SCOPE AND LIMITATIONS

In recent times, organizations are on a lookout on a system to record employee attendance and time. The study assumes that the training and testing of the system use only face images, but non-face images are included to establish threshold values for rejecting non-face images if they are mistakenly presented to the system. While face detection is not the focus of this thesis,

certain pre-processing techniques are employed to ensure that all faces are approximately located in the same position across the images.

However, the scope of this paper is to focus on how the Government organization can easily take the attendances of their employee and track them the time they clock in and out on the office through the easy way of application Cloud based Timesheet system using FR to reduce the activity of manual attendance taken manually.

The major limitation of this study is that due to the restriction of time in completion of this research, it was difficult to construct a larger face database. The other limitation of the proposed system is it assumes the inputs are all face images.

1.11 APPLICATION OF STUDY

A cloud-based timesheet model using facial recognition system can be applied in various industries and business settings where there is a need to accurately track employee work hours and prevent time theft.

Manufacturing: In a manufacturing setting, a cloud-based timesheet model using facial recognition can be used to track the work hours of employees in the assembly line or warehouse. This can help ensure that employees are working the appropriate hours and prevent time theft.

Healthcare: In a healthcare setting, a cloud-based timesheet model using facial recognition can be used to track the work hours of nurses, doctors, and other healthcare professionals. This can help ensure that healthcare professionals are working the appropriate hours and prevent time theft.

Retail: In a retail setting, a cloud-based timesheet model using facial recognition can be used to track the work hours of employees in the store. This can help ensure that employees are working the appropriate hours and prevent time theft.

Hospitality: In a hospitality setting, a cloud-based timesheet model using facial recognition can be used to track the work hours of employees in the hotel or restaurant. This can help ensure that employees are working the appropriate hours and prevent time theft.

Education: In an education setting, a cloud-based timesheet model using facial recognition can be used to track the work hours of teachers and staff. This can help ensure that teachers and staff are working the appropriate hours and prevent time theft.

1.12 ORGANIZATION OF THESIS

This study has a different section that is classified by chapter. This thesis is organized and set forward based on the flow of content of each chapter under this study accordingly starting from the second chapter through the last chapter were discussed as follows.

In **Chapter 2** We will discuss about the literatures from different sources will be reviewed, similar works of related literatures will be discussed, theories of attendances and timesheets, comparison of attendance and timesheets, and so many other related issues will be discussed and summary of their contribution and gaps will be discussed.

In **Chapter 3** the research methodology which includes development tools including hardware and software needed for success of our thesis, the computer vision algorithms employed in our work, the type of research methods followed will be discussed.

In **Chapter 4** the proposed solution, research design and development, dataset preparation, image preprocessing will be discussed

In **Chapter 5** the development of the model, results found, the implementation of proposed solution and graphical evaluation of the model will be discussed.

In **Chapter 6** the process followed in the research, model developed, and method employed, result found will be discussed and recommendations for future work will be forwarded.

CHAPTER 2

LITERATURE REVIEW AND RELATED WORK

2. 1. OVERVIEW

This chapter reviews the outlines of attendances, timesheets and different literatures that related to the objective of the study discussed. Also a variety of articles related to timesheets, methods for tracking time and attendance, as well as associated research on these topics both domestically and internationally, in order to help readers, understand how to use them into practice in businesses or governmental institutions.

2. 2. CONCEPTS OF ATTENDANCE AND TIMESHEET

Manual and Automated system are the two categories of Attendances. Paper-based time and attendance systems rely on manual processes where employees complete time cards and timesheets, which are then reviewed by managers to ensure accuracy (Mohammed, S, N, & F, 2014). When multiple employees execute jobs that entail recording numbers, information on this time and attendance system is prone to human error. When employees come at work, go to lunch, take a break, then leave for the day, they punch in and out. Instead of using paper-based attendance tracking systems, organizations can implement electronic systems like tags, barcodes, magnetic stripe cards, biometrics, and sensors to automate the process of identifying employees' entry and exit from the workplace. Automated time and attendance systems offer several advantages to organizations, including a reduction in the reliance on manual methods of tracking attendance using pen and paper. Now days, most organization are dependent mainly on data (Lakshmi & P, July, 2017), but they uses manually or paper based time and attendance sheet to track their Employees. This attendance and timesheet system is for the purpose of payroll system.

According to (IceHrm.com, 2020), the developer of the HRMS for small and medium sized organizations: Timesheet and Attendance are different concepts. (ICEHrm.com, 2020) A timesheet is a record that shows the hours worked by an employee, typically organized by the days of the week.

2. 3. BIOMETRIC ATTENDANCE SYSTEM

Tracking the time spent by employees on a job is essential for ensuring accurate payment (Solution, 2022). This led to the practice of recording attendance records, which began with the introduction of time clocks in the late 1800s. Initially mechanical, these clocks were later replaced by electric ones. However, they were prone to failures and required frequent repairs. As technology advanced, time clock software emerged in the 1990s, prompting businesses to transition away from mechanical devices. With the development of computing systems, time clock software evolved into sophisticated packages like biometric attendance systems, addressing issues such as proxy attendance.

Biometric time and attendance systems utilize various biometric scans, such as fingerprints, irises, faces, typing cadence, and voices, to establish unique identifiers for individuals. These identifiers serve as the exclusive codes for accessing or leaving the workplace. By employing biometric attendance systems, the risk of fraudulent activities like proxy entry is significantly minimized. This is due to the fact that the biometric characteristics, such as fingerprints, of each individual are distinct and cannot be replicated by others, ensuring a high level of accuracy and security.

Biometric systems have significant benefits for institutions and users (Smith, 2022). Institutions can save costs by eliminating the need for ID cards and equipment, while ensuring high accuracy and security through multi-modal biometric identification. These systems prevent fraudulent activities like buddy punching and easily integrate with popular payroll systems. They efficiently monitor attendance using passive recognition and surveillance cameras. For users, biometrics provide convenience by eliminating the need for time cards and offering accurate attendance recording through face, fingerprint, or iris recognition. Users can record attendance from anywhere using their personal smartphones, and the contactless nature of biometrics ensures hygiene. Offline attendance recording guarantees that users never miss out on wages, even in the absence of connectivity.

By integrating the biometric system with timesheet system, we can streamline the process of tracking employee attendance and ensure that the timesheets reflect accurate and reliable data. This reduces manual effort, minimizes errors, and provides a more efficient and transparent method of managing employee working hours.

2. 4. CONCEPT OF BIOMETRICS

Biometric is a unique, measurable characteristics of a human being that can be used automatically recognize or verify an individual's identity (Ms. Swati & Mr. Sumit , October, 2014). (Savvides) For our use biometric is refers to technologies of measuring and analyzing persons physiological and behavioral characteristics of individuals that uniquely to identify or verify persons.

- **Physiological biometric** : - are a characteristics based on measurements and data driven from direct measurements of a part of human body such as DNA recognition, Iris scanning, Ear recognition, Face recognition, Finger print or geometry, Retina recognition, Hand geometry recognition, Vein recognition.
- **Behavioral biometrics**: - are a characteristic based on a measurements and data driven from an action of human such as gait, keystroke, voice and signature recognitions.

Biometrics is a science of automatically recognizing people based on physical or behavioral characteristics such as face, fingerprint, iris, hand, voice, gait, and signature (D.A & A., 2013). (Marthin, 2009) (Martin, 2014) Biometrics is the analysis of biological observation phenomena that we routinely used to recognize other people using the shape of face or the sound voices and etc. It is used to create automated ways of recognizing a person based on physical and behavioral characteristics. Using biometrics in security application is pleasing. Biometrics cannot be changed either without medical procedure or injury and cannot be copied. They are intrinsic to person down to the DNA, with very few exceptions. Determining a person through the presence of the physical object such as key or access cards has the problem while they can be stolen or lost. Biometric identity is the cornerstone of personal physical identification (Brett & John , 2016). Biometrics are private but not secret such as iris scans, fingerprint, face image and palm (Raj, Surya, & ...., 2019). Biometric identifiers are have yet to gain acceptance in many developed nation despite the technologies becoming more affordable agreeable to daily use, and that currently using in healthcare sectors to identify their employees when they login to use their health IT systems (Cristina & Shaun J, 2023). Involves the study of approaches (i.e. finger, iris, face) and algorithms for uniquely recognizing human based on physical and behavioral cues , and those traditional approaches are based on the physiological biometrics that rely on physical attributes for recognition (Pavan & Ashok , 2010) .

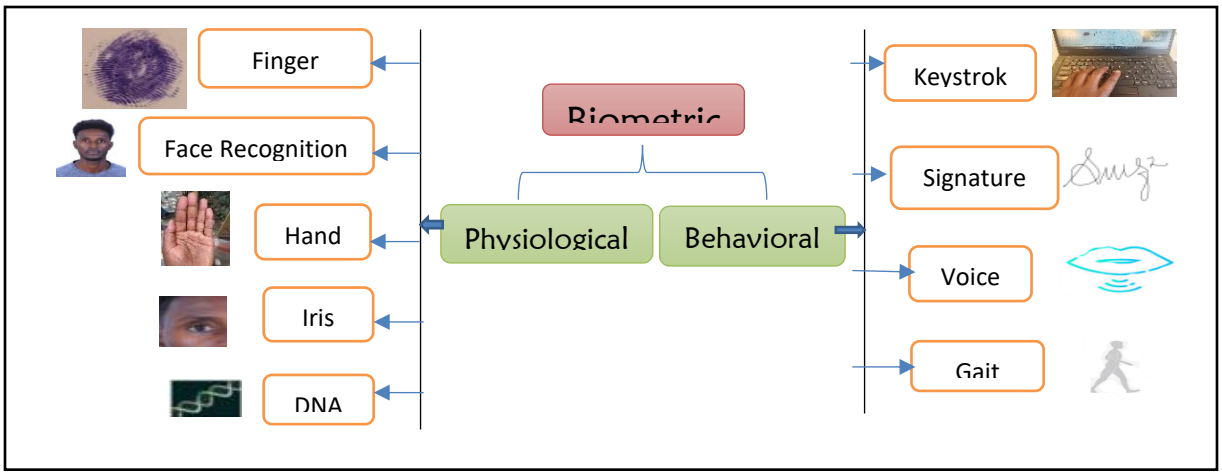


FIGURE 4: Biometric types of human depend on characteristics

(Chirag , Harsh , & Motahar , 2022) Face of individual is an important biometric attribute that can be used to perform real time computer based biometric authorization of an individuals. In order to create such system the data human faces are taken as input and various domain on such as visual, thermal, sketch or fused images are available. (Solution, 2022)Various biometric systems utilizing different technologies, such as fingerprint, face, hand geometry, iris recognition, and DNA matching, are currently available in the market. Among these, fingerprint and face recognition technology are the most commonly adopted for biometric attendance systems due to their cost-effectiveness and quick identification capabilities. It is essential for the installed biometric system to accurately identify employees within milliseconds to ensure seamless operations.

Biometrics, which relies on authenticating unique human characteristics, presents itself as a viable alternative to conventional methods like PIN codes or passwords. One of the earliest biometric techniques is fingerprint recognition, which dates back to 700 AD in China, where it was employed for official contract certification. Subsequently, in the mid-19th century, fingerprint recognition was adopted in Europe for personal identification purposes (Heindl., 1922).

(Ms. Swati & Mr. Sumit , October, 2014) A biometric system refers to the combination of hardware and software utilized for the purpose of conducting biometric identification and verification processes. (Yukti , Sukhvir , & Prince , November, 2015) The biometric system operates by capturing biometric information from an individual, extracting a feature set from the acquired data, and then comparing this feature set with the stored template in the database.

Every biometric authentication system is designed with the purpose of carrying out the following basic operations (Authentication, 2019):

a) The biometric authentication system involves the initial step of data capture, where a sensor of some kind is used to collect data from the biometric identifier employed.
b) Following data capture, the collected data is analyzed and its distinct characteristics are stored as a digital template during the enrollment/stored process.
c) During the authentication/comparison stage, when the enrolled user seeks to verify their identity, their biometric data is once again captured and compared to the template generated during the enrollment process.
d) The matching process involves employing an algorithm to compare and determine whether there is a match between the stored template and the captured biometric data. If a match is found, the user is authenticated, granting access. However, if there is no match, access is denied.

Biometric systems serve two primary purposes (Ms. Swati & Mr. Sumit , October, 2014): firstly, to verify the authenticity of a user by comparing the acquired biometric trait with the stored data specific to that user, and secondly, to identify the user by comparing the acquired biometric traits with a collection of similar traits from multiple users.

(Gutema, 2018) As a biometric system, a face recognition system functions in one or both of the following modes:

1. Face Verification (authentication): This mode involves conducting a one-to-one comparison, where a query face image is matched against an enrollment image of the claimed identity. The objective is to match the face against a specific individual's face.
2. Face Identification (Recognition): This mode entails conducting one-to-many matching, where a query face is compared to numerous faces in the enrollment database to establish the identity of the query face by linking it to one of the entries in the database. In certain identification applications, the objective is to locate the most similar face. However, in scenarios such as conducting face identification for watch list checks in surveillance videos, the requirements exceed finding the most similar faces. A specified confidence level threshold is set, and all faces with similarity scores above the threshold are reported.

2. 5. CONCEPT OF COMPUTER VISON AND FACE RECOGNITION

In recent years, the IT industry has witnessed a significant demand for a specific skill set called Deep Learning. This skill, along with advancements in AI and ML, has greatly enhanced the efficiency and speed of data processing in the field of data science. Machine Learning, a subset of AI, focuses on enabling computers to learn and perform decision-making and prediction tasks without explicit programming. Deep Learning, a subset of Machine Learning, utilizes Neural Networks with multiple layers to analyze intricate patterns and their relationships within data. Deep Learning models, such as Artificial Neural Networks (ANN), Recurrent Neural Networks, Auto-encoders, and Reinforcement Learning, are trained using large datasets and algorithms that improve over time, resulting in increased accuracy as more data is accessed. Among these models, Convolutional Neural Networks (ConvNets) have played a significant role in computer vision and image analysis.

Deep Learning has revolutionized numerous technology fields in the current era, with computer vision being particularly noteworthy. Computer vision refers to the remarkable capability of computers to comprehend and interpret images and videos independently. It stands as one of the most prominent and actively discussed subjects in the industry. Therefore the technology like self-driving cars, robotics, biometrics such as facial recognition are all depend on computer visions to work. However at the core of computer vision there is an image processing.

(Gutema, 2018) Computer vision focuses on the development of tools and theories that empower the creation of machines capable of extracting valuable information from visual data, encompassing images and videos. Its primary objective is to interpret the world through these means. In essence, computer vision has two main goals:

1. From a biological science standpoint, computer vision strives to develop computational models that mimic the functioning of the human visual system.
2. From an engineering perspective, computer vision seeks to construct autonomous systems capable of performing tasks similar to those accomplished by the human visual system, often surpassing it in various instances. Numerous vision tasks involve extracting three-dimensional (3D) and temporal information from time-varying two-dimensional (2D) data, such as that obtained from television cameras. Additionally, computer vision aims to comprehend and interpret dynamic scenes captured by these cameras, broadening the scope of its application.

Face recognition is a dynamic and captivating field of study encompassing neuroscience, psychology, and computer vision (Wenyi & Rama , 2006). Our ability to remember individuals is often based on their facial appearance, hair, and other physical attributes. The human face plays a crucial role in social interactions and conveying personal identity. Face recognition has gained significant popularity in image analysis and processing, offering numerous benefits and finding applications in various fields. However, researchers are still working to address certain challenges in its current implementation as a biometric system.

To be effective, face recognition characteristics must possess specific properties. Firstly, they should be robust, displaying durability and maintaining low variability over time within the same class. Secondly, they should be distinctive, allowing for differentiation and uniqueness between individuals, with substantial variability between classes. Additionally, an ideal biometric identifier should be universally possessed by every person and easily accessible for data collection.

As a biometric system operates as a pattern-recognition system, it necessitates the processes of data acquisition, pre-processing, data representation, and decision-making. These steps are essential for extracting physiological or behavioral characteristics from individuals, which are then stored in a template database for future recognition. Biometric identifiers, which represent unique attributes, are often considered a reliable solution for verifying an individual's identity. They serve as distinctive markers for characterizing a person's physiological and behavioral traits effectively.

2. 5.1. NEURAL NETWORK (NN)

It is a type of machine learning model inspired by the structure and functionality of the human brain. Neural networks are composed of interconnected nodes, called neurons, organized in layers. The information flows through these layers, and each neuron performs a simple computation based on its inputs and an activation function.

(Singh, 2021) Neural networks are made up of many layers (i.e. input, hidden, output), and each layer was consisted of different number of neurons or nodes which have trainable weights and biases that perform mathematical operation to detect patterns in data to produce output (Koech, 2022). All the neurons are fully connected to the neurons in previous and post layers. These neurons are the core processing unit of the NN. The first layer is input layer which was viewed as a single vector which uses for accepting the data and passes to the other networks. The last

layer is output layer whose output view be as predict result. Other layers between input and output layer are called hidden layer which will process and pass the ’message’ from previous layer to post layer. Every neuron will receive some inputs from neurons in previous layer. Then it performs a dot product of all the inputs, following with a non-linearity optionally function as output of this neuron. In the context of neural networks that are related with our research these below Algorithms are described. Each of these models has its strengths and weaknesses and is suited for different types of tasks and data.

