MODIFYING FAST BATTERY CHARGING SYSTEM BY ADDING DC MOTOR

Bedada Adugna Tadesse

A Thesis Submitted to

The Department of Mechanical Engineering

School of Mechanical, Chemical and Materials Engineering

Presented in Partial Fulfillment of the Requirement for the degree of Master of Science in Automotive Engineering

Office of Graduate Studies

Adama Science and Technology University

January, 2023 G.C

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CANDIDATE'S DECLARATION

I hereby declare that this Master Thesis entitled "Modifying Fast Battery Charging System by Adding Dc Motor" is my original work. That is, it has not been submitted for the award of any degree, diploma or certificate in any other university. All sources of material that are used for this thesis have been duly acknowledged through citation.

Bedada Adugna Tadesse	__________________	__________________
Name of the student	Signature	Date

RECOMMENDATION

We, the advisors of this thesis, hereby certify that we have read the revised version of the thesis entitled "Modifying Fast Battery Charging System by Adding Dc Motor" prepared under our guidance by Bedada Adugna submitted in partial fulfillment of the requirements for the degree of Mater's of Science in Automotive Engineering. Therefore, we recommend the submission of revised version of the thesis to the department following the applicable procedures.

Mekonnen Liben (Asst. Prof)	________________	________________
Major Advisor	Signature	Date

APPROVAL OF BOARD OF EXAMINERS

We, the advisors of the thesis entitled "Modifying Fast Battery Charging System by Adding Dc Motor" and developed by Bedada Adugna, hereby certify that the recommendation and suggestions made by the board of examiners are appropriately incorporated into the final version of the thesis.

Mekonnen Liben (Asst. Prof)	______________	____________
Advisor	Signature	Date

We, the undersigned, members of the Board of Examiners of the thesis by Bedada Adugna have read and evaluated the thesis entitled "Modifying Fast Battery Charging System by Adding Dc Motor" and examined the candidate during 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 Automotive Engineering.

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ACRONYMS

AC	Alternative Current
BES	Battery Energy Storage
BMS	Battery Management System
CAD	Computer-Aided Design
DC	Direct current
EMF	Electromotive Force
ARB	Air Resources Board
EV	Electric Vehicle
LDP	Lithium Deposition Potential
LIB	Lithium Ion Battery
PHEV	Plug-In Hybrid Electric Vehicle
PV-EV	Photovoltaic Electric Vehicle
SME	Small And Micro-Enterprise
SOC	State Of Charge
USDE	United States Department of Energy
TVET	Technical and Vocational Education and Training
ZEV	Zero Emissions Vehicle

ABSTRACT

Negative impacts from the dominant use of petroleum-based transportation have propelled the globe towards electrified transportation. With this thrust, many technological challenges are being encountered and addressed, one of which is the development and availability of fast charging technologies. To compete with petroleum-based transportation, electric vehicle (EV) battery charging times need to decrease to the 5–10 min range. Fast Battery charging system plays significant role in the transportation system. The charging system converts the engine's mechanical energy into electrical energy. This electrical energy is used to maintain the battery's state of charge and to operate the loads of the automotive electrical system. The objective of this study is to modify fast battery charging system by adding DC motor without crankshaft moving. It is well known that when vehicle's battery runs down most of the time starting of the vehicle is done by using human power, i.e., pushing the vehicle or using manual starting system which was mostly applied to trucks (old model). This trend of starting a vehicle has many drawbacks, i.e. breakage of engaged gear teeth, clutch disk distortion, excessive torsional loads on rotating parts of transmission and engine, the researcher targeted to solve such crucial problems that has intended to design and develop a compact and easily portable battery charger which is aimed for fast battery charging system by adding DC motor. The methods followed were used different sources of data such as related literatures, reports, automotive electrical workshops, and research documents. And also, the result showed that, 0.075Volt were produced at every 0.5min. duration of recharging time and concluded that, many studies on fast charging protocols have been of empirical or experimental nature, and therefore their performance has only been assessed for a limited range of cell chemistries, form factors, and operating conditions.

Keywords: *Battery Energy Storage, Battery Management System, fast battery charging,*

CHAPTER ONE

INTRODUCTION

The battery is an electrical storage device whose function is to store the energy, usually thanks to an electrochemical process, that is generated by the generator device and is not consumed by the loads. Moreover, it allows the supply of the loads even when the engine is stopped and provides the peak of energy demanded when the engine starts. The charging system, usually composed of an alternator, a rectifier, and a voltage regulator, keeps the optimal level of charge of the battery to supply the loads (Group, 2005).

The circuitry to recharge the batteries in a portable product is an important part of any power supply design. The complexity (and cost) of the charging system is primarily dependent on the type of battery and the recharge time (Simpson, 2005).

As EV technologies improved and electrified transportation has become more widespread, a need for standardized charging ports has developed. Just as a driver of an internal combustion engine vehicle (ICEV) can fill up at any gas station, the same need arose for EVs. Even today, a lack of charging port standardization is a major hurdle that is holding back EV adoption, as the various EV manufacturers still use different charging port configurations. The Society of Automotive Engineers (SAE) exists with the purpose of uniting and developing technologies by creating industry accepted standards (SAE, 2018).

Fast Battery charging system play significant role in enhancing uninterrupted mobility of vehicles. The charging system converts the engine’s mechanical energy into electrical energy. This electrical energy is used to maintain the battery’s state of charge and to operate the loads of the automotive electrical system. In this chapter we will use the conventional theory of current: Electrons move from positive to negative (+ to -). During cranking, all electrical energy for the vehicle is supplied by the battery. After the engine is running, the charging system must produce enough electrical energy to recharge the battery and to supply the demands of other loads in the electrical system. If the starting system is in poor condition and draws too much current, or if the charging system cannot recharge the battery and supply the additional loads, more energy must be drawn from the battery for short periods of time. By minimize car accident which make road cording and closes the line by making crash on the road and minimize the traffic operation service on the field of transportation. In the normal charging system, the charging system of car is only engine operation charging system which makes accident when it was fail and make other problem like building crashing etc. For this we researched again Fast Battery charging system that helps tore charge the battery on the vehicle to minimize the problem which is came by this. Because it is fast to charge and easy to recharge the battery on the vehicle at needed place and time. As we know on to day the new model of car Interring is increase day to day Ethiopia. For this new model didn’t need to start the engine by pushing because of the transmission Automatic for this try to start the car by pushing is cause engine damage. Due to this reason, we lost a large amount of birr and time. To solve this problem why we are going to make new technology that means fast battery charging system without crank the engine that helps us when we need to check our engine problem to crank again and again. In the first charging system the system is connected with engine for this we should have taken off the battery for the vehicle and recharge at other place it is hard and costly, this new technology gives a solution for this (Muhammad Umair Ali, 2018).

Fast charger is a device that helps to recharge the battery when the battery is rundown that means if it is out needed voltage for start the engine. It is equipped with the all-engine charging system component with adding DC motor. Fast charger is helps to recharge the Battery when we need to check the engine to crack again and again. If the engine system is failed to and want to check for correction is ok. the privies battery charging system is installed with engine crank shaft, know to recharge the engine battery the engine most have to be start. As the researcher have seen this operation it is hard to recharge the battery when the system of engine is failed so this to re charge battery, we need other force or operation by removing battery form vehicle it is bad (Hajara S. et al, 2016).

1.1. Background of study

Rather than charging the battery by removing out of the vehicle using bench like battery charger, the emergency fast battery charger is best to save time.

Marcel M, (2019). Discussed the charging circuit has two input stages, which consists of:

1. Rectifier to convert AC grid supply to DC, for our work we have chosen 3-phase full bridge rectifier.

2. Convertor in order to step up or step down the DC voltage. The main work is to identify the functional parameters of the power electronics components examining the boost convertor, so that they can fulfil the power. Requirements of each charging posts. To the other end, it is essential to focus on finding the required electronics components to provide the charging posts with the required electronic components to provide the charging posts with the required level of voltage, rather than evaluating the efficiency of this part of the system. Diode Rectifier: Post recharges of a battery, while considering an optimal power storage strategy from the grid overnight, can minimize the electricity cost and the power supplies to EV batteries through the day time. In case of a three-phase grid voltage rectification scenario i.e., AC, can be combined with the DC car that can be used to charge the EV.