Artificial Neural Network (ANN): also known as a feedforward neural network. It is a type of machine learning model inspired by the biological neural networks in the human brain. In image processing, (ANN) is a machine learning model that is utilized for tasks such as image classification, object detection, and image segmentation. ANNs consist of interconnected nodes called neurons, organized in layers. The input layer receives image data, and the output layer produces the desired output, such as classifying the image into different categories. Hidden layers in between process and transform the input data. ANNs learn patterns and features in images through training, adjusting weights and biases. Once trained, ANNs can recognize objects and identify specific features in images. ANNs are stimulated by biological neural networks and are widely used for classification, regression, and pattern recognition tasks. ANNs learn the patterns and features present in the images through a training process where the network adjusts its weights and biases.

Support Vector Machine (SVM): is a supervised machine learning algorithm used for classification or regression tasks. SVMs work well with high-dimensional data and can handle both linearly separable and non-linearly separable datasets. In classification, SVMs aim to find an optimal hyperplane that separates different classes while maximizing the margin between them. They identify support vectors, which are data points closest to the decision boundary. SVMs can utilize kernel functions to transform input data into a higher-dimensional feature space, enabling better class separation. In image processing, SVMs are effective for tasks like image classification, object recognition, and image segmentation. They learn discriminative features from images to classify them into different categories. SVMs excel in handling high-dimensional feature spaces and leverage kernel functions to enhance class separability.

Convolutional Neural Network (CNN): is a specialized type of neural network designed for processing structured grid-like data, such as images or time series. CNNs are highly effective in

computer vision tasks, including image classification, object detection, and image segmentation. They consist of multiple layers, such as convolutional layers, pooling layers, and fully connected layers. Convolutional layers apply filters to capture local patterns and features in the input image, enabling the network to learn spatial hierarchies of features. Pooling layers down-sample the feature maps to reduce dimensionality while preserving essential features. CNNs incorporate non-linear activation functions and can have multiple channels or feature maps. The final layers are usually fully connected layers for classification or regression based on the extracted features. CNNs have revolutionized computer vision and achieved state-of-the-art results in various image-related tasks, making them a powerful tool in image processing.

2. 5.2. CONVOLUTIONAL NEURAL NETWORK/CNN

Facial recognition, as we know, relies on artificial intelligence (AI) and machine learning (ML). ML involves the process of identifying patterns from vast amounts of existing data using specific algorithms until it becomes proficient at predicting new data. Within the realm of ML, Convolutional Neural Networks (CNNs) have proven to be effective deep artificial neural networks for analyzing visual imagery. Facial recognition is among the various applications of CNNs. To enhance the capabilities of this technology, a cloud-based facial recognition system has emerged.

CNN belongs to the category of Deep Neural Networks that excel at identifying and categorizing specific features within images (Gurucharan, 2022). Its application in visual image analysis is extensive, as it offers remarkable accuracy. CNN is particularly valuable in image recognition tasks and works based on basic NN which was described above, i.e. it's a class of NN that specializes on processing data that has a grid like topology such as image. (Sharma, 2022) There are three main layers in CNNs architecture: Convolutional Layer, Pooling Layer and Fully-Connected Layer. (Khandelwal, 2023) CNN mainly used in extracting features using these layers from the images. Is also widely used in image classification where each image input is passed through the series of layers to get the probabilistic values between 0 and 1. CNN can reduce the number of parameters in the network i.e. it is parameter efficient.

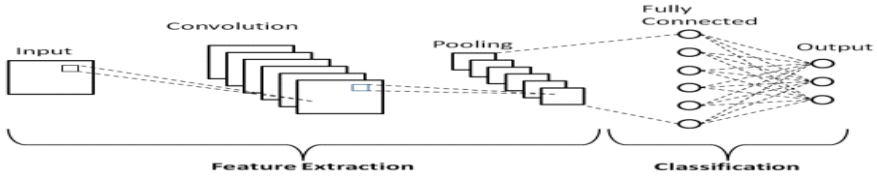


FIGURE 5: CNN Layers Source adopted from Analytics Vidhya

1. **Convolutional layer/ CONV**- is the first layer and a core building block of CNN. It takes the image as input and starts the process and extracts a set of features from the image and is responsible for performing the convolutional operation. Kernel/Filter/Matrix is the element where the convolutional operation is carried out. Kernel is used for make the image horizontal and vertical shifts based on the stride rate until the full image is traversed. There are 3 main elements in CONV: input image, filters and feature map.
2. **Pooling Layer/POOL**- is the 2nd layer in a Convolutional Neural Network (CNN), plays a crucial role in reducing the dimensionality (number of pixels) of the input. It is responsible for extracting the most important features while eliminating any noise that may have been introduced during the previous feature extraction process by the convolutional layer (CONV). By doing so, it enhances the overall accuracy of the CNN. Additionally, the pooling layer is utilized to decrease the computational power required for data processing. It comprises three essential components: the feature map, the filter, and the pooled feature map.
3. **Fully connected (dense) layer/FC**- is the last layer in a CNN and is responsible for classifying the detected features in an image into specific class labels. It operates on a flattened input where each input is connected to all neurons in the layer. Typically, the fully connected layers are located towards the end of the CNN architecture, if they are present.

Additionally there are also some operations are carried out by CNN (Pramoditha, 2022):

- **Convolutional operation**- occurs in each convolutional layer. It's an element wise multiply sum operation b/n an image section and the filter. Focuses on extracting or preserving important features from the input i.e. image. It outputs the feature map or reduced image.

  Mathematical operation:

  Input: N*N

  Filter: F*F

  Then, (N*N) * (F*F) = (N-F+1)*(N-F+1) => Convolutional Operation

  : Where Filter or Kernels are used for the operation
- **Pooling operation** – occurs b/n a section of feature map and filter. It is also called subsampling, used to reduce the dimensionality of feature maps from the convolution

operation (Wenbo & Jose , 2018). Is used to maintain spatial invariance or it deal with other kind of distortions in the process. It outputs pooled feature map. Max pooling and Average pooling are the two operations carried out. Max pooling returns the maximum value from the area covered by the kernel/filter on the image, and the Average pooling returns the average of all values in the part of the image covered by the kernel/filter applied.

Mathematical operation by considering the feature of maps *H*W*C:*

Where:

H – Height of the feature map, W- Width of the feature map, C- Channel in the feature map, F- Filter, S- stride length

Then, [(H-F)/S] +1*[(W-F)/S] +1*C => pooling operation result

- **Flatten operation:-** In a CNN, the flatten operation involves taking the output from the final pooling layer, known as the final pooled feature map, and feeding it into a Multi-Layer Perceptron (MLP) for classification into a specific class label. The MLP can only accept one-dimensional data, so the final pooled feature map is flattened by converting it into a single column. This flattened representation serves as the input data for the MLP. During this operation, the pooled feature map is transformed into a vector, which acts as the input layer for subsequent neural networks.
- **Fully connected operation-** is where all the recognition and classification parts are done by this operation.

CNN algorithm has two main processes: convolution and sampling, which will happen on convolutional layers and max pooling layers.

2. 6. FACE RECOGNITION TECHNOLOGY

Face recognition uses Machine Learning (ML) algorithms to analyze and learn the facial features of an individual in order to verify someone's identity. (Lucas D. Introna) Face recognition technology has appeared an attractive solution to address many present-day needs for identification and the verification of identity claims which brings together the capacity of other biometric system attempt to bond identity to individually unique features of the body and more functional familiarity of visual surveillance system.

Face recognition presents a wide-ranging challenge when it comes to verifying or identifying individuals in images or videos (Vidha). Major technology companies are continuously striving to develop faster and more precise face recognition models. Face recognition goes beyond face

detection, which focuses solely on identifying the location of human faces in an image. In contrast, face recognition involves creating a system that can accurately identify specific individuals.

The face recognition model involves several key steps:

i Face detection - identifying and outlining faces by drawing bounding boxes and retaining the coordinates of these boxes.

ii Face alignments - standardizing the face's orientation and position to ensure consistency with the training database.

iii Feature extraction - extracting distinctive facial features that will be utilized for both training and recognition purposes.

iv Face recognition - comparing the extracted features of a face with one or more known faces in a prepared database for identification or verification.

Face Detection

The primary objective of face detection is to locate the position of a face within an image (Gutema, 2018) . It entails identifying and recognizing a person's face within an image or video. When dealing with video input, there is a benefit in tracking the face across multiple frames to minimize computational requirements and maintain the consistency of the identified face (person) across frames. Face detection methods encompass various approaches such as shape templates, neural networks, and Active Appearance Models (AAM).

The objective of the face detection process is to determine whether or not a given image contains any faces. If faces are present, the process aims to identify their locations and sizes within the image. Several challenges to accurate face detection in arbitrary images are associated with face detection, which can be attributed to the following factor:

- Occlusion: Faces may be partially covered or hidden by other objects. In group images, some faces might be partially obscured by the presence of other faces.
- Facial expression: The appearance of faces is directly influenced by the facial expressions of individuals, which can introduce variations in the detected face patterns.
- Pose: Images of faces can differ based on the relative position and orientation of the camera in relation to the face. Different poses, such as frontal, 45 degrees, profile, or even upside-down, can affect the appearance of a face.

- Illumination: Lighting conditions and camera characteristics play a role in capturing face images, which can introduce variations in the appearance of faces due to differences in illumination levels.

Face Detection Algorithm

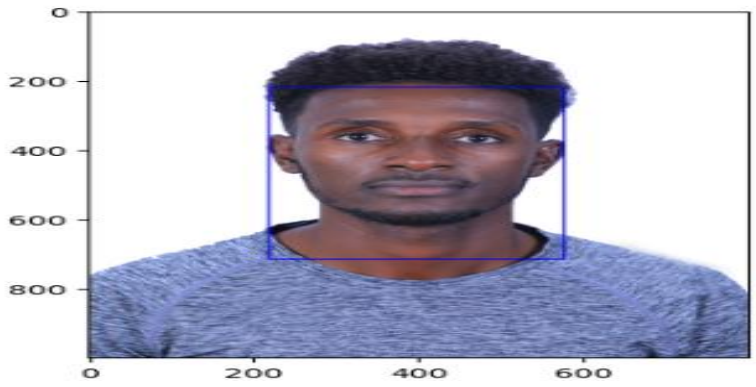
In the context of face detection, neural networks (NN) are trained to recognize human face landmarks and differentiate faces from other objects within an image. These landmarks refer to universal features found on the human face, such as eyes, noses, mouths, and eyebrows. However, the specific implementation of face detection algorithms may vary, as different algorithms employ distinct approaches and techniques.

Haar Cascade classifier is used for face detecting of different features in an image. Its built into OpenCV has already been trained on a large dataset of human faces; therefore no further need of training is required.

```
faceCascade = cv2.CascadeClassifier(cv2.data.haarcascades +
'haarcascade_frontalface_default.xml')
```

Algorithm used to load the pre- trained classifier which is designed specifically for detecting frontal faces in visual input:

```
In [33]: faceCascade = cv2.CascadeClassifier(cv2.data.haarcascades + 'haarcascade_frontalface_default.xml')

In [34]: gray=cv2.cvtColor(img_array,cv2.COLOR_BGR2GRAY)

In [35]: gray.shape
Out[35]: (1000, 800)

In [36]: faces = faceCascade.detectMultiScale(gray, 1.1,4)
         for x,y,h,w in faces:
             chala_gray = gray[y:y+h, x:x+w]
             chala_color = img_array[y:y+h, x:x+w]
             cv2.rectangle(img_array, (x,y), (x+w, h+w), (255, 0, 0), 2)
             facess = faceCascade.detectMultiScale(abdi_gray)
             if len(facess) == 0:
                 print("Not Detected")
             else:
                     for (ex,ey,eh,ew) in facess:
                         face_chala = chala_color[ey:ey+eh, ex:ex + ew]

In [37]: plt.imshow(cv2.cvtColor(img_array, cv2.COLOR_BGR2RGB))
Out[37]: <matplotlib.image.AxesImage at 0x2456e768580>
```



```
In [38]: final_image =cv2.resize(face_chala, (224,224))
         final_image = np.expand_dims(final_image,axis= 0)
         final_image = final_image/255.0

In [40]: Predictions = new_model.predict(final_image)

         1/1 [==============================] - 0s 81ms/step
```

Face Recognition

Face is the important part of who you are and how people identify you. Is a system used to verify a person's identity by matching their face against an existing database after the face detection was used to detect human face in visual input. To build FR model also it needs to perform pre-processing techniques such as noise reduction and image transformation.

Facial Recognition Algorithm/FRA

It is technique of building a biometric face model for advance analysis and it processes the face recognition. They are based on mathematical calculations, and NN perform large number of this mathematical operation simultaneously.

Face recognition process can be carried out by three steps using Open-CV:

- Face detection
- Feature extraction using face embedding
- Facial recognition

FRA is a primary component of any facial detection and recognition system. Some experts categorize this algorithm in to two main approaches (RecFaces, 2023) . The Geometric approach is method that focuses on distinguishing the features, and Photometric approach is a method that used to extract values from an image statistically.

(Lucas D. Introna) To implement those approaches above many algorithms are developed, but in case of our activity we try to describe some main algorithms.

1. Principal Component Analysis (PCA) is utilized to convert each 2D image into a one-dimensional vector. This vector is then decomposed into uncorrelated or orthogonal principal components, known as Eigenfaces. The technique selects the image or face features that exhibit the most significant variation compared to the rest of the image. Each image face is represented as a weighted sum, referred to as a feature vector, of the principal components (Eigenfaces), which are stored in a one-dimensional array. Eigenfaces represent certain facial features that may or may not be present in the original

image. To compare a probe image with a gallery image, the distance between their respective feature vectors is measured. Therefore, for PCA to work effectively, the probe or inquiry image must be similar to the gallery image in terms of size, pose, and illumination, although PCA is sensitive to scale variation.

2. Linear Discriminant Analysis (LDA) is employed to classify faces of unknown individuals based on a set of training images of known individuals. This technique identifies underlying vectors in the facial feature space that maximize the variance between individuals or classes while minimizing the variance within a set of samples from the same person within a class. LDA is based on a similar statistical approach as PCA.
3. Elastic Bunch Graph Matching (EBGM) involves placing small blocks of numbers, known as Gabor filters, over specific areas of the image. These blocks are multiplied and added with the pixel values to produce numbers called jets at various locations on the image. EBGM addresses the non-linear characteristics present in real face images that are not adequately addressed by linear analysis methods such as PCA and LDA. These non-linear characteristics include variations in illumination, pose, and expressions.

Facial Recognition methods are the first explored in security systems to identify and compare human faces and is far superior when compared with other biometric recognition that implements on Iris recognition (Sanmoy & Sameer , 2020). The paper illustrates different algorithms that used for facial recognition and compare their recognition accuracies. Therefore, the face is detected through Haar cascade algorithm which was stored in database that intended to compare the well-known algorithm Eigen Faces with PCA, SVM, KNN and CNN, and they got the results of CNN with the maximum accuracy according to Sanmoy and Sameer in their article title “A Comparative Study on Facial Recognition Algorithms”

2. 7. IMAGE PROCESSING

Image is represented by its dimension (i.e. height and width) based on the number of pixel. The pixel is a point on image that takes on specific shade and opacity or color. (Simplilearn, 2023) Is the process of transforming an image to digital form and performing certain operations to get some useful information from it. Image processing usually treats all images as 2D signals when applying certain pre-determined signal processing method. Some of the main types of image processing’s: Visualization, Recognition, Sharpening, Pattern recognition, Retrieval.

Image usually represents:

- Grayscale image- the images that contain single channel, and contains shades of white (255) and black (0) shades. Is an image integer (intensity) representing a pixel value 0 to 255.
- RGB image – the image that contains Red, Green and Blue channel, and three layer of 2D image. Is a pixel made up of 3 integers (intensity) between 0 to 255
- RGBA – is an extension of RGB with the addition of alpha field, which represents the opacity (i.e. denseness) of an image.

When we say 2D functions;

- F(x, y) where x and y are spatial coordinates,
- Pixels are shown as array and arranged as column and rows.
- The amplitude of F at a particular value of x, y is representing the intensity of the image at that point.
- If the x, y and the amplitude value is finite, then its digital image.

An image can also be represented as 3D (width, height and depth) functions;

- Where F(x,y,z) i.e. x, y and z become spatial coordinates, i.e. (4000, 2667, 3)
- pixels are arranged in the form of matrix, and they are called RGB images i.e. 3 layered images (Blue, Green, Red while OpenCv uses the opposite layout)

Some of the Classic image processing algorithms are;

- Morphological image processing- is employed to eliminate imperfections from binary images. Binary regions created by a simple thresholding technique can be distorted or affected by noise. It helps to address and remove these imperfections from the binary images. Dilation and Erosion are the two operation done in this image processing techniques
- Gaussian image processing – is used to reduce image noise and reduce details. It's known as smoothing, which is the result of blurring image.
- Edge detection in image processing
- Fourier transform in image processing

However, to display an image with the detected face we first need to convert the image from BGR format to RGB.

```
img_rgb = cv2.cvtColor (img, cv2.COLOR_BGR2RGB)
```

2. 7.1. IMAGE PROCESSING TOOLS

Image processing can be performed by many known libraries, and explained some that are used. OpenCv, Numpy, Scikit image, PIL and etc.

OpenCV

Open-CV (Open Source Computer Vision) is a popular library of computer vision algorithms, image processing and numerical open source general purpose algorithm (RecFaces, 2023). (Khandelwal, 2023) It has more than 2000 optimized algorithm that are useful for computer vison and machine learning. In computer vision, OpenCv is the tool used for image processing while it supports programming languages like Python, java, C++, and etc. It allows developers and non-mathematicians to build computer vision applications easily without having to code them from scratch and users to perform tasks like face recognition and object detection. It was designed for computational efficiency and with strong focus on real time applications, therefore its perfect for real time face recognition using a camera.

Python

Python is the most programming language tool supported by OpenCv, is simple tool to use achieving the task of image processing efficiently. Anaconda has a variety of python packages that are used in data science and machine learning.

Some functions can be operated by OpenCV;

- Converting images from one color to another i.e. between BGR and HSV, HSV and Gray
- Image threshold performing i.e. simple threshold, adaptive threshold…
- Smoothing of image i.e. by applying custom filters, blurring images, …
- Building image pyramids
- Performing morphological operations on images
- Image segmentation i.e. using watershed algorithm
- Extracting foreground on image i.e. using Grab-Cut algorithm

Numpy

Is a library that enables the execution of basic image operations, including image cropping, image extraction, and image analysis (Khandelwal, 2023). Images can be depicted using Numpy's multi-dimensional arrays, known as NdArrays. Color images are represented as 3D Numpy arrays. By utilizing array slicing techniques, it is possible to extract and separate the RGB channels of the image.

NumPy enables various operations to be performed on an image, including the following examples:

- The image is loaded into a variable called test_Img using the **Imread**() function.
- A vertical flip of the image can be achieved using **np.flipud(test_Img).**
- Flip image horizontal direction is **np.fliplr(test_Img)**
- Reverse image is **test_Img(::-1)**
- Add filter in image is **np.where(test_Img>150,255,0)**

2.8. CLOUD COMPUTING

In this modern technology advancement, people are beginning to advantage on cloud computing infrastructure because it delivers on features like scalability and cost effectiveness. Cloud computing has certain effective deliverables like security, infinite storage, low cost and multiple user access on certain resources like files and applications on the cloud infrastructure, (Isaac U, S. , & Robertas Damaševičius, 10 January 2018) (Daryl C., Thomas J., Tom, & David W., 2008) Cloud computing is a term used to describe an internet-based infrastructure that allows users to access computing resources at any time and from any location through a self-service model.

(Cloudflare, 2022) Cloud computing involves accessing servers, software, and databases through the internet instead of managing physical servers locally. Users can access files and applications from any device since computing and storage occur on data center servers. This model, defined by NIST, offers convenient and on-demand access to a shared pool of configurable computing resources. The resources include networks, servers, storage, applications, and services that can be quickly provisioned and released. Cloud computing encompasses internet-delivered applications and the hardware and software in data centers, commonly referred to as Software as a Service (SaaS) and the cloud, respectively.

However, Cloud computing can also provide good benefit for human resource management system. This is because of large volumes of data that needs to be stored and accessed with ease (Isaac, Sanjay, Nicholas, & et'al, 1 January, 2017). Allows to the companies to reduce the IT infrastructure costs, uses for the enterprises with several computing capabilities to store and process their data in either private owned cloud or the third-party server located in the data center. Cloud computing involves a vast collection of virtualized resources, including hardware, development platforms, and services, that are readily available and easy to use. These resources can be adjusted and reconfigured in response to changing demands, allowing for efficient

utilization of resources. Typically, users pay for the resources they consume based on a pay-per-use model. Infrastructure providers offer guarantees and assurances through customized Service Level Agreements to ensure the quality and reliability of the cloud services (Susan & Girija , 2014)

2. 8.1. CLOUD COMPUTING MODELS

Cloud computing involves utilizing IT infrastructure as a service, which can range from renting hardware to leveraging third-party APIs. Financial institutions can benefit from cloud service models as they provide opportunities to shift from capital-intensive approaches to more adaptable business models, ultimately reducing operational expenses. According to (Peter & Timothy , September 2011) NIST cloud models is composed of five essential characteristics, three service models and four deployment models described as follows:

A. Five Essential characteristic

To summarize the characteristics of the Cloud computing models by tables;

Characteristic	Description	Parameter
Broad network access	Consume services from anywhere	Where
On-demand self-service	Consume services when you want	When
Resource pooling and virtualization	Pool the infrastructure, virtual platforms, and applications	How
Rapid elasticity	Share pooled resources to enable horizontal scalability	How
Measured service	Pay for the service you consume as you consume it	How much

TABLE 1: SUMMARY OF THE CHARACTERISTICS OF CLOUD COMPUTING MODELS

B. Cloud Deployment Models

When deciding on a cloud deployment model, our specific requirements, preferences, and constraints, such as service delivery models, play a crucial role. It is not mandatory to choose a particular deployment model for storage services; instead, we have the flexibility to select a model that best suits our needs. Here are some factors to consider when it comes to cloud deployment models for storage services:

1. Private Cloud deployments - involve storage services that are exclusively dedicated to a single organization and can be operated within their own infrastructure or by a third-party provider. This model provides advanced security measures, greater control, and customization options. It is particularly suitable for organizations that have strict compliance requirements or a strong need for maintaining high levels of control over

their data. In this deployment, the cloud infrastructure is managed by a single organization that possesses its own data center, enabling complete control over infrastructure and management. The private cloud can be situated either on-premises or off-premises and can be managed by the organization itself, a third-party provider, or a combination of both.

2. Public Cloud deployments - involve storage services provided by a third-party cloud service provider, allowing multiple users to share resources. This model offers scalability, cost-efficiency, and requires minimal infrastructure management. It is a suitable choice for organizations seeking flexibility and cost savings. In a public cloud, resources are shared, and information is accessed over the internet. The cloud infrastructure is open for public use, enabling anyone to view, share, and download data. However, due to security concerns, sensitive or confidential data may not be ideal for the public cloud. Public clouds can be owned, managed, and operated by various entities such as businesses, academic institutions, government organizations, or a combination of them. Typically, the public cloud infrastructure is hosted on the premises of the cloud provider.
3. Hybrid Cloud deployments- combine the use of public and private clouds, enabling organizations to benefit from both. Storage services are distributed across public and private environments based on specific data requirements, security needs, and cost considerations. Hybrid cloud is suitable for organizations seeking a balance of scalability, control, and data segregation. It involves integrating two or more distinct cloud infrastructures, such as private, public, or community clouds, while keeping them separate but connected through standardized or branded technology. The hybrid cloud facilitates data and application portability, allowing applications to run utilizing a combination of computing, storage, and services across different environments. This model provides flexibility to leverage the advantages of both private and public clouds while addressing specific needs and requirements.

These deployment models offer different levels of control, accessibility, and security, allowing organizations to choose the most suitable approach based on their specific use cases and considerations.

2. 8.2. CLOUD-BASED TIME AND ATTENDANCE SYSTEM

Cloud-based attendance systems and software have become essential for numerous businesses today (360Connect.LP, 2022). These systems offer a wide range of benefits and are crucial for the day-to-day operations of many companies. To understand the concept of a cloud-based attendance system and its significance in supporting businesses, let's explore its definition and the specific ways it aids organizations. Previously, the majority of businesses relied on manual attendance systems like "punch clocks" to monitor employee hours. They also utilized separate systems to handle other attendance-related tasks such as time off requests, benefits eligibility, and payroll processing. However, with the advent of cloud-based technology, businesses now have the advantage of moving away from outdated manual attendance systems.

A manual attendance system relies on individuals recording their clock-in and clock-out times through methods like paper, printed cards, or electronic spreadsheets (Janza, 2021). However, this approach presents several challenges. It involves repetitive manual work, making it time-consuming and prone to errors. Additionally, individuals may forget to clock in or out, leading to inaccurate attendance records. There is also a risk of files getting lost, further complicating record-keeping. Furthermore, manual attendance systems lack the capability for comprehensive analytics, limiting the ability to extract meaningful insights from the data.

Thus, the majority of companies have moved to automated time & attendance systems, using terminals, ID cards, badges and similar hardware. These systems have also been further upgraded with biometric readers and touch screen devices.

The final trend came with the rise of mobile phones. The dominant choices today consequently are “application-based” time and attendance systems, offered as Software as a Service (SaaS) and we call such applications a cloud-based attendance system. In practical terms, that means everything related to time and attendance is done with the use of online applications by computer and mobile apps, sometimes in combination with other hardware, with everything residing in the cloud and accessible from anywhere.

There are three types of attendance systems: on-premises, hybrid cloud-based, and cloud-based systems. On-premises systems are deployed on the company's servers or private cloud, with maintenance and updates handled by the IT department. Hybrid cloud-based systems combine private and public cloud services, offering flexibility in data hosting. Cloud-based attendance systems, known as Software as a Service (SaaS), are managed by the vendor, eliminating the need for company infrastructure. Cloud-based systems are cost-efficient, scalable, and accessible

from anywhere. They have become a popular choice due to their ease of use, affordability, flexibility, and widespread availability.

2. 8.3. CLOUD SERVICE PROVIDER

Cloud service providers offer flexible infrastructure and tools for creating, deploying, and expanding software applications and databases (Zhang, 2023). They cater to developers, start-ups, small and medium-sized businesses, and large enterprises. These providers can be categorized as commercial or non-commercial and primarily operate in the Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) markets. In the IaaS market, services like computing power, servers, storage, data centers, and networking are offered. PaaS combines IaaS elements with operating systems, development tools, database management systems, application platforms, and analytics capabilities.

By combining IaaS and PaaS, cloud service providers support various use cases such as web and mobile applications, website hosting, e-commerce, media and gaming, and managed services. These services rely on shared servers, ensuring scalability and uninterrupted performance. Customers typically pay for cloud computing services based on their usage through a pay-per-use model.

In addition, certain public cloud service providers offer Software-as-a-Service (SaaS), which refers to applications accessible to end users over the internet (Microsoft, 2023). SaaS allows users to connect to and utilize cloud-based applications, such as email, calendaring, and office tools like Microsoft Office 365. This model provides a comprehensive software solution that is purchased on a pay-as-you-go basis from the cloud service provider. All the necessary infrastructure, middleware, application software, and data are hosted in the service provider's data center. The service provider takes care of managing the hardware, software, and ensuring the availability and security of the application and data through the appropriate service agreement. SaaS enables organizations to quickly implement applications with minimal upfront costs. It incorporates elements of Platform-as-a-Service (PaaS) and includes hosted applications. Generally, cloud providers offer a range of services, from storage to pre-built solutions.

Selecting the appropriate technological stack is a crucial consideration when designing a cloud-based solution (Developers), 2020). Making the wrong technology choices can impede business growth, result in subpar web performance, and potentially lead to data loss. To mitigate these risks and challenges when embarking on the development of a cloud-based application, it is

recommended to opt for a cloud service vendor that is recognized as a market leader. By doing so, organizations can increase their chances of avoiding mistakes and ensuring a successful initial deployment.

According to (Developers), 2020) , the leading cloud service providers worldwide in 2023 include Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), Alibaba Cloud, Oracle Cloud, IBM Cloud (Kyndryl), Tencent Cloud, OVH cloud, Digital Ocean, and Linode (owned by Akamai). These providers offer a range of regions and availability zones, and each holds a distinct market share.

1. **Amazon Web Service (AWS) -** is a prominent and highly regarded provider that offers an extensive selection of services, including compute, storage, and database options. It offers over 140 services that are flexible and integrative, making it suitable for building custom applications.
2. **Google Cloud Platform (GCP)** - is a direct competitor to AWS, offering a comprehensive suite of cloud computing services, storage solutions, API services, advanced analytics capabilities, NoSQL database services, and virtual machines. GCP is known for its flexibility and cost-effectiveness, making it particularly attractive for startups and smaller organizations. As a part of Alphabet Inc., GCP has emerged as the third largest global cloud service provider, delivering enterprise-grade cloud services that excel in areas such as security, data management, analytics, and artificial intelligence (AI).
3. **Microsoft Azure**- is another well-known cloud service provider that specifically caters to enterprises with expansion strategies and web-based products. It offers a wide range of services including ML modules, database services, mobile back-end solutions, and virtual machines. Azure holds the position of being the second largest global cloud service provider, known for delivering a seamless hybrid cloud experience, enhancing developer productivity, providing advanced AI capabilities, and prioritizing security and compliance measures.
4. **Heroku** : is another cloud platform that offers a free tier for hosting applications and databases. Supports various databases, including PostgreSQL, MySQL, and more.

When considering cost, a comparison by Linode shows that these providers offer different pricing options for deployments. It is important to evaluate specific requirements and costs when selecting a cloud service provider.

2. 8.4. CLOUD STORAGE

Cloud storage refers to a method of storing computer data where digital information is kept on server's located offsite (Developers). The service providers ensure that the data stored on their servers remains accessible at all times through public or private internet connections. This approach allows organizations to store, access, and manage their data without the requirement of maintaining their own data centers.

One of the services we can get from Cloud computing platform is storage. Therefore for the purpose of Timesheet Facial recognition model the case of OOCAA, we're planning to use Cloud storage for better performance here. In addition to referring the official documentation and resources provided by our chosen cloud storage provider for detailed guidance on using their specific services and APIs, to store our data these general procedures or use these prototypes as starting points. However, the specific implementation details may vary depending on the cloud storage provider we choose:

Choosing a Cloud Storage Provider: Selecting a cloud storage provider that meets our requirements in terms of storage capacity, pricing, security, and availability. The most popular include Amazon S3, Google Cloud Storage, Microsoft Azure Blob Storage, and Dropbox.

Sign up and Set up an Account: Create an account with the chosen cloud storage provider and set up our storage environment. This typically involves creating a storage bucket or container and configuring access controls.

Install Required Libraries or SDKs: Install the necessary libraries or SDKs provided by the cloud storage provider. They will provide the functionality to interact with the cloud storage service programmatically.

Authenticate and Establish Connection: Authenticate our application or code with the cloud storage provider using appropriate credentials (e.g., API keys, access tokens). By using the SDK's establish a connection to the cloud storage service.

Upload Data: Use the library or SDK functions to upload data to the cloud storage. This typically involves specifying the file or data to be uploaded, the destination storage location (e.g., bucket or container name), and any metadata or additional parameters.

Download or Retrieve Data: To retrieve data from the cloud storage, use the library or SDK functions to download or retrieve the desired files or objects. Specify the file or object name and the destination location on our local system.

Manage Data: Cloud storage providers often offer additional functionality for managing data, such as organizing files into folders, setting access controls, and deleting or updating files. Explore the library or SDK documentation to learn about these features and implement them as needed.

Error Handling and Exception Handling: Implement error handling and exception handling mechanisms to handle any unexpected issues that may arise during the data storage and retrieval process. This ensures that our application can gracefully handle errors and provide appropriate feedback to users.

Testing and Deployment: Test our code thoroughly to ensure that the data storage and retrieval processes work as expected. Consider testing different scenarios, such as uploading large files, handling concurrent requests, and verifying data integrity. Once testing is complete, deploy our code to a production environment.

Monitoring and Maintenance: Monitor the cloud storage usage, performance, and any relevant service metrics. Monitor for any errors or issues that may occur during data storage or retrieval. Regularly update the cloud storage libraries or SDKs to benefit from bug fixes and new features provided by the cloud storage provider.

2. 11. RELATED WORK

To improve the employee time and attendance tracking in industries, various technologies are uses for the attendance management systems. Some of the technology used are; Radio frequency Identification (RFID) based, Biometric technologies (fingerprint), Near field communication (NFC) based, and etc. Throughout the development of face detection and recognition, various approaches and methods have been employed to enhance the accuracy, quality, and efficiency of algorithms. Hailing Z. and Kin-Man L. et al utilized Probabilistic Linear Discriminant Analysis (PLDA) to simultaneously model human identity and aging variables. Additionally, techniques such as PCA (Principal Component Analysis) and ANFIS (Adaptive Neuro-Fuzzy Inference System) have been utilized to address variations in face recognition, including factors like illumination, pose, identity, facial expression, and hair style (R. & D. , 2011).

According to (A HAFINAZ , April, 2006), there is currently a growing interest in project management among individuals and organizations. In the past, project management mainly revolved around providing schedule and resource information to top management in the military and construction sectors. While tracking key project parameters remains essential, modern project management has evolved to encompass a broader scope and has become a crucial factor in numerous businesses. The introduction of computer hardware, software, networks, as well as the utilization of interdisciplinary and global work teams, has brought about significant changes to the work environment.

2. 12.1. FACIAL RECOGNITION ATTENDANCE SYSTEM

Biometric face recognition has become ubiquitous in our society, serving as an advanced, automated, and intelligent identification system that can accurately identify individuals based on their facial features (Monika, 2022). This technology utilizes a digital camera to capture facial images, a computer for processing and analysis, and an output device to display the identification results. It is a straightforward process to identify individuals using various facial images. The face recognition system is both fast and reliable, providing a high level of security as it can accurately identify individuals without errors.