The batteries charging systems can be of two types: public chargers and residential chargers. Public chargers are an optimal solution to charge the batteries of the vehicles using energy from several sources of energy (as wind or sun) and can be deployed at strategic places around a town or city, like for example, at companies, public buildings and shopping centers parking lots. On the other hand, residential chargers are designed to deliver low power, in an efficient way, since in general they are used to make a complete charge of the batteries during long periods of time (slow charging). The main benefits of these two types of chargers are the comfort for the user, and the freedom of the user to charge the batteries when he wants, according with the best prices of energy. The main disadvantage is that, since each charging process is independent, the limit of overload of the electrical power grid can be easily reached.

The process of charging a plug-in electric vehicle exposes new hazards and risks that differ from internal combustion engine vehicles. These new hazards and risks must be defined and mitigated through proper system design and verified via functional system performance testing. If not properly protected and controlled, vehicle charging using either alternating current or direct current can introduce a range of possible hazards ranging from high-voltage exposure to vehicle or battery damage. Regardless of charging method, actions including establishing and monitoring an equipment grounding path, exchanging control information between the vehicle and the electrical supply equipment, monitoring the system for isolation issues and shorting, avoiding vehicle movement while connected, and returning the vehicle to a safe state following any unexpected behavior or faults are of critical importance to ensure safe charging of a PEV.

DC charging represents additional challenges since the DC charger is external to the vehicle. Unlike AC charging where the on-board charger (converter) and battery management system/controls are under direct control of a vehicle, DC charging uses an external charger and thus requires the vehicle, high-voltage system controls, and battery management systems to interact with an external device that is directly connected to the vehicle's high-voltage battery. While a range of documents describe the interoperability, requirements required to have chargers that can function reliably across a range of vehicles and situations, this document focuses on system-level safety verification procedures to test if a connected vehicle/charging system can safely handle failure modes and hazards commonly associated with charging.

Davide De. (2010), Demonstrated that the majority of EVs. are designed with on-board unidirectional batteries charging systems. Besides the on-board batteries charging systems, some vehicles allow the charge of their batteries with off-board chargers. An on-board battery charging system refers to a charger implemented inside the vehicle. The user only has access to the input of the charging system. This type of charger is connected to the AC electrical grid voltage and is used to slowly charge the batteries – it is denominated as "slow charging". On the other hand, an off-board battery charging system is implemented outside the vehicle. It is given access to the DC voltage of the batteries and is used to charge the batteries as fast as possible – it is denominated as "fast charging".

1.2. Statement of the problem

The fast battery charger is used to recharge the battery by fast charging system. It is well known that when vehicle's battery runs down most of the time starting of the vehicle is done by using human power, i.e., pushing the vehicle or using manual starting system which was mostly applied to trucks (old model). This trend of starting a vehicle has many drawbacks, i.e., breakage of gear teeth selected, clutch disk distortion, excessive torsional loads on rotating parts of transmission and engine etc.; To solve such crucial problem the researcher has intended to design and develop a compact and easily portable battery charger which is aimed for fast battery charging.

Fast battery charger is used to recharge a rundown battery within short period of time. This can be achieved by using the normal charging system components without engine operation; this system needs a DC motor with a voltage of more than 9 volts. This motor starts its function of fast charging whenever the battery voltage is less than cranking voltage.

1.3. Objectives

1.3.1. General objective

The general objective of this thesis is to develop a prototype DC motor device for use in the charging system for fast battery charging.

1.3.2. Specific objectives

The specific objectives of the study are:

- To identify the loads or currents required
- To select DC motor from standard
- To assemble the modeled components
- To analysis of the newly designed system and
- To preparing a prototype of the newly designed system.

1.4. Significance of the Study

The existing way of charging system were difficult to recharge the battery on the vehicle. To overcome these problems the fast-charging system were designed in this study to have the better essentiality of:

- Filling the knowledge on the gap created around the issues;
- Supporting researchers, automotive workshop organizations etc. with adequate, implement possible and appropriate engineering solutions to reduce the car stopping problem on the road by battery case;
- The research will also give information to those who are interested in conducting research on charging system.
- Identifying the advantages of fast battery charging system in the workshop city;
- Investigating the cause and effect of fast battery charging system to propose preventive measures in terms of design and control;
- To inspire small and micro-enterprise (SME) to produce as per the demand and to increase income;
- To satisfy transportation needs in rural and urban areas of our country.