Face recognition serves as an initial step in constructing biometric access control-based applications, involving the extraction of biometric features from individuals. This system finds application in various settings such as government offices, corporations, banks, and other establishments.

- Face detection- purpose is to determine the presence and location of a face within an input image or photo frame. It accomplishes this task by identifying and localizing the object as a "face."
- Face recognition- aims to answer the question of identity, specifically "who is this?" or "who does this face belong to?" It determines whether the detected face corresponds to a known individual or an unknown person, leveraging a database of faces to validate the input image.

2. 12.2. FACIAL RECOGNITION AND CLOUD COMPUTING

As per the articles of the National Institute of Standards and Technology (NIST), cloud computing refers to a framework that facilitates constant, convenient, and readily available network access to a shared collection of configurable computing resources (Gu, 2019) (Peter &

Timothy , September 2011). These resources include networks, servers, storage, applications, and services, which can be swiftly provisioned and released with minimal effort and limited interaction with service providers. Cloud computing is characterized by five key attributes: on-demand self-service, broad network access, resource pooling, and rapid elasticity.

Cloud-based facial recognition systems have gained popularity in commercial applications due to their seamless integration capabilities (Gu, 2019) . In this approach, both the facial recognition engine and the facial recognition database are moved to the cloud. The process involves a user capturing a query face, which is then transmitted to a cloud server for authentication. The cloud server compares the query face with the faces stored in the facial recognition database located on the cloud. To enable Face Tagging, new faces are enrolled through a user interface or application. The user interface interacts with a cloud-based web API that includes the facial recognition engine and a face database. The user interface enrolls new faces, encodes their facial images, and sends them to the cloud-based API. The cloud-based API processes the encoded images using the facial recognition engine, which applies a predefined facial recognition algorithm. The query face captured from the user interface is compared to a gallery of images using the facial recognition engine. Once a conclusive match is determined, the query face is classified as belonging to a specific individual or not, and the result is sent back to the user interface.

Cloud-based facial recognition systems offer several benefits due to their inherent characteristics. These systems provide real-time processing capabilities, allowing for immediate results. On-demand self-service enables customers to quickly access and utilize the required services. Additionally, cloud computing ensures broad accessibility, allowing for easy integration with other applications. The scalability of cloud services allows the system to adapt to a wide user base, ensuring efficient performance.

Throughout generations, face recognition has emerged as a prominent and highly effective biometric identification technique. Humans possess an innate talent for distinguishing and recognizing various faces, and advancements in technology have enabled computers to acquire this capability as well (Sri Harish J., 2021).

In (F. Hamami, 2020) paper, the implementation of face recognition as a biometric approach for smart attendance is discussed. The paper also introduces an integrated system that involves capturing data from edge devices such as CCTVs, streaming the data to a dedicated server, and

presenting real-time information on Android mobile devices. This system utilizes deep learning algorithms based on Convolutional Neural Network (CNN) to achieve accurate face recognition.

The (Ankit Rana, 2019) paper offers a range of essential functions including capturing attendance records using Near Field Communication (NFC), automated time calculation, verification of leave and overtime, evaluation of working hours, real-time access to updated information, and report generation. To enhance the security of accurate attendance tracking, the system incorporates a facial recognition mechanism to prevent fraudulent activities. Additionally, an online portal is developed to enable managers to monitor and efficiently manage employee attendance. This system is suitable for companies of various sizes, from small to medium, seeking a cost-effective and efficient attendance tracking solution using a facial recognition attendance system in the workplace.

Therefore, in order to improve employee timesheet and employee attendances, scholars chipped away at the change from the alternate point of view showed by table.

Authors and year	Title	Contribution	Gap
(Shaheen, 2016)	"Web based Timesheet system	Proposed web-based timesheet application that provides an automated time of tracking work times of employee by enabling to the manager to track their work time, which helps to assign projects to specific employees, measures performance and productivity and also provide automate salary calculation depending on the hour they spent on their task.	- The system is not fully prepared to implement in companies who has different departments, employees, and managers' high level. - It is developed for small business companies.
Sia Ba Oo, Nang Hlang Myat Oo, Suparat Chainan, Arpha Thongniam and Waralak Chongdarakul; 2018, Thailand	Cloud based web Application with NFC Employee attendance Management system	Provide the activities; i.e. - Capture attendance records using NFC - Automatically calculates the time , leave and check the overtime of the employee - Evaluates working hour - Update the information accessed by real-time - Generate the reports - Offer online portals to access multiple company (his own) user accounts - No need of special software installation - Provide flexible data storage	On their proposed system with NFC technology, their system does not consider the remote workers or their system does not support track the working hours of the field employees who are always outside of the office.
Syeda T. Tarannum, Chaithra C., Soundarya V. S., Indhu S.N, Mohan Raj, India	Attendance and time system management using cloud for corporate companies	Present the application called TAMS (Time attendance management system) that offers multiple company accounts in which each of the user can have his/her own account and containing the application performances with the entering and leaving hours, real time upgrading information and access to produce reports. Also provides online portal service for many organization users without any special software to install and always allocate the adaptable data storage.	This system was only accessible online.
Harsh shinde, Sagar Shirke and et al, 2017, India	GPS based attendance and management system with RFID	Propose employee time and attendance management system by using the unique integration of GPS and RFID technology on the Android platform.	The system cannot be compatible with another operating system.

	Technology		
Aashish Kumar and Ravi Tiwari, 2017, India	Review paper on Geolocation based attendance monitoring using Geotagging	Present their reviews as the system used to acquire data from individual computer or mobile to identify his/her physical location and to identify where the attendance is marked on the map. They used Geotagging attendance software to track field and contractual employees.	Only this system is worked on the defined territory by manager. The movement, distance traveling and time spent, automatic employee based work location on employee territory, etc. are not assigned.
Md. Shakil and Rabindra Nath, 2013, Balgladesh	Attendance management system for Industrial Worker Using finger print scanner	Attendance management is the act of managing attendance or presence in work setting that maximizes and motives employee attendance thereby minimizing loss. In addition, it affect productivity, it can cost the company profit, or even additional contracts. They proposed the improvements of attendance management system to minimize fake attendance based on fingerprint identification and implementation on large database i.e. Industry, by using new algorithms like gender estimation, removing boundary minutes and one to many matching.	During attendance taking, there must be internet connection while the application is web-based, so they did not describe the solution if the system fails during the attendance taking.
(Ankit Rana, 2019)	Cloud based employee attendance management system using NFC and Face Recognition	Proposed the employee attendance management system that's used by NFC and embedded with Face recognition which captures the attendance records by using NFC.	Its similar with the manual attendances coz of: - Employee can view their attendance log in and out timestamp by using the NFC cards, and update their profiles, - While it is online access, is open for all users can manage the employee attendance to modify, view and reports.
(Mohammad Sabik Irbaz, 13 Oct 2021)	Real time Face Recognition system for Remote Employee tracking	They proposed the system on Employee tracking using Facial Recognition in real time during COVID 19 pandemic virus.	The system uses KNN algorithm for its accuracy.

TABLE 2: Related Work

CHAPTER 3

RESEARCH METHODOLOGY AND TOOLS

3.1 OVERVIEW

This research methodology summarizes the tools used, specific research methods followed, model development and evaluation, as well as the workflow for the development of a cloud-based employee timesheet system using facial recognition technology. The system aims to improve accuracy and efficiency in tracking employee attendance, time entry and hours worked.

3.2 RESEARCH METHODOLOGY

In this research, we aim to develop a cloud-based employee timesheet model using facial recognition technology. The system will allow employees to clock in and out of work using facial recognition, and the data will be stored in the cloud for easy access and management.

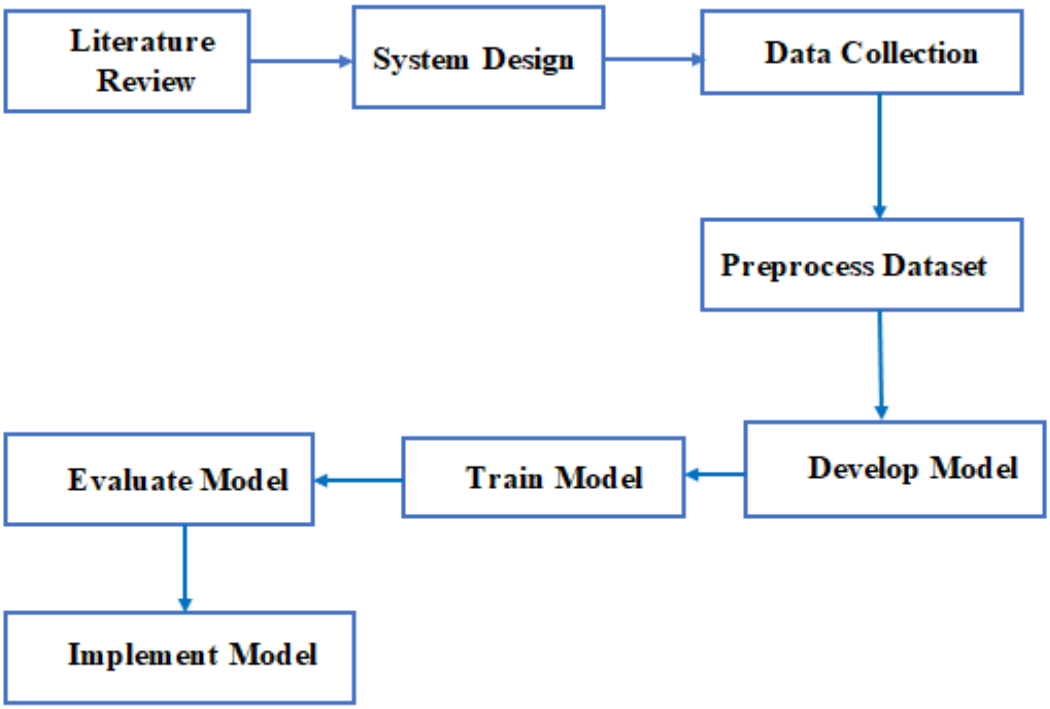


Figure 6: The Research Process

Literature review: We conducted a literature review to gain a better understanding of the current state-of-the-art in facial recognition system and cloud-based timesheet systems and we reviewed journals, academic articles, industry reports, websites, and other relevant sources.

System design: We will design the system architecture and workflow, including the data flow from the facial recognition system to the database.

Data Collection: Since we can't find enough Ethiopian face dataset, we consider to add some images from internet and add our own dataset by collecting face images of employees from my workplace and friends. Mobile camera is used to capture images of employees and friends from different angles and under different lighting conditions, and then label the images with the corresponding employee names or IDs.

Model development: We will develop a deep learning model for facial recognition using Tensor Flow and Keras. We will train the model on a dataset of facial images and evaluate its performance using metrics such as accuracy.

System implementation: We will implement the system using Python, integrating the facial recognition model and the database.

System evaluation: We will evaluate the system's performance by testing its accuracy and usability

3.3 RESEARCH DESIGN

Research design is an important component of the research methodology, and it refers to the overall plan or strategy for conducting a research study. This section determines the methods and procedures to be used to collect and analyze data in order to answer the research questions. The research design involves the following components:

Research question: The research question stated under chapter one should be clearly defined and focused.

Research approach: The research approach refers to the overall strategy for conducting the study. In this case, a quantitative research approach will be appropriate, as the study aims to measure the effectiveness of the system in terms of accuracy and efficiency.

Data collection methods: Data collection methods refer to the specific techniques used to gather data. In this case, the primary data collection method will be facial image.

Data analysis methods: Data analysis methods refer to the specific statistical or qualitative techniques used to analyze the data collected. In this case, the data analysis methods will include measuring the system's performance and efficiency using metrics such as accuracy.

Ethical considerations: It is important to consider any ethical implications of the research design, particularly when it comes to the use of facial recognition. Include obtaining informed consent from

participants, ensuring the security and privacy of employee data, and ensuring that the system is not used for discriminatory purposes.

Overall, the research design for a cloud-based employee timesheet system model using facial recognition technology should be carefully planned and executed in order to achieve reliable and valid results. By defining clear research questions, using appropriate data collection and analysis methods, and considering ethical implications, the study can provide valuable insights into the effectiveness of the system in improving accuracy and efficiency in tracking employee attendance and their time entry.

3.4 DATA COLLECTION

In order to build or train and reliably test the proposed face recognition algorithms, sizable databases of face images are needed. Many face databases to be used for uncommercial purposes are accessible on the Internet. The data collected may include images of employees' faces, as well as timestamp data indicating when they clocked in and out.

3.5 DEVELOPMENT TOOLS

The success of the research depends heavily on the choice of the right tools, which can assist the researcher in designing and putting the architecture into practice.

- **Anaconda**: - is used for the implementation of the model and it is a free and open-source distribution of the python and R programing languages for computer vision and primarily used in data science and machine learning. It provides a comprehensive package management system and a collection of pre-built libraries and tools that are commonly used in scientific computing and data analysis. Anaconda simplifies the process of setting up and managing software environments for data-related tasks by allowing users to easily install, update, and switch between different packages and dependencies. Anaconda includes popular data science libraries such as NumPy, Pandas, Matplotlib, and SciPy, as well as development environments like Jupyter Notebook and others. It also offers a graphical user interface called Anaconda Navigator, which provides a convenient way to manage packages, launch applications, and create new environments.
- **Tensor Flow**: is an open-source machine learning framework and is widely used for building and deploying machine learning models, particularly in deep learning applications. It has the key feature ability to work with computation graphs. The architecture of Tensor flow works for pre-processing of the data, building the model, train the model, and estimate the model. All the Computation in Tensor Flow involves tensor (n-dimension array) that represents all kinds of data.

Tensor Flow also uses graph framework for graphical representation of the series of computation during the training. It has two distributions for CPU and GPU. It supports a wide range of applications beyond deep learning, including traditional machine learning algorithms such as linear regression, support vector machines (SVMs), and decision trees. It also provides tools and libraries for data preprocessing, visualization, and model serving. TensorFlow offers a high-level API called Keras, which simplifies the process of building and training neural networks.

- **Keras:-** is a high-level neural network application programming interface (API) that runs on top of various deep learning frameworks, including TensorFlow. It provides a user-friendly and intuitive interface for building, training, and deploying deep learning models. It is very simple to develop a model, user friendly, easily extensible with python, and most importantly it contains pre-trained CNN models. It provides a range of utilities and functionalities for model training, evaluation, and inference. It includes built-in methods for data preprocessing, data augmentation, and model visualization.
- **Visual Paradigm: -** is a software modeling and diagramming tool that supports various types of visual modeling techniques. It provides a comprehensive set of features and tools for creating professional-looking diagrams and models. It offers a user-friendly interface with drag-and-drop functionality, making it easy to build and edit diagrams. Users can create a wide range of diagrams, such as class diagrams, use case diagrams, activity diagrams, flowcharts, and more.
- **SQLite**: - is a freely available open-source relational database management system that can be used by anyone. Its server-less database and its self-contained. Its embedded database which means the database engine runs as the part of the app. Its suitable for small database. Uses for basic development and testing.
- **MYSQL:-** is a widely used open-source relational database management system (RDBMS) designed for storing and managing structured data. It offers a scalable and robust platform suitable for a range of applications, from small-scale projects to large enterprise systems. MySQL is compatible with multiple platforms and programming languages, making it a popular choice for data-driven applications and web development. It incorporates features like data integrity, ACID compliance, efficient indexing, and advanced query optimization. Known for its reliability, user-friendly interface, and extensive community support, MySQL is capable of storing various data types, including facial images, associated labels, and pertinent information. Its efficient data organization and retrieval capabilities make it a suitable choice for integrating with facial

recognition algorithms and models within a system.

3.6 Model Development and Evaluation

We will develop a deep learning model for facial recognition using TensorFlow and Keras. The model will be trained on a dataset of facial images and evaluated regarding with classification metrics such as accuracy. The classification metrics evaluate the performance of the model. The pros of the accuracy evaluation in case of our model is to balance a classes and care about the overall model correctness. We will also perform hyper parameter tuning to optimize the performance of the model. To determine the accuracy our model, by passing the ground truth and predicted values is:

```
from sklearn.metrics import accuracy_score
    print (f'Accuracy Score is {accuracy_score(y_test,y_hat)}')
```

We will evaluate the accuracy of the facial recognition model by comparing the predicted faces to the actual faces. In order to measure the performance of a model based on the training and test dataset, how close a measurement is to the true or accepted value or how much accurately the model learns to classify the data, we evaluated how much loss the model have. The accuracy of the model will be evaluated. Evaluation of the model is a critical step in assessing the accuracy and effectiveness of a cloud-based employee timesheet system model using facial recognition technology. Here are some possible evaluation methods that could be used:

Accuracy metrics: is one common method for evaluating the classification accuracy of a facial recognition model. It defines the number of correct prediction divided by the total of prediction multiplied by 100.

Holdout: is a method used to evaluate the performance or efficiency of a model by splitting the data into training and testing subsets. It helps in assessing the model's ability to generalize to unseen data and can identify potential overfitting or under fitting issues.

By carefully evaluating the model, researchers can identify any areas where the system may be struggling and make adjustments to improve its accuracy and effectiveness. This can help to ensure that the system is able to accurately track employee attendance and hours worked, and that it is usable and effective in a real-world setting.

CHAPTER 4

PROPOSED MODEL

4.1 OVERVIEW

In reviewing the current system, the system would use deep learning algorithms and facial recognition systems to verify the identity of the employee. The facial recognition system would capture the facial features of the employee and compare them to a database of known employee faces to verify their identity. The system would store the clock in/out data in a cloud-based database. This would allow for easy access and management of employee timesheet.

The main object of this research is to model a new system for OOCAA that can give advantage and efficiency in tracking information when implement.

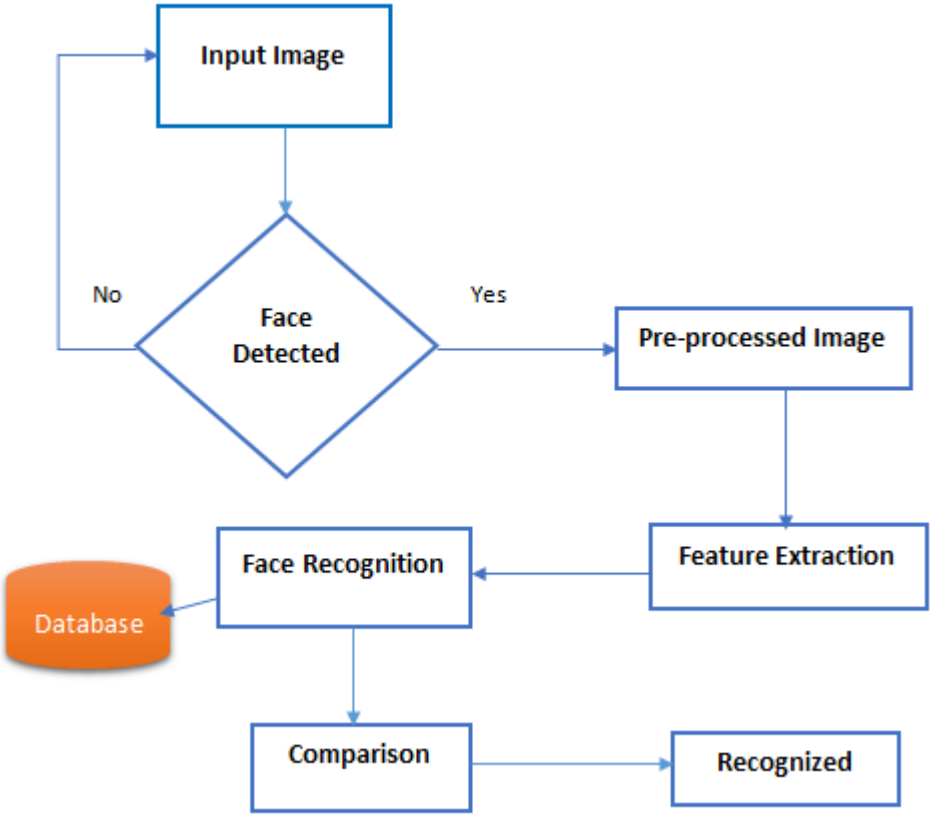


Figure 7: Proposed Model

The beauty of deep learning is that it works for all type of images regardless of age, gender and race. To train a deep learning architecture for different faces such as identifying as Known-face and Unknown-face. The motivation behind this research was stems from the inefficiencies, time

consumption, and inaccuracies of the traditional timesheet process, and also Covid-19 happens to create many problems in the year 2020 since other types of biometric systems require physical contact of object which promotes the transmission of the virus, as a result, so it is the need of the day that applying facial recognition is the better solution intensified by the need for touchless solutions during that pandemic.

4.2 PROPOSED MODEL

The cloud-based employee timesheet model is a system that uses facial recognition to track employee attendance and availability at a working hour. The system consists of a computer vision algorithm that recognizes the employees from their facial features, and a cloud-based database that stores the employee data and timestamps.

4.3 DATASET PROCESSING

Now that we have collected a dataset we need to model with, then we have to process them to split into Training, and Test sets programmatically. By considering creating our own dataset, collecting face images of friends and also from internet. We used a mobile camera to capture images of friends from different angles and under different lighting conditions, and then label the images with the corresponding employee names or IDs. Out of the ***Total datasets*** we used **441** faces with known face and **2504** face datasets with unknown face data sets, and a ***total of 2945 dataset*** were used for the development of the model.

In a deep learning approach to a cloud-based employee timesheet model using facial recognition technology, dataset preparation is a critical step. The dataset will be used to train the deep neural network to recognize the facial features of employees and verify their identity when they clock in and out. Here are some steps that could be followed in dataset preparation:

Data collection: The first step is to collect a dataset of facial images. This dataset should include images of individuals from various angles, with different lighting conditions, and with different facial expressions. The images can be collected using a camera or obtained from an existing dataset.

Data preprocessing: After collecting the dataset, the images should be preprocessed to prepare them for training the deep neural network. This includes resizing the images to a standard size, feature scaling, and normalizing the pixel values. We use this technique to transform the data into a suitable range or distribution for machine learning models, depending on the requirements of the specific problem.

```
In [208]: import numpy as np
          from sklearn.preprocessing import MinMaxScaler, StandardScaler

          # Sample data
          data = np.array([[1, 2, 3],
                           [4, 5, 6],
                           [7, 8, 9]])

          # Normalization
          normalizer = MinMaxScaler()
          normalized_data = normalizer.fit_transform(data)
          print("Normalized Data:")
          print(normalized_data)

          # Standardization
          standardizer = StandardScaler()
          standardized_data = standardizer.fit_transform(data)
          print("Standardized Data:")
          print(standardized_data)

          # Feature scaling
          # Define the range for scaling
          scaling_range = (0, 1)
          scaler = MinMaxScaler(feature_range=scaling_range)
          scaled_data = scaler.fit_transform(data)
          print("Scaled Data:")
          print(scaled_data)

Normalized Data:
[[0.  0.  0. ]
 [0.5 0.5 0.5]
 [1.  1.  1. ]]
Standardized Data:
[[-1.22474487 -1.22474487 -1.22474487]
 [ 0.          0.          0.        ]
 [ 1.22474487  1.22474487  1.22474487]]
Scaled Data:
[[0.  0.  0. ]
 [0.5 0.5 0.5]
 [1.  1.  1. ]]
```

Up on installing and importing the important library packages used for preprocessing the images libraries like tensorflow, Keras, matplot, OpenCV, graph viz, NumPy and many more.

```
In [8]: import tensorflow as tf
        import cv2
        import os
        import matplotlib.pyplot as plt
        import numpy as np

In [9]: img_array = cv2.imread("Dataset/001-Chala.jpg")

In [10]: img_size= 224

In [11]: gray=cv2.cvtColor(img_array,cv2.COLOR_BGR2GRAY)
```

FIGURE 8: Image Preprocessing

Data augmentation: is a technique commonly used in machine learning and computer vision to expand the size of a training dataset by applying various transformations or modifications to the existing data. The goal of data augmentation is to increase the diversity and variability of the training examples, which can help improve the generalization and robustness of a machine learning model. Some possible data augmentation techniques include flipping, rotating and zooming the images as can be observed in figure below.

Running the following command,

```
In [30]: import tensorflow as tf
         from tensorflow import keras
         from tensorflow.keras import layers

In [33]: data_augmentation = keras.Sequential(
             [
                 layers.experimental.preprocessing.RandomFlip("horizontal"),
                 layers.experimental.preprocessing.RandomRotation(0.1),
             ]
         )

In [48]: plt.figure(figsize=(10, 10))
         for images, _ in train_ds.take(1):
             for i in range(8):
                 augmented_images = data_augmentation(images)
                 ax = plt.subplot(4, 4, i + 1)
                 plt.imshow(augmented_images[0].numpy().astype("uint8"))
                 plt.axis("off")
```

FIGURE 9: Data Augmentation

Data labeling: The next step is to label the images with the identities of the employees as Known-face and Unknown-face classes. This can be done manually or using an automated tool. The labeled data will be used to train the deep neural network to recognize the facial features of employees and verify their identity.

Data splitting: is a common practice in machine learning, where the available dataset is divided into subsets to assess the model's performance on unseen data and its generalization ability. This involves splitting the labeled data into training, validation, and testing sets. The training set is used to train the deep neural network, while the validation set helps monitor the network's performance and adjust hyper-parameters during training. The testing set is used to evaluate the network's performance after

training. Holdout validation is one method of data splitting, where the dataset is divided into a training set and a testing set. The training set is used to train the model, while the testing set is used to assess its performance on new data. By carefully preparing the dataset, researchers can ensure that the deep neural network is trained on diverse and representative facial images. This approach enhances the accuracy and robustness of the facial recognition system, enabling accurate verification of employees' identities during clock-in and clock-out processes.

After collecting a dataset for modeling, the next step is to split it into training and test sets, which depends on factors such as the dataset's parameters, size, and the desired model. In this thesis, the train-test split ratio is determined using the hold-out method. The specific proportion for data splitting, such as 80/20 or 90/10, is not fixed and relies on various considerations, including the dataset's size, problem complexity, and available computational resources. While an 80/20 split is commonly used, other ratios like 90/10 or 70/30 can be employed depending on the specific requirements of the task. Therefore in our case we use the 80:20 ratios. The total dataset (2945) is first divided into Training (2356) and Testing sets (589) (80% for training, 20% for testing) then keeping aside the testing set, and randomly choose validation dataset from the total dataset using holdout to avoids over fitting.

```
In [18]: image_size = (224, 224)
         batch_size = 32

         train_ds = tf.keras.preprocessing.image_dataset_from_directory(
             "Face_Image",
             validation_split=0.2,
             subset="training",
             seed=1337,
             image_size=image_size,
             batch_size=batch_size,
         )
         val_ds = tf.keras.preprocessing.image_dataset_from_directory(
             "Face_Image",
             validation_split=0.2,
             subset="validation",
             seed=1337,
             image_size=image_size,
             batch_size=batch_size,
         )
         Found 2945 files belonging to 2 classes.
         Using 2356 files for training.
         Found 2945 files belonging to 2 classes.
         Using 589 files for validation.
```

Figure 10: Data Split

Total dataset100%	Training Set 80%	Validation set 20%
2945	2356	589

TABLE 3: Dataset Split (Hold-Out)

The total number of dataset 2945 is after augmentation. The training set is used to train the model's parameters, while the validation set is used to assess the model's performance during training and make decisions about hyper-parameter tuning and model selection. Splitting the dataset into these

subsets helps evaluate the model's generalization ability and prevent overfitting (when the model performs well on the training data but poorly on new, unseen data).

Data Visualization

The training dataset can be visually observed in label where label **1** was for *Known-face* and label **0** was for label representing *Unknown-face* classification. The below figure shows the using **matplotlib.pyplot()** function to visualize a batch of image with their labels in grid format of the trained data. :

```
In [30]: import matplotlib.pyplot as plt

         plt.figure(figsize=(10, 10))
         for images, labels in train_ds.take(1):
             for i in range(10):
                 ax = plt.subplot(5, 5, i + 1)
                 plt.imshow(images[i].numpy().astype("uint8"))
                 plt.title(int(labels[i]))
                 plt.axis("off")
```

Figure 11: Image Classification with Label

4.4 BUILD A MODEL

We start the model building with the preparation of dataset, split the dataset into training and test set having two classes followed by data-augmentation, Preprocessing and a rescaling layer. To prevent overfitting in neural networks, we introduce a Dropout layer before the final classification layer. Dropout is a regularization technique that addresses overfitting by randomly deactivating a fraction of nodes during training. By doing so, the network is compelled to develop more resilient and generalized representations, avoiding reliance on specific nodes or connections. The inclusion of

Dropout can enhance the model's capacity to generalize to new data and mitigate the risk of overfitting. Placing Dropout before the final classification layer effectively applies regularization to the network, ensuring that nodes are randomly dropped out during training. This approach encourages the network to learn more robust and generalized features, ultimately leading to improved performance on unseen data. In NN, while the activation function is responsible for transforming the summed weighted input from the node in to the activation of the node or the output for that input we use the activation functions.

ReLU (Rectified Linear Unit) - is a default activation function for many types of NN because the model that it use is easy to train to achieve better performance by speeding the training. It is also linear function that will output the input directly if it's positive, otherwise it generates zero. No transform input in this function.

Sigmoid activation function – is maps the input to a value between 0 and 1. It is often used in binary classification problems or as an activation function in the output layer of a neural network.

Softmax activation function –is commonly used in multi-class classification problems. It converts a vector of real numbers into a probability distribution, where the values sum up to 1. It is often used in the output layer of a neural network.

```
In [13]: def make_model(input_shape, num_classes):
             inputs = keras.Input(shape=input_shape)
             # Image augmentation block
             x = data_augmentation(inputs)

             # Entry block
             x = layers.experimental.preprocessing.Rescaling(1.0 / 255)(x)
             x = layers.Conv2D(32, 3, strides=2, padding="same")(x)
             x = layers.BatchNormalization()(x)
             x = layers.Activation("relu")(x)

             x = layers.Conv2D(64, 3, padding="same")(x)
             x = layers.BatchNormalization()(x)
             x = layers.Activation("relu")(x)

             previous_block_activation = x  # Set aside residual

             for size in [128, 256, 512, 728]:
                 x = layers.Activation("relu")(x)
                 x = layers.SeparableConv2D(size, 3, padding="same")(x)
                 x = layers.BatchNormalization()(x)

                 x = layers.Activation("relu")(x)
                 x = layers.SeparableConv2D(size, 3, padding="same")(x)
                 x = layers.BatchNormalization()(x)

                 x = layers.MaxPooling2D(3, strides=2, padding="same")(x)

                 # Project residual
                 residual = layers.Conv2D(size, 1, strides=2, padding="same")(
                     previous_block_activation
                 )
                 x = layers.add([x, residual])  # Add back residual
                 previous_block_activation = x  # Set aside next residual
```

```
    x = layers.SeparableConv2D(1024, 3, padding="same")(x)
    x = layers.BatchNormalization()(x)
    x = layers.Activation("relu")(x)

    x = layers.GlobalAveragePooling2D()(x)
    if num_classes == 2:
        activation = "sigmoid"
        units = 1
    else:
        activation = "softmax"
        units = num_classes

    x = layers.Dropout(0.5)(x)
    outputs = layers.Dense(units, activation=activation)(x)
    return keras.Model(inputs, outputs)

model = make_model(input_shape=image_size + (3,), num_classes=2)
keras.utils.plot_model(model, show_shapes=True)
```

Figure 12: Building Model

The main purpose of developing this model is at last recognizing specific face image of individual from the database. Therefore by using the above algorithm we confirm that the model we develop output was 1.

4.3 TRAIN THE MODEL

Training a model involves feeding it with a diverse dataset of labeled face images, allowing it to learn facial features, landmarks, and representations. Then, the model uses this knowledge to identify or classify faces in new, unseen images or video frames. The accuracy and effectiveness of the trained model depend on factors such as the quality and diversity of the training data, the model architecture, and the training process.

Before starting training the model we have to setup certain things such as the category in which Class the image belongs, the paths where our training data located, and the index of our data have to be set in order.

```
In [16]: Datadirectory = "Face_Image/"
         Classes = ["KnownFace","UnknownFace"]
         for category in Classes:
             path = os.path.join(Datadirectory, category)
             for img in os.listdir(path):
                 img_array = cv2.imread(os.path.join(path,img))
                 plt.imshow(cv2.cvtColor(img_array, cv2.COLOR_BGR2RGB))
                 plt.show()
                 break
             break
```

Figure 13: Data Directory

Then we train our data set using the following command, and the training function starts on the dataset on specified directory.

```
In [25]: training_Data = []
         def create_training_Data():
             for category in Classes:
                 path = os.path.join(Datadirectory, category)
                 class_num = Classes.index(category)
                 for img in os.listdir(path):
                     try:
                         img_array = cv2.imread(os.path.join(path,img))
                         new_array= cv2.resize(img_array, (img_size,img_size))
                         training_Data.append([new_array,class_num])
                     except Exception as e:
                         pass

In [26]: create_training_Data()

In [27]: print(len(training_Data))
         2945

In [28]: import random
         random.shuffle(training_Data)

In [29]: X = []
         y = []
         for features,label in training_Data:
             X.append(features)
             y.append(label)
         X = np.array(X).reshape(-1, img_size, img_size, 3)

In [30]: X.shape
Out[30]: (2945, 224, 224, 3)
```

Figure 14: Training Data

4.4 DEEP LEARNING ARCHITECTURE

Up on installing important libraries like Tensor flow and Keras with layers to use pre-trained model of MobileNet which is a light weight model having around 4.2 million parameters but still a light weight model. MobileNet is a convolutional neural network architecture designed for efficient and lightweight deep learning models, is to provide high accuracy while minimizing the model size and computational complexity, making it suitable for resource-constrained environments. It utilizes depthwise feature. It has proven to be highly effective for a wide range of computer vision tasks, including image classification, object detection, and facial recognition. Its lightweight nature makes it suitable for deployment on mobile devices, embedded systems, and other resource-constrained environments where computational efficiency and real-time performance are crucial.