Based on this, the researcher analyzes how to design and control fast battery charging systems. Accordingly, this study was used for any automotive workshop in general and that can have auto-electric workshop in particular.

1.5. Scope

This study focuses on modifying fast battery charging system by adding DC motor in case of battery run down. In order to ignore pushing when we need to start the vehicle, to solve the car stopping problem on the road by battery case, and used to the currently modified fast battery charging system by taking in to consideration of the problem of existing battery charging system by the researcher and also, this fast battery charging system operated without engine starting of the vehicle.

1.6. Limitation of the study

At the time of this study the absence of materials related to battery charging system, some materials are too expensive, and other related factors made this study difficult.

1.7. Organization of the study

This study consists of five chapters. The first chapter is an introduction to the study. It includes: Background of the study, Statement of the problem, Objectives of the study, Significance of the study, Scope of the study, Limitation of the study, and Organization of the study. Chapter two focuses on the literature review based on the previous related works. Chapter three describes materials and methods used to fulfil this thesis work. Chapter four consists of results and discussion. Chapter five consists of conclusions, recommendations, and future work areas.

CHAPTER TWO

LITERATURE REVIEW

This chapter were discuses a review of the existing literature on the topic of modifying battery charging system to which is portable and fast charging system by using DC motor. Recharging the battery while parking at work place could be one of the prominent solutions. However, consumers are bound to charge their EVs via residential mains due to the lack of charging infrastructure. These residential chargers are referred to as level-1 (120 V) and level-2 (240 V) chargers as per SAEJ1772 standards (Williamson, Rathore, & Musavi, 2015).

2.1. Charge Scheme Definitions

2.1.1. Slow Charging

Slow charging is typically associated with overnight charging. This is a definition easy to grasp that translates into a six to eight-hour period. Slow charging makes use of the EV or PHEV onboard charger, which is sized based on input voltage from the grid. For example, a 120V, 15A (80%) service would supply a 1.4KW charger, while a 240V, 32A service would supply a 6.6KW charger. How does this translate into recharging the vehicle battery pack? A PHEV with a 5kWh battery pack, for example, would have a 1.4kW on-board charger that allows complete recharge on the order of five hours. An EV with a 40KWh battery pack might have a 6.6KW charger, which allows complete recharging on the order of six to eight hours, depending on thermal considerations and charge algorithms for the battery chemistry (Szczepanek, 2009).

2.1.2. Fast Charging

Fast charging could be defined as any scheme other than slow charging. But the real definition, or set of definitions, is much more complex. Table 1 lists a few of the more commonly used terms, which include fast charge, rapid charge, and quick charge. The California Air Resources Board (ARB), in their Zero Emissions Vehicle (ZEV) mandate program, lists a certification requirement for fast charging as a ten-minute charge that enables the vehicle to travel 100 miles (Szczepanek, 2009).

Table 2.1. Power Levels for DC Charging

Type of Charge	Charger Power Level, kW		
	Heavy Duty	SUV/Sedan	Small Sedan
Fast Charge, 10 minutes, 100% SOC	500	250	125
Rapid Charge, 15 minutes, 60% SOC	250	125	60
Quick Charge, 60 minutes, 70% SOC	75	35	20
Plug-In Hybrid, 30 Minutes	40	20	10

Fast charging tests were performed on cells of three lithium-ion chemistries to determine their characteristics for charging rates up to 6C. The test results showed that the lithium titanate oxide chemistry has a clear advantage over the other chemistries especially compared to the Nickel Cobalt Manganese chemistry for fast charging.