Here, we decided using MobileNet model to effectively maximize the accuracy of our model and training our classifier while it has pre-trained model for Tensor Flow that was designed to do so. We

develop a new model with less parameter since we optimize the parameters because of the last fully connected layers. On a new model almost similar layers but reduced number of parameters to 3.2 million. We have only one neuron in the last dense layer in our new model.

```
In [93]: import tensorflow as tf
         from tensorflow import keras
         from tensorflow.keras import layers

In [94]: model = tf.keras.applications.mobilenet.MobileNet()

         Downloading data from https://storage.googleapis.com/tensorflow/keras-applications/mobilenet/mobilenet_1_0_224_tf.h5
         17225924/17225924 [==============================] - 36s 2us/step

In [106]: model.summary()

          Model: "mobilenet_1.00_224"
          _________________________________________________________________
          Layer (type)                 Output Shape              Param #
          =================================================================
          input_4 (InputLayer)         [(None, 224, 224, 3)]     0

          conv1 (Conv2D)               (None, 112, 112, 32)      864

          conv1_bn (BatchNormalizati   (None, 112, 112, 32)      128
          on)

          conv1_relu (ReLU)            (None, 112, 112, 32)      0

          conv_dw_1 (DepthwiseConv2D   (None, 112, 112, 32)      288
          )

          conv_dw_1_bn (BatchNormali   (None, 112, 112, 32)      128
          zation)
```

```
In [106]: model.summary()

          conv_pw_13_relu (ReLU)       (None, 7, 7, 1024)        0

          global_average_pooling2d_1   (None, 1, 1, 1024)        0
           (GlobalAveragePooling2D)

          dropout (Dropout)            (None, 1, 1, 1024)        0

          conv_preds (Conv2D)          (None, 1, 1, 1000)        1025000

          reshape_2 (Reshape)          (None, 1000)              0

          predictions (Activation)     (None, 1000)              0

         =================================================================
         Total params: 4253864 (16.23 MB)
         Trainable params: 4231976 (16.14 MB)
         Non-trainable params: 21888 (85.50 KB)
         _________________________________________________________________
```

Figure 15: MobileNet Pre-Trained Model

For compiling the model binary cross entropy was used, and for optimization we used Adam optimizer as well we applied accuracy for as metrics and as activation function, in the output layer we used

Sigmoidal function (used for identify the face/not) binary classification that maps the input a value in between 0 and 1 instead of Softmax (uses for multi-class classification problems) converts a vector of real number values sum up to 1.

In neural networks, finding the minimum point of the cost function is crucial. This local minimum is determined by evaluating the slope at a specific point and descending towards the minimum of the cost function. However, it's important to note that the cost function can have multiple local minima within localized regions. Despite the risk of getting stuck in local minima, gradient descent generally finds satisfactory solutions due to the high dimensionality of neural networks and the random initialization of parameters. To mitigate this issue, one approach is to freeze the layers that are not meant for training.

This paper has proposed to use MobileNet due to its light weight feature and fewer parameters and *higher classification accuracy*. The feature extractor is constructed using MobileNet and CNN. The model has one input, the face image which is either *Known_face* or *Unknown_face*. Our model has only two classes such as faces with Known_face, and faces with Unknown_face.

Following that a similar model with minor difference only some of the last layers are removed from the previous model and a new model with fewer parameters was built and can be observed from the following figure.

```
In [96]: base_input = model.layers[0].input

In [97]: base_output= model.layers[-4].output

In [98]: Flat_layer= layers.Flatten()(base_output)
         final_output = layers.Dense(1)(Flat_layer)
         final_output = layers.Activation('sigmoid')(final_output)

In [99]: new_model = keras.Model(inputs = base_input, outputs= base_output)

In [104]: new_model.summary()
```

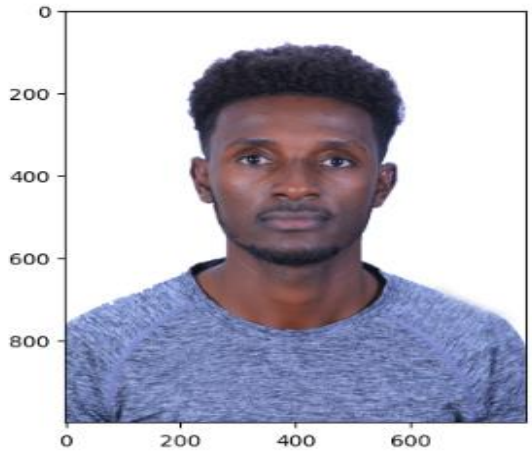
```
Model: "model_1"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 input_4 (InputLayer)        [(None, 224, 224, 3)]     0

 conv1 (Conv2D)              (None, 112, 112, 32)      864

 conv1_bn (BatchNormalizati  (None, 112, 112, 32)      128
 on)

 conv1_relu (ReLU)           (None, 112, 112, 32)      0

 conv_dw_1 (DepthwiseConv2D  (None, 112, 112, 32)      288
 )

 conv_dw_1_bn (BatchNormali  (None, 112, 112, 32)      128
 zation)
```

```
In [104]: new_model.summary()
 conv_dw_13_relu (ReLU)       (None, 7, 7, 1024)        0

 conv_pw_13 (Conv2D)          (None, 7, 7, 1024)        1048576

 conv_pw_13_bn (BatchNormal   (None, 7, 7, 1024)        4096
 ization)

 conv_pw_13_relu (ReLU)       (None, 7, 7, 1024)        0

 global_average_pooling2d_1   (None, 1, 1, 1024)        0
  (GlobalAveragePooling2D)

 dropout (Dropout)            (None, 1, 1, 1024)        0

=================================================================
Total params: 3228864 (12.32 MB)
Trainable params: 3206976 (12.23 MB)
Non-trainable params: 21888 (85.50 KB)
_________________________________________________________________
```

Figure 16: The New Model

The new model was saved, and finally compiled on binary cross entropy since we build on two classes that classify face images as Unknown face or Known faces, and to improve the accuracy and speed Adam optimizer is used. Compiling the CNN is done using the compile function. The function uses the optimizer, the loss functions the performance metrics.

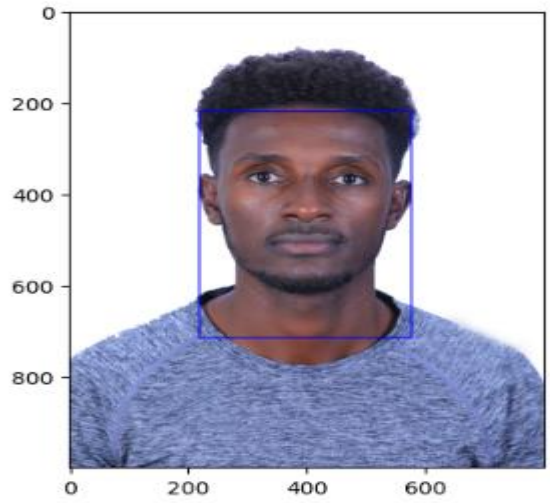
```
In [23]: new_model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])

In [24]: new_model = tf.keras.models.load_model('my_model03.h5')

In [43]: new_model.save('my_model03.h5')

In [44]: img_array = cv2.imread("C:/Users/WIN- 10/Desktop/Chala/Face_Image/KnownFace/001-Chala.png")

In [45]: plt.imshow(cv2.cvtColor(img_array, cv2.COLOR_RGB2BGR))
Out[45]: <matplotlib.image.AxesImage at 0x24567c87430>
```



Therefore by using the pre trained Keras model, we model the new one that saves the data depend on the pre-trained and detect the face and predict the image using the feature extraction. Therefore for detecting faces in an image, extracting the regions of interest corresponding to the detected faces based the new model;

```
In [104]: faces = faceCascade.detectMultiScale(gray, 1.1,4)
for x,y,h,w in faces:
    chala_gray = gray[y:y+h, x:x+w]
    chala_color = img_array[y:y+h, x:x+w]
    cv2.rectangle(img_array, (x,y), (x+w, h+w), (255, 0, 0), 2)
    facess = faceCascade.detectMultiScale(chala_gray)
    if len(facess) == 0:
        print("Not Detected")
    else:
            for (ex,ey,eh,ew) in facess:
                face_chala = chala_color[ey:ey+eh, ex:ex + ew]
```

```
In [105]: plt.imshow(cv2.cvtColor(img_array, cv2.COLOR_BGR2RGB))
Out[105]: <matplotlib.image.AxesImage at 0x20987c58160>
```




```
In [106]: final_image =cv2.resize(face_chala, (224,224))
final_image = np.expand_dims(final_image,axis= 0)
final_image = final_image/255.0

In [107]: Predictions = new_model.predict(final_image)
1/1 [==============================] - 4s 4s/step
```

Figure 17: The Detected Face by the new model prediction

4.5 CREATING DATABASE OF OUR MODEL

For storing our model we're creating the database called OOCAA in our local server. The connection with Server and Face recognition processes are undertaken. Timesheet table are created in order to store and update the data of Employee and to recognize the identity of the individual.

4. 5.1. CREATING OOCAA DATABASE

Under this programming stage importing the required modules, initializes a database connection, creates a table to store photo information, loads known images and names, initializes the camera capture, and then enters a loop to capture and process frames from the camera are cascaded. Within

the loop, the code converts the captured frame to grayscale, detects faces using a Haar cascade classifier, and compares the detected faces with the **known images**. If a match is found above a certain threshold, the photo information is stored in the database and the name is displayed on the frame. If no match is found, the photo is stored as an **unknown face**. The **cv2.matchTemplate ()** function requires both images to have the same size. The known image is resized using **cv2.resize ()** function to match the width and height of the targeted image before performing template matching. This ensures that both images have the same size, and the error should be resolved.

```
In [151]: # Creating the OOCAA database

          import sqlite3

          # Connect to the SQLite database (create if it doesn't exist)
          conn = sqlite3.connect('OOCAA.db')

          # Create a cursor object to execute SQL commands
          c = conn.cursor()

          # Create a table for the timesheet
          c.execute('''
              CREATE TABLE IF NOT EXISTS timesheet (
                  id INTEGER PRIMARY KEY AUTOINCREMENT,
                  employee_name TEXT NOT NULL,
                  image_data BLOB,
                  employee_id INTEGER,
                          date TEXT NOT NULL,
                          hours_worked REAL NOT NULL
              )
          ''')
          c.execute("PRAGMA table_info(timesheet)")
          print(c.fetchall())
          # Commit the changes and close the database connection
          conn.commit()
          conn.close()

          print("OOCAA database created successfully!")

          [(0, 'id', 'INTEGER', 0, None, 1), (1, 'employee_name', 'TEXT', 1, None, 0), (2, 'image_data', 'BLOB', 0, None, 0), (3, 'employ
          ee_id', 'INTEGER', 0, None, 0), (4, 'date', 'TEXT', 1, None, 0), (5, 'hours_worked', 'REAL', 1, None, 0)]
          OOCAA database created successfully!
```

FIGURE 18: Creating OOCAA database

4. 5.2. RECOGNIZING THE IMAGE FROM TIMESHEET TABLE DATABASE

After we creating our database and its table, we load the trained known image. At this stage tasks such as importing the required modules for creating database, for establishes a connection to the database, and for creating the table were imported using import keyword, additionally, we load the known face encodings from the database to initializes the camera capture for real-time image comparison, and we start a loop to capture and process frames from the camera are accomplished. For real-time image capture the webcam is used here.

Within the loop, we compare the detected face encodings with the known face encodings, and achieves actions based on the match results. If a match is found, we can classify images as known image in the database.

If match is found from the database with on the camera, it generates the image information stored in the database. If no match is found, the system sets “Known face not found in the database”.

```python
# Compare the known face with the detected faces from the camera
def compare_faces(known_face, employee_name, employee_id, detected_faces):
    # Convert the known face image to RGB
    known_face_rgb = cv2.cvtColor(known_face, cv2.COLOR_BGR2RGB)
    known_face_encoding = face_recognition.face_encodings(known_face_rgb)[0]

    for (top, right, bottom, left) in detected_faces:
        # Extract the face region from the frame
        face = frame[top:bottom, left:right]

        # Convert the detected face image to RGB
        face_rgb = cv2.cvtColor(face, cv2.COLOR_BGR2RGB)

        # Encode the detected face
        face_encodings = face_recognition.face_encodings(face_rgb)

        if len(face_encodings) > 0:
            face_encoding = face_encodings[0]

            # Compare the face encodings
            results = face_recognition.compare_faces([known_face_encoding], face_encoding)
            if results[0]:
                cv2.rectangle(frame, (left, top), (right, bottom), (0, 255, 0), 2)  # Green bounding box
                cv2.putText(frame, 'Match', (left, top - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 255, 0), 2)
                cv2.putText(frame, f'Name: {employee_name}', (left, top - 40), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 255, 0), 2)
                cv2.putText(frame, f'ID: {employee_id}', (left, top - 70), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 255, 0), 2)
            else:
                cv2.rectangle(frame, (left, top), (right, bottom), (0, 0, 255), 2)  # Red bounding box
                cv2.putText(frame, 'No Match', (left, top - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 0, 255), 2)

    return detected_faces

# Load the known face and employee information from the database
known_face, employee_name, employee_id = load_known_face()
if known_face is None:
    print("Known face not found in the database.")
else:
    # Initialize the camera
```

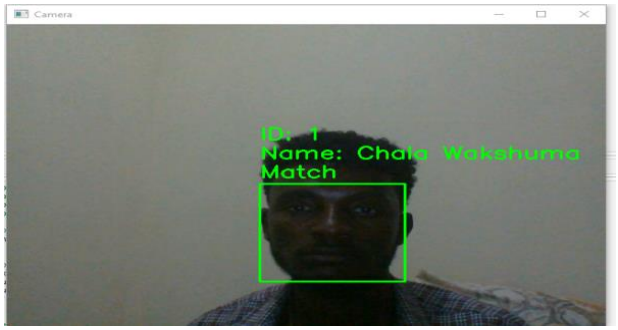


Figure 19: Image of Employee Detected From Database

4.5 EVALUATING THE RESULT OF PROPOSED SYSTEM

After completing the training of the model developed using the trained data, evaluating the selected model based on the result is the critical step. In machine learning, model evaluation refers to the process of assessing the performance and effectiveness of a trained model on unseen data. It helps us understand how well the model generalizes to new, unseen examples and provides insights into its strengths and weaknesses.

Once the model is trained, it is evaluated on the testing set. The testing set contains data that the model has not seen during training, allowing for an unbiased assessment of its performance on new, unseen data. The model's performance metrics, such as accuracy, are calculated based on its predictions on the testing set. These metrics provide an indication of how well the model generalizes to new data and can help identify any overfitting or under fitting issues.

To select the best model depend on the accuracy performance metrics we compare three algorithm models that fits this section can be explained theoretically and graphically in the next chapter.

CHAPTER 5

RESULT AND DISCUSSION

5.1 RESULT

During training, the model utilizes the Adam optimizer and binary cross-entropy loss. To determine the optimal learning rate, various learning rates are experimented with. However, if a lower learning rate is employed, the model may not converge as it requires more time and data for effective training. Conversely, using a higher learning rate enables faster learning, but it may result in unstable accuracy. Face recognition is a complex task, and achieving accurate results often involves training deep learning models on large datasets specific to the task at hand.

Comparison of Algorithms:

Accuracy measures the overall correctness of the model's predictions. It is the ratio of correctly classified faces to the total number of faces in the dataset. A higher accuracy indicates better performance. In order to select the highest and more preferable for facial recognition system for image processing and measuring the accuracy of our model three different machine learning approaches of algorithms are compared including ANN, SVM, and CNN.

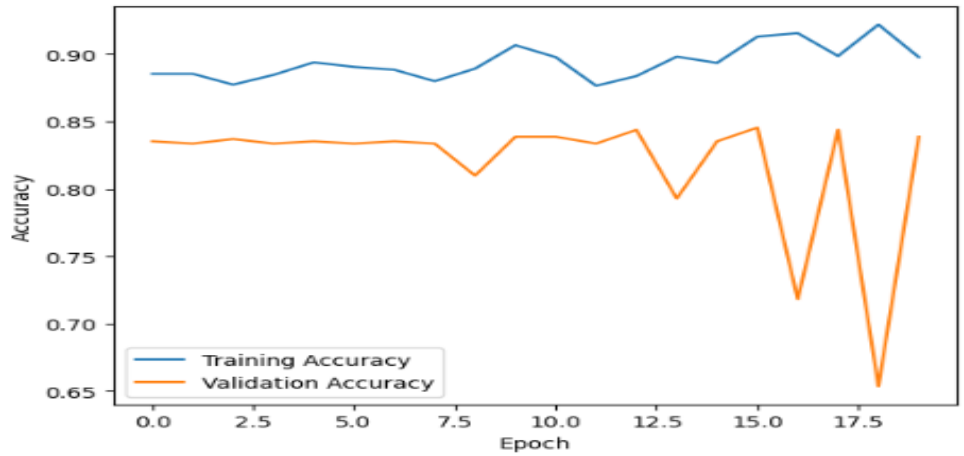
ANN: They learn to extract features from facial images and make predictions based on those features and provide a general framework for learning from data.

```
# Create an ANN model
model = keras.Sequential([
    layers.Flatten(input_shape=(img_size, img_size, 3)),
    layers.Dense(64, activation='relu'),
    layers.Dense(1, activation='sigmoid')
])

# Compile the model
model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])

# Train the model
model.fit(X_train, y_train, epochs=20, batch_size=32, validation_data=(X_test, y_test))
```

```
Epoch 15/20
74/74 [==============================] - 4s 51ms/step - loss: 0.2772 - accuracy: 0.8977 - val_loss: 0.4476 - val_accuracy:
0.8200
Epoch 16/20
74/74 [==============================] - 4s 51ms/step - loss: 0.2943 - accuracy: 0.8820 - val_loss: 0.4410 - val_accuracy:
0.8319
Epoch 17/20
74/74 [==============================] - 4s 50ms/step - loss: 0.2773 - accuracy: 0.8960 - val_loss: 0.5579 - val_accuracy:
0.8336
Epoch 18/20
74/74 [==============================] - 4s 50ms/step - loss: 0.2501 - accuracy: 0.9075 - val_loss: 0.5072 - val_accuracy:
0.8421
Epoch 19/20
74/74 [==============================] - 4s 49ms/step - loss: 0.3330 - accuracy: 0.8769 - val_loss: 0.6771 - val_accuracy:
0.8336
Epoch 20/20
74/74 [==============================] - 4s 51ms/step - loss: 0.3342 - accuracy: 0.8803 - val_loss: 0.6076 - val_accuracy:
0.8353
```

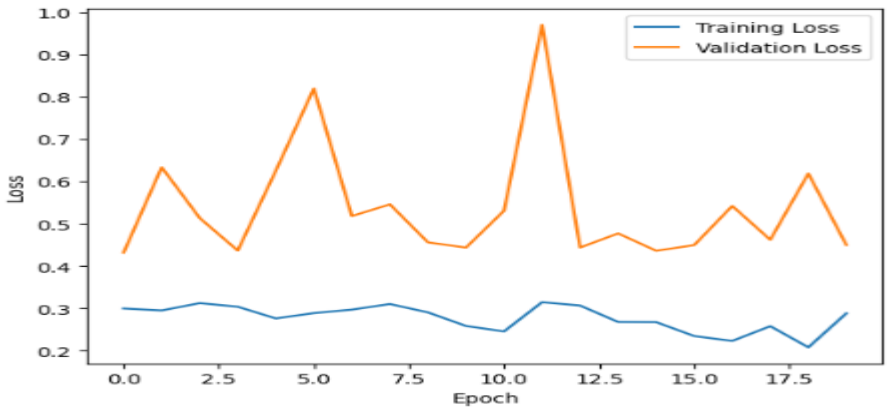
Accuracy graph:

```
In [12]: import matplotlib.pyplot as plt

         # Plotting the training and validation accuracy values
         plt.plot(history.history['accuracy'], label='Training Accuracy')
         plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
         plt.xlabel('Epoch')
         plt.ylabel('Accuracy')
         plt.legend()
         plt.show()
```



Loss graph:

```
In [11]: import matplotlib.pyplot as plt

         # Plotting the training and validation loss values
         plt.plot(history.history['loss'], label='Training Loss')
         plt.plot(history.history['val_loss'], label='Validation Loss')
         plt.xlabel('Epoch')
         plt.ylabel('Loss')
         plt.legend()
         plt.show()
```



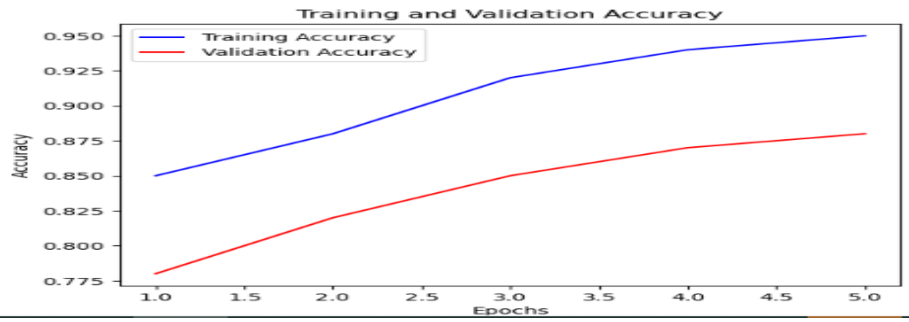
SVM: finds an optimal hyperplane that separates different classes or determines the similarity between faces. It is particularly effective when dealing with high-dimensional feature spaces and it is a versatile machine learning algorithm.

```
# Split the dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, labels, test_size=0.2, random_state=42)

# Create an SVM classifier
svm = SVC()

# Train the SVM classifier
svm.fit(X_train, y_train)

# Make predictions on the training set
y_train_pred = svm.predict(X_train)
train_accuracy = accuracy_score(y_train, y_train_pred)
train_error = 1 - train_accuracy
print("Training Accuracy:", train_accuracy)
print("Training Error:", train_error)

# Make predictions on the testing set
y_test_pred = svm.predict(X_test)
test_accuracy = accuracy_score(y_test, y_test_pred)
test_error = 1 - test_accuracy
print("Validation Accuracy:", test_accuracy)
print("Validation Error:", test_error)
```

```
Training Accuracy: 0.8713921901528013
Training Error: 0.12860780984719866
Validation Accuracy: 0.833616298811545
Validation Error: 0.16638370118845502
```

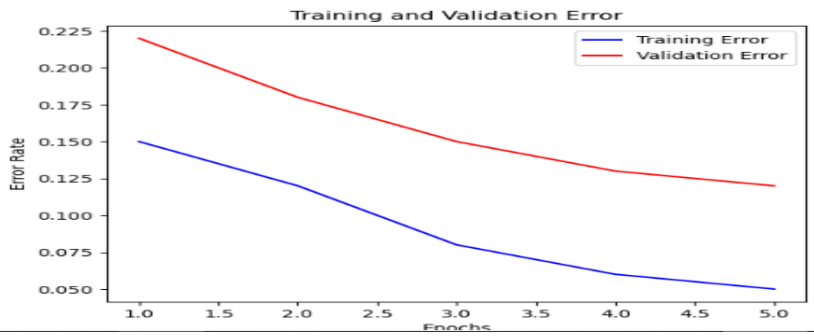
Accuracy graph:

```
In [35]: import matplotlib.pyplot as plt
         # Assuming you have calculated and stored the accuracy values for training and validation
         train_accuracy = [0.85, 0.88, 0.92, 0.94, 0.95]
         val_accuracy = [0.78, 0.82, 0.85, 0.87, 0.88]
         epochs = range(1, len(train_accuracy) + 1)
         # Plotting the accuracy values
         plt.plot(epochs, train_accuracy, 'b', label='Training Accuracy')
         plt.plot(epochs, val_accuracy, 'r', label='Validation Accuracy')
         plt.title('Training and Validation Accuracy')
         plt.xlabel('Epochs')
         plt.ylabel('Accuracy')
         plt.legend()

         plt.show()
```



Loss graph:

```
In [36]: import matplotlib.pyplot as plt
         # Assuming you have calculated and stored the error/misclassification rates for training and validation
         train_error = [0.15, 0.12, 0.08, 0.06, 0.05]
         val_error = [0.22, 0.18, 0.15, 0.13, 0.12]
         epochs = range(1, len(train_error) + 1)
         # Plotting the error rates
         plt.plot(epochs, train_error, 'b', label='Training Error')
         plt.plot(epochs, val_error, 'r', label='Validation Error')
         plt.title('Training and Validation Error')
         plt.xlabel('Epochs')
         plt.ylabel('Error Rate')
         plt.legend()

         plt.show()
```

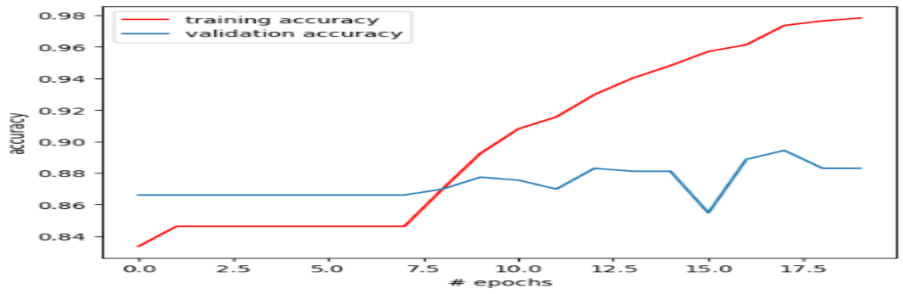


CNN: CNN is a specialized type of neural network commonly used for image processing tasks, including facial recognition. CNNs are designed to automatically learn and extract hierarchical features from images. In facial recognition, CNNs can be trained to detect facial landmarks, extract facial features, or perform face matching tasks. CNNs have achieved state-of-the-art performance in various face recognition benchmarks and are specialized neural networks known for their success in image processing tasks, including facial recognition.

```
In [82]: checkpoint = ModelCheckpoint('model-{epoch:03d}.model',monitor='val_loss',verbose=0,save_best_only=True,mode='auto')
         history=model.fit(train_data,train_target,epochs=20,callbacks=[checkpoint],validation_split=0.2)
0.8811
Epoch 15/20
67/67 [==============================] - 148s 2s/step - loss: 0.1453 - accuracy: 0.9481 - val_loss: 0.5671 - val_accuracy:
0.8811
Epoch 16/20
67/67 [==============================] - 143s 2s/step - loss: 0.1345 - accuracy: 0.9571 - val_loss: 0.6210 - val_accuracy:
0.8547
Epoch 17/20
67/67 [==============================] - 151s 2s/step - loss: 0.1431 - accuracy: 0.9613 - val_loss: 0.5998 - val_accuracy:
0.8887
Epoch 18/20
67/67 [==============================] - 150s 2s/step - loss: 0.1238 - accuracy: 0.9736 - val_loss: 0.6952 - val_accuracy:
0.8943
Epoch 19/20
67/67 [==============================] - 158s 2s/step - loss: 0.1124 - accuracy: 0.9764 - val_loss: 0.8409 - val_accuracy:
0.8830
Epoch 20/20
67/67 [==============================] - 147s 2s/step - loss: 0.1123 - accuracy: 0.9783 - val_loss: 0.8444 - val_accuracy:
0.8830
```

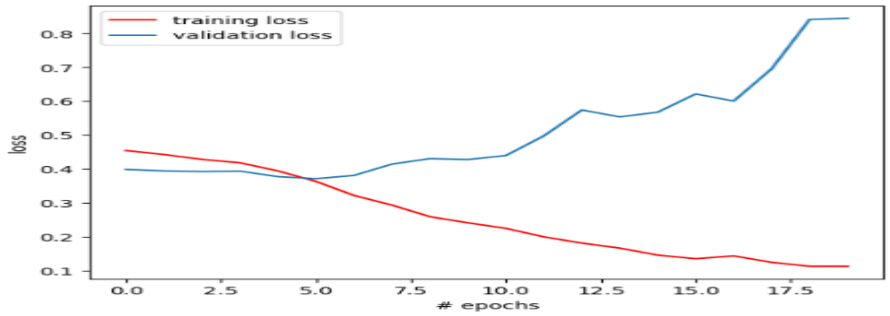
Accuracy graph:

```
In [84]: plt.plot(history.history['accuracy'],'r',label='training accuracy')
         plt.plot(history.history['val_accuracy'],label='validation accuracy')
         plt.xlabel('# epochs')
         plt.ylabel('accuracy')
         plt.legend()
         plt.show()
```



Loss graph:

```
In [83]: from matplotlib import pyplot as plt

         plt.plot(history.history['loss'],'r',label='training loss')
         plt.plot(history.history['val_loss'],label='validation loss')
         plt.xlabel('# epochs')
         plt.ylabel('loss')
         plt.legend()
         plt.show()
```



This table provides the training and validation accuracy, as well as the training and validation error, for three different models: CNN (Convolutional Neural Network), ANN (Artificial Neural Network), and SVM (Support Vector Machine).

Algorithm	Training Accuracy	Validation Accuracy	Training Error	Validation Error
CNN	*0.9783 %*	*0.8830%*	*0.1123%*	*0.8444%*
ANN	*0.8803%*	*0.8353%*	*0.3342%*	*0.6076%*
SVM	*0.8713%*	*0.8336%*	*0.1286%*	*0.1663%*

Therefore based on the provided table, the CNN model performs the best in terms of training accuracy and shows potential for better performance on unseen data. The ANN model performs slightly worse than the CNN model and the SVM model performs reasonably well but with lower accuracy compared to the CNN and ANN models.

In [90]:
```
from keras.models import Sequential
from keras.layers import Dense,Activation,Flatten,Dropout
from keras.layers import Conv2D,MaxPooling2D
from keras.callbacks import ModelCheckpoint

model=Sequential()

model.add(Conv2D(200,(3,3),input_shape=data.shape[1:]))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
#The first CNN layer followed by Relu and MaxPooling layers

model.add(Conv2D(100,(3,3)))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2,2)))
#The second convolution layer followed by Relu and MaxPooling layers

model.add(Flatten())
model.add(Dropout(0.5))
#Flatten layer to stack the output convolutions from second convolution layer
model.add(Dense(50,activation='relu'))
#Dense layer of 64 neurons
model.add(Dense(2,activation='softmax'))
#The Final layer with two outputs for two categories

model.compile(loss='binary_crossentropy',optimizer='adam',metrics=['accuracy'])
```

In [91]:
```
from sklearn.model_selection import train_test_split

train_data,test_data,train_target,test_target=train_test_split(data,target,test_size=0.1)
```

Here, we use Binary Cross entropy loss because of it measures the dissimilarity or discrepancy between predicted probabilities and true binary labels to compile the model by specifying the loss function, and the Adam optimizer is used while it provide efficient and effective optimization during the training process, and also the metrics accuracy to evaluate during training

Based on the above code the trained model achieves better accuracy on both training and validation dataset. On training dataset the model achieves 0.***9783%*** of training accuracy on the *epoch 20*, we

achieved ***0.1123%*** of training loss, and *validation loss of* ***0.8444%***, and *validation accuracy* of ***0.8830 %*** was achieved.

```
In [82]: checkpoint = ModelCheckpoint('model-{epoch:03d}.model',monitor='val_loss',verbose=0,save_best_only=True,mode='auto')
         history=model.fit(train_data,train_target,epochs=20,callbacks=[checkpoint],validation_split=0.2)
8811
Epoch 15/20
67/67 [==============================] - 148s 2s/step - loss: 0.1453 - accuracy: 0.9481 - val_loss: 0.5671 - val_accuracy: 0.
8811
Epoch 16/20
67/67 [==============================] - 143s 2s/step - loss: 0.1345 - accuracy: 0.9571 - val_loss: 0.6210 - val_accuracy: 0.
8547
Epoch 17/20
67/67 [==============================] - 151s 2s/step - loss: 0.1431 - accuracy: 0.9613 - val_loss: 0.5998 - val_accuracy: 0.
8887
Epoch 18/20
67/67 [==============================] - 150s 2s/step - loss: 0.1238 - accuracy: 0.9736 - val_loss: 0.6952 - val_accuracy: 0.
8943
Epoch 19/20
67/67 [==============================] - 158s 2s/step - loss: 0.1124 - accuracy: 0.9764 - val_loss: 0.8409 - val_accuracy: 0.
8830
Epoch 20/20
67/67 [==============================] - 147s 2s/step - loss: 0.1123 - accuracy: 0.9783 - val_loss: 0.8444 - val_accuracy: 0.
8830
```

Figure 20: Model Result

To determine the each training dataset of our model through algorithm we use a hyper parameter Epoch. Here the epoch number specifies the complete passes or iteration of the entire training dataset passing through the training process. The number of epochs is a hyperparameter that determines how many times the model will go through the entire training dataset. Choosing the right number of epochs is important to strike a balance between underfitting (too few epochs) and overfitting (too many epochs) the data.