To improve the model's precision and interpretability, the potentials of the positive electrode and the negative electrode should be modeled separately to obtain an improved analysis of the entire cell charging voltage curve for battery aging mechanism analysis and SOH diagnostic applications. voltage curve analysis methods, including the point counting method, the polynomial curve fitting method, and a proposed new method based on a neural network model, are compared and analyzed for the purposes of Li-ion cell aging mechanism analysis and battery SOH estimation in a BMS in an EV. Their results showed that the node parameters of the neural network have certain physical meanings. The capacities related to the voltage plateaus that correspond to different phase transformation reactions can easily be derived from the node parameters of the trained neural network model. The experimental results also showed that, based on the neural network model, the battery's aging mechanism and SOH can be analyzed quantitatively. The electrochemical mechanism of the neural network model is also discussed (Xuebing Han, 2011).

(G. Joos and M. de Freige J. , 2010), conducted the importance given to the market integration of PHEV (Plug-in-Hybrid Electric Vehicle) area and proposes a fast-charging station by using a flywheel energy storage and a supercapacitor as energy storage devices and resulted in an increase in the interest for the fast charging technology of such car batteries. Design issues and simulation results for a typical Level III charger.

(D. Christen, 2012), Discussed briefly about the ultra-fast charging station utilizes an intermediate storage battery, in order to avoid power pulsations at the grid and to provide additional functionality as e.g., energy storage for renewables. By splitting the intermediate storage battery, the voltage ratings of the semiconductor devices used in the high-power DC-DC converter can be reduced, which increases the system efficiency. For further increasing the efficiency, a triangular current modulation (TCM) scheme is applied, which allows zero voltage switching (ZVS) for all semiconductor devices. To achieve a high-power density as well as to implement ripple cancelation on the output current, several power electronic modules are parallel interleaved. A detailed analysis of the proposed system and simulation resulted on their paper.

objective of this analysis is to support USABC and DOE identification of battery available energy, mass, volume, cost, discharge power, and charge power requirements that enable broad commercial success of BEVs once achieved. By working closely with USABC and DOE, NREL has developed a simulation-based approach to achieving this objective they applied this approach to multiple vehicle platforms (compact car, midsize sedan, and small SUV) and vehicle ranges (150 and 300 miles). For each vehicle platform, they defined the total vehicle mass using a vehicle mass factor parameter (the ratio of total BEV mass to total conventional vehicle mass) and varied this as well (Ahmad Pesaran, 2014).

2.2. Fast Re charging Battery

Charging times have been an Achilles heel of electrified transportation technology, as it has been much faster and more convenient, historically, to refuel from petroleum-based sources. Charging of EVs has been categorized by the U.S. Department of Energy in three levels, as follows: Level 1 is standard charging that has a charge power less than 5 KW, Level 2 is fast-charging that occurs between 5 KW and 50 KW, and Level 3 is super-fast charging that is greater than 50 KW. Level 3 charging consists of an off-board charger, meaning the charger is exterior to the vehicle. The high-power charging levels of Level 3 charging make it impractical to carry the required power electronics onboard, due to size constraints. In order to reduce the mass of on-board electronics, Level 3 charging usually conveys the power to the vehicle as DC, while Level 1 and Level 2 charging often times contain onboard electronic converters, allowing for AC energy transfer (Ryan Collin, 2019).

By comparing, it is possible to state that the full charging power capabilities were achieved even though the stationary storage system had a lower capacity than the highest-range vehicle. He achieved control strategy was validated by using Simulink. the AC and DC power levels could be controlled separately by exploiting the DSCC storage system as an energy buffer, recharging the vehicles at their full capabilities without overloading the grid. Moreover, the stationary storage was sized to maximize its expected lifespan using only an SOC range of 20%–80% (Piegari, 2019).