The information described on each epoch helps to track the progress of the model during training. It allows monitoring the loss, accuracy, and other metrics to assess the performance and convergence of the model over time. The accuracy of training and validation is displayed below on data trained and new model, also their losses to identify the performance of model.

```
In [84]: plt.plot(history.history['accuracy'],'r',label='training accuracy')
         plt.plot(history.history['val_accuracy'],label='validation accuracy')
         plt.xlabel('# epochs')
         plt.ylabel('accuracy')
         plt.legend()
         plt.show()
```

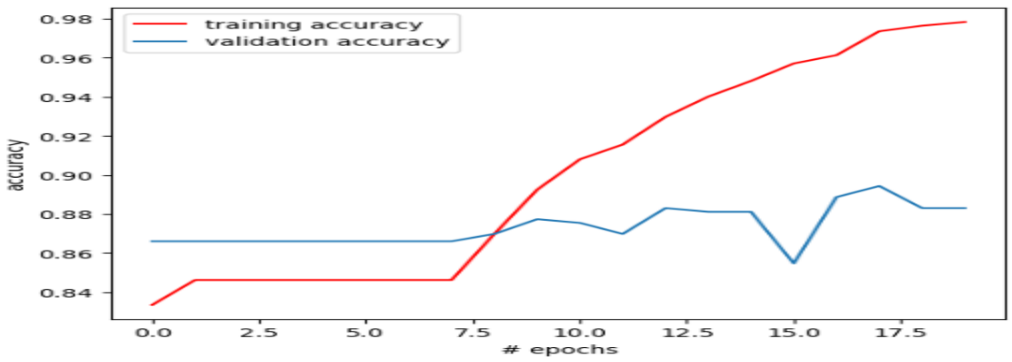


Figure 21: Training and Validation Accuracy of the Proposed Model

Here, their number indicates the training and validation accuracy of the model at the current epoch and represents the proportion of correctly predicted samples in the training and validation data.

```
In [83]: from matplotlib import pyplot as plt

plt.plot(history.history['loss'],'r',label='training loss')
plt.plot(history.history['val_loss'],label='validation loss')
plt.xlabel('# epochs')
plt.ylabel('loss')
plt.legend()
plt.show()
```

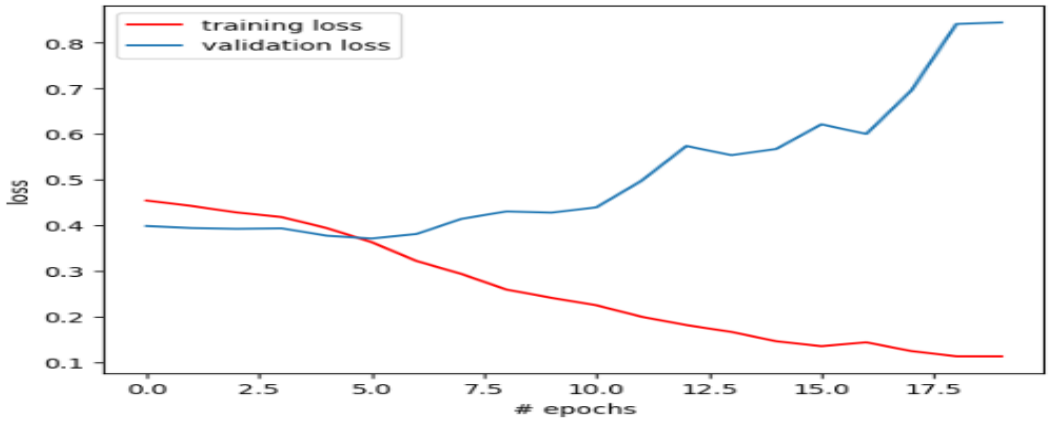


Figure 22: Training and Validation Loss

Here, the loss number of the training represents the value of the loss function at the current stage of training and a lower loss value indicates better model performance. Here the training loss number is decreasing during the training process which indicates that the model is improving its performance on the training data over successive epochs. A decreasing training loss suggests that the model is learning to fit the training data better and reducing the discrepancy between its predictions and the true labels. A number of validation losses represent the value of the loss function on the validation set at the current epoch. The validation loss is a measure of how well the model is performing on unseen data. As we seen the Validation loss number is increasing which is assign of overfitting. It occurs when a model becomes too specialized in learning the training data, to the point that it starts to memorize patterns and noise specific to the training examples, rather than generalizing well to new, unseen data. As a result, the model may struggle to make accurate predictions on data it has not encountered before. This is coz of model complexity, insufficient regularization, dataset mismatch and learning rates.

In the graph above we can observe that our model has achieved to learn and classify, on the dataset we provided. And able to achieve ***97.83%*** of training accuracy and *validation accuracy* of ***88.30%*** was achieved, we achieved ***11.23*** % of training loss and ***84.44% of*** *validation loss was achieved and* the results shown in table below.

Training Accuracy	Validation Accuracy	Training Loss	Validation Loss
97.83 %	*88.30%*	*11.23%*	*84.44%*

Figure 23: Result of the Model

From the above table we can observe that our model accurately classifies our facial dataset 97.83% on training data and 88.30% on validation dataset, it was also observed that an error or loss of 11.23 % on training dataset and 84.44 % on validation dataset was found. From the above result out of the 20 epochs we perform check on epoch 20 was found to have less error and maximum accuracy, therefore it was selected as the best model for our dataset.

5.2 DISCUSSION

Here we discuss the finding of our thesis; To answer the research questions of different tools and methods used for modeling the employee timesheet system such as libraries of machine learnings (i.e. OpenCV, Python, Keras, Tensorflow, SQLite, Algorithms, and etc.) and the overall methods used starting from understanding the research area to solve the gaps by reviewing the literatures, data collecting (from locally found workers of Oromia Occupational competence assurance agency and open source Flicker database), training the collected data, building the model and train the model methods are implemented. Also the model was built from pre trained model of MobileNet frame works that have around 4.2 million parameters but, still have a light weight one, the new model that was derived from this version was built having around 3.2 million which was reduced in number of parameters. Still the new model have performed well in classifying the images into their appropriate classes, since we have only two classes in our problem we use Sigmoid for binary classification, instead of using Softmax which is helpful for large number of class.

To select the best algorithm for modeling the employee timesheet system we compare three algorithms ANN, SVM and CNN are implemented to evaluate the performance of the new model based on our dataset. Therefore: The CNN model achieves a high training accuracy of 97.83%, indicating that it performs well on the training data. The validation accuracy is slightly lower at 88.30%, which suggests that the model might be slightly overfitting to the training data. The training error is 11.23%, meaning that the model makes incorrect predictions on about 11.23% of the training samples. The validation error is quite high at 84.44%, indicating that the model performs poorly on unseen data.

The ANN model achieves a lower training accuracy compared to the CNN model, at 88.03%. The validation accuracy is also lower at 83.53%. These values suggest that the ANN model is less accurate than the CNN model on both the training and validation data. The training error is 33.42%, indicating a significant percentage of incorrect predictions on the training set. The validation error is 60.76%, which is quite high and suggests poor performance on unseen data.

The SVM model achieves a training accuracy of 87.13%, which is slightly lower than the CNN and ANN models. The validation accuracy is also comparable to the ANN model at 83.36%. The training error is 12.86%, indicating a relatively low percentage of incorrect predictions on the training set. The validation error is 16.63%, which is lower than both the CNN and ANN models, suggesting better generalization to unseen data.

Additionally, according to the performance metrics, the model we chosen for the accuracy of our model we get by CNN are best. The results of the *training accuracy*, *validation accuracy,* and also the results of *training* and *validation loss* from the training and validation data was found to be **97.83%** for training accuracy, **88.30%** for validation accuracy, 84.44% for validation loss and **11.23%** for training loss was found at **20** epoch.

CHAPTER 6

CONCLUSION, RECOMMENDATION AND FUTURE WORKS

6.1 CONCLUSION

We have presented in this thesis a deep learning architecture in classifying a dataset of images with two classes; that have a category of face images that have a Known face and another category that have Unknown face, we have collected dataset of images from real world dataset of individuals and from internet.

We split these datasets into two classes having a face that have a Known face and another category that have Unknown face classes. To avoid over fitting during training we split our dataset into 80 for training and 20% for validation. We used a specifically this method to avoid over fitting, since we followed holdout to avoid over fitting. A deep learning model was developed using Jupiter notebook which was fast open-source library that was found with anaconda module. It was used to run python codes, it was also used together with libraries like Keras, Numpy, open-cv and many more as necessarily. The model was evaluated to validate the performance of the system and the result was measured in the training accuracy, validation accuracy and The results of the *training accuracy*, *validation accuracy* and the results of *training loss* and *validation loss* from the training and validation data was found to be **97.83%** for training accuracy, **88.30%** for validation accuracy, 84.44% for validation loss and **11.23%** for training loss was found at **20** epoch.

6.2 RECOMMENDATIONS

In the future research we recommend that the model implementation with improvements to the model and data collection techniques. To further reduce the transmission of the pandemic disease named like COVID-19 and to track the entry of employee developing a mechanism which recommends contactless biometric technology is somehow a better solution. Consider also different machine learning algorithms that have high accuracy and improve the efficiency of the model.

We also recommend for future researchers to use cloud servers especially if they consider developing a research for organizations having large amount of employees, and huge data.

6.3 FUTURE WORKS

Future research was needed to be focused on improving the accuracy and functionally made it cloud based system. So that we can control, access and view status of the individual when we are not around. To do this we need to have enough and quality data from different areas, taken at different times, under different condition because this has effect on the learning efficiency of a model. Therefore having data with a variety and large dataset will help us to take this study a long way to forward to improve the classification and identification of individuals. Collecting enough and well-refined data on different condition will help this study to progress.

Implement with Biometric devices by Mounting the facial detection device on a wall is the future work we recommend and also to fasten the computerized system of tracking employees at the working environment the facial recognition system is easier. Additionally, linking the timesheet of the employee with the profile is necessary for updating and tracking to measure the performance of the employees in working environment.

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APPENDIXES

Code used for image classification

```
import cv2
import os
import matplotlib.pyplot as plt
import numpy as np
image_size = (224, 224)
batch_size = 32
train_ds = tf.keras.preprocessing.image_dataset_from_directory(
    "Face_Image",
    validation_split=0.2,
    subset="training",
    seed=1337,
    image_size=image_size,
    batch_size=batch_size,
)
val_ds = tf.keras.preprocessing.image_dataset_from_directory(
    "Face_Image",
    validation_split=0.2,
    subset="validation",
    seed=1337,
    image_size=image_size,
    batch_size=batch_size,
)
```

Code used for image processing i.e. create training data

```
training_Data = []
def create_training_Data():
    for category in Classes:
        path = os.path.join(Datadirectory, category)
        class_num = Classes.index(category)
        for img in os.listdir(path):
```

```
        try:
            img_array = cv2.imread(os.path.join(path,img))
            new_array= cv2.resize(img_array, (img_size,img_size))
            training_Data.append([new_array,class_num])
        except Exception as e:
            pass
```

Code used for image detection

```
faces = faceCascade.detectMultiScale(gray, 1.1,4)
for x,y,h,w in faces:
    chala_gray = gray[y:y+h, x:x+w]
    chala_color = img_array[y:y+h, x:x+w]
    cv2.rectangle(img_array, (x,y), (x+w, h+w), (255, 0, 0), 2)
    facess = faceCascade.detectMultiScale(chala_gray)
    if len(facess) == 0:
        print("Not Detected")
    else:
        for (ex,ey,eh,ew) in facess:
            face_chala = chala_color[ey:ey+eh, ex:ex + ew]
plt.imshow(cv2.cvtColor(img_array, cv2.COLOR_BGR2RGB))
```

Code used for creating database

```
# Creating the OOCAA database
import sqlite3
# Connect to the SQLite database (create if it doesn't exist)
conn = sqlite3.connect('OOCAA.db')
# Create a cursor object to execute SQL commands
c = conn.cursor()
# Create a table for the timesheet
c.execute('''
    CREATE TABLE IF NOT EXISTS timesheet (
        id INTEGER PRIMARY KEY AUTOINCREMENT,
        employee_name TEXT NOT NULL,
        image_data BLOB,
        employee_id INTEGER,
```

```
        date TEXT NOT NULL,
        hours_worked REAL NOT NULL
    )
''')
c.execute("PRAGMA table_info(timesheet)")
print(c.fetchall())
# Commit the changes and close the database connection
conn.commit()
conn.close()
print("OOCAA database created successfully!")
```

Code used for matching the image

```
# detecting the face from camera and match the image from the databse
import cv2
import sqlite3
import numpy as np
import face_recognition
# Load the known face image from the database
def load_known_face():
    conn = sqlite3.connect('OOCAA.db')
    c = conn.cursor()
    c.execute("SELECT image_data FROM timesheet WHERE employee_name = ?", ('Chala Wakshuma',))
    result = c.fetchone()
    conn.close()
    if result:
        image_data = np.frombuffer(result[0], np.uint8)
        known_face = cv2.imdecode(image_data, cv2.IMREAD_COLOR)
        return known_face
    else:
        return None
# Compare the known face with the detected faces from the camera
```

```
def compare_faces(known_face, detected_faces):
    # Convert the known face image to RGB
    known_face_rgb = cv2.cvtColor(known_face, cv2.COLOR_BGR2RGB)
    known_face_encoding = face_recognition.face_encodings(known_face_rgb)[0]
    for (top, right, bottom, left) in detected_faces:
        # Extract the face region from the frame
        face = frame[top:bottom, left:right]
        # Convert the detected face image to RGB
        face_rgb = cv2.cvtColor(face, cv2.COLOR_BGR2RGB)
        # Encode the detected face
        face_encodings = face_recognition.face_encodings(face_rgb)
        if len(face_encodings) > 0:
            face_encoding = face_encodings[0]
            # Compare the face encodings
            results = face_recognition.compare_faces([known_face_encoding], face_encoding)
            if results[0]:
                cv2.rectangle(frame, (left, top), (right, bottom), (0, 255, 0), 2)  # Green bounding box
                cv2.putText(frame, 'Match', (left, top - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 255,
0), 2)
            else:
                cv2.rectangle(frame, (left, top), (right, bottom), (0, 0, 255), 2)  # Red bounding box
                cv2.putText(frame, 'No Match', (left, top - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 0,
255), 2)
    return detected_faces
# Load the known face from the database
known_face = load_known_face()
if known_face is None:
    print("Known face not found in the database.")
else:
    # Initialize the camera
    cap = cv2.VideoCapture(0)
```

```
    while True:
        # Capture frame-by-frame
        ret, frame = cap.read()
        # Detect faces in the frame
        face_locations = face_recognition.face_locations(frame)
        # Compare the known face with the detected faces
        compare_faces(known_face, face_locations)
        # Display the frame with bounding boxes and labels
        cv2.imshow('Camera', frame)
        # Exit loop if 'q' key is pressed
        if cv2.waitKey(1) & 0xFF == ord('q'):
            break
    # Release the capture and close all windows
    cap.release()
    cv2.destroyAllWindows()
```

Code used for image recognition

```
# detecting the face from camera and recognizing and generate the information from database
import cv2
import sqlite3
import numpy as np
import face_recognition
# Load the known face and employee information from the database
def load_known_face():
    conn = sqlite3.connect('OOCAA.db')
    c = conn.cursor()
    c.execute("SELECT image_data, employee_name, employee_id FROM timesheet WHERE employee_name = ?", ('Chala Wakshuma',))
    result = c.fetchone()
    conn.close()
    if result:
        image_data = np.frombuffer(result[0], np.uint8)
```

```
        known_face = cv2.imdecode(image_data, cv2.IMREAD_COLOR)
        employee_name = result[1]
        employee_id = result[2]
        return known_face, employee_name, employee_id
    else:
        return None, None, None
# Compare the known face with the detected faces from the camera
def compare_faces(known_face, employee_name, employee_id, detected_faces):
    # Convert the known face image to RGB
    known_face_rgb = cv2.cvtColor(known_face, cv2.COLOR_BGR2RGB)
    known_face_encoding = face_recognition.face_encodings(known_face_rgb)[0]
    for (top, right, bottom, left) in detected_faces:
        # Extract the face region from the frame
        face = frame[top:bottom, left:right]
        # Convert the detected face image to RGB
        face_rgb = cv2.cvtColor(face, cv2.COLOR_BGR2RGB)
        # Encode the detected face
        face_encodings = face_recognition.face_encodings(face_rgb)
        if len(face_encodings) > 0:
            face_encoding = face_encodings[0]
            # Compare the face encodings
            results = face_recognition.compare_faces([known_face_encoding], face_encoding)
            if results[0]:
                cv2.rectangle(frame, (left, top), (right, bottom), (0, 255, 0), 2)  # Green bounding box
                cv2.putText(frame, 'Match', (left, top - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 255,
0), 2)
                cv2.putText(frame, f'Name: {employee_name}', (left, top - 40),
cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 255, 0), 2)
                cv2.putText(frame, f'ID: {employee_id}', (left, top - 70), cv2.FONT_HERSHEY_SIMPLEX,
0.9, (0, 255, 0), 2)
            else:
```

```
            cv2.rectangle(frame, (left, top), (right, bottom), (0, 0, 255), 2)  # Red bounding box
            cv2.putText(frame, 'No Match', (left, top - 10), cv2.FONT_HERSHEY_SIMPLEX, 0.9, (0, 0, 255), 2)
    return detected_faces
# Load the known face and employee information from the database
known_face, employee_name, employee_id = load_known_face()
if known_face is None:
    print("Known face not found in the database.")
else:
    # Initialize the camera
    cap = cv2.VideoCapture(0)
    while True:
        # Capture frame-by-frame
        ret, frame = cap.read()
        # Detect faces in the frame
        face_locations = face_recognition.face_locations(frame)
        # Compare the known face with the detected faces
        compare_faces(known_face, employee_name, employee_id, face_locations)
        # Display the frame with bounding boxes and labels
        cv2.imshow('Camera', frame)
        # Exit loop if 'q' key is pressed
        if cv2.waitKey(1) & 0xFF == ord('q'):
            break
    # Release the capture and close all windows
    cap.release()
    cv2.destroyAllWindows()
```