By using the initialization process, gradient search rule (GSR), and local escaping operator (LEO), they are concluded that the growing concerns regarding climate change, global warming and increased fuel price have initiated transportation electrification. For the adoption and acceptance of Electric Vehicles (EVs) amongst the masses, it is necessary to set up a sustainable and easily accessible charging infrastructure. The management strategy and the placement of the charging station play a significant role in maintaining the distribution network reliability, power loss and voltage stability. The charger placement formulation presented in this work was a single-objective formulation with cost as the objective function. The problem was solved considering the worst-case scenario. The uncertainty in road traffic, different scenarios of charging load, coordinated charging and the impact of vehicle grid integration were not considered in this work. A novel metaheuristic named GBO was used in this work for solving the charger placement problem. The Newton method was the main inspiration of the Gradient-based optimizer (GBO), that involves the LEO and GSR concepts. The performance of the GBO was compared with other metaheuristics such as DE, GA and PSO. The best fitness value of 1.4898 was achieved by the proposed GBO, PSO and DE algorithms. Furthermore, the values of SAIFI, SAIDI and CAIDI after and before the charger allocation were within the safe limits. A voltage deviation of 0.0114 occurred based on the best location extracted from the GBO algorithm. It was noted that the GBO presented comparatively well as competed to the aforesaid algorithms. Our future formulations will consider these aforementioned factors. Our future work will concentrate on testing the GBO behavior on multi-objective charger placement problems, and several applications such as optimal load flow, the identification of a super-capacitor and fuel cell parameters, extraction of transformer parameters and optimization of a wind farm layout (Essam H. Houssein, 2021)

To review the technological status of Photovoltaic–Electric vehicle (PV-EV) charging stations during the last decade, By Using or include charging standards, the power converters topologies that focus on the adoption of Vehicle-to grid technology and the control for both PV-grid and PV standalone DC charging systems, and they concluded that the Photovoltaic charging structure is becoming more complex with several functions integrated into the system, which require intelligent controls in each block and real time management for the whole station (Cheddadi Youssef, 2018).

To proposes an efficient, real-time, fast-charging methodology of lithium-ion batteries. The proposed method of charging also protects the battery from overvoltage and overheating. Extensive testing and comprehensive analysis were conducted to examine the proposed charging technique. The results showed that the proposed charging strategy favors a full battery recharging in 9.76% less time than the conventional constant-current–constant-voltage (CC/CV) method (Muhammad Umair Ali, 2018).

To analyze the effect of pulse width current to the charging efficiency of lithium-ion battery by considering the capacity loss effect. The result shows that charging using 8-minute pulse width current is the effective method for charging the lithium-ion cell since it can reduce the charging time and decrease the capacity loss of the cell (Majid, 2017).

In particular, by using a DSCC power converter, to achieve the following goals: (i) increasing the dc output voltage using lower voltage battery modules and (ii) balancing the battery modules by separately controlling the power drawn by each module, allowing the use of second life batteries, and the results the control strategy was validated using Simulink. that the ac and dc power levels could be controlled separately by exploiting the DSCC storage system as an energy buffer, recharging the vehicles at their full capabilities without overloading the grid (Piegari, 2019).

(Cheddadi Youssef, 2018), reported about lithium plating at temperatures below 25degree, it can also occur at higher temperatures, particularly when high C-rates or high energy density cells are used. Additionally, the efficiency of fast charging equipment is often strongly dependent on temperature, with power conversion efficiencies of 50 KW chargers reported at up to 93% and as low as 39% for operation at 25 degree and -25 degree, respectively, primarily due to the rerating of power levels requested at lower temperatures. Efficiency in this case is defined as the ratio between the instantaneous DC power delivered by the charger to the vehicle and the instantaneous AC power supplied to the charger by the grid. The level of this temperature-dependency varies between charger models, with some still able to maintain about 70% efficiencies at -25 degree and others failing to function at all. This section looks to provide insights into the fundamental phenomena involved in fast charging and their resulting impacts.

(Kutkut, 2006). Fast-charging power electronics consists of 3 stages, as follows: An input filter for the reduction of input harmonics, which also contributes to power factor optimization, an AC-DC rectifier, and a DC-DC converter that transfers power to the battery, as depicted in DC fast-charging of a plug-in hybrid electric vehicle (PHEV). For AC charging, the AC-DC rectifier and DC-DC converter are part of the onboard charger, which also illustrates an advantage of DC charging. The size of the onboard charging device is constrained by the space inside the vehicle. As the onboard converter is small, the amount of power that it is able to deliver to the battery is typically low (3–6 KW). In contrast, the DC charger is external to the vehicle and therefore not constrained in size or cost. In addition, DC fast chargers can interface with 3-phase power and enable adjustment of the charge level to suit the battery state.

(Dearborn, 2013), by using a mixed-signal approach to developing battery chargers, battery charger designs can take advantage of the best of both the analog and digital worlds. Employing a mixed-signal approach enables high frequency operation (500 kHz), high-speed protection (12ns current sense to output), and minimizes the size of filtering components. In addition, the programmable digital features of the system enable appropriate determination of stage of charge and set charge current.

(Krein, 2012), based on the amount of power, charging time and location, cost, equipment, and other factors, they concluded that current status and implementation of battery chargers, charging power levels, and infrastructure for EVs. Battery performance depends not only on types and design of the batteries, but also on charger characteristics and charging infrastructure. Battery infrastructure and charging power levels are categorized into three types: Level 1, Level 2, and Level 3. Charger systems are categorized into off-board and on-board types with unidirectional and bidirectional power flow. Unidirectional charging limits hardware requirements, simplifies interconnection issues, and tends to reduce battery degradation.

Marcel MEEUS, (2019), discussed about electric vehicles (EVs) that spreading in the private transportation sector. Although these vehicles contribute less to city pollution, their spread is being hindered by limitations such as their high price, short range, and long recharge time compared to the equivalent category of internal combustion vehicles.

Safety Rationale for Specific Tests

From these five risk areas, specific test procedures were developed to evaluate a PEV's ability to mitigate the hazards associated with specific failure modes associated with DC and AC charging. The following paragraphs provide the safety rationale for each specific test detailed within this report. The tests included in the discussion below should be considered holistically in that each test is tailored to identify a specific response to a particular hazard. Selecting individual tests or skipping tests without confidence of sufficient protection could lead to missing certain safety-relevant behaviors given the integrated nature of the test procedure development (H., 2012).

Ground Fault Test (DC Only)- Ground faults can lead to unintended discharge of the PEV battery and possibly a thermal event.

PEV Inlet Temperature Test (AC or DC When Applicable) - Contamination, degradation, or improper fit of the CCS connector or inlet could result in increased resistance at the connection point between the charger and the DC charging port. A potential safety hazard may occur if the coupler begins to significantly heat up. The risk of fire and possibly burning the PEV driver are potential risks. It is worth noting that a significantly smaller subset of tests is provided for AC charging versus DC charging. This is due to the lack of direct connection between the vehicle RESS and off-board charging equipment for AC charging. For AC charging, an on-board charger acts as the interface between the off line EVSE equipment and the vehicle RESS, allowing for much tighter coordination and thus fewer hazards (www.tenney.com).

Fast and safe charging systems that do not damage the batteries, and do not negatively affect the electric grid must be developed. With continued charging research, technologies will be refined and standards will be developed, which will encourage the increased adoption of EVs, leading to a more sustainable energy future (Ryan Collin, 2019).

2.3. Fast battery charger

(G. Joos and M. de Freige J. , 2010). In order to increase fast charging technology, their work conducted the area and proposes a fast-charging station by using a flywheel energy storage and a supercapacitor as energy storage device. Resulted in an increase in the interest for the fast charging technology of such car batteries.

Fast Battery charging system play significant role in transportation Authority. By minimize car accident which make road cording and closes the line by making crash on the road and minimize the traffic operation service on the field of transportation. In the normal charging system, the charging system of car is only engine operation charging system which makes accident when it was fail and make other problem like building crashing etc. For this we researched again Fast Battery charging system that helps tore charge the battery on the vehicle to minimize the problem which is came by this. Because it is fast to charge and easy to recharge the battery on the vehicle at needed place and time.

- Solar Array which collects solar energy and converts it to electrical energy
- Power trackers to achieve the proper voltage to be stored in batteries.
- Batteries to stir power.
- Regulator controller which adjusts the power input to the motor.
- DC motor which drives the Alternator

(Wishar, 2015), by testing Four new 2012 Nissan Leaf battery electric vehicles were instrumented with data loggers and operated over a fixed-on road test cycle. Each vehicle was operated over the test route, and charged twice daily. Two vehicles were charged exclusively by AC level two electric vehicle supply equipment, while two were exclusively DC fast charged with a 50-kilowatt fast charger. The vehicles were performance tested on a closed test track when new, and after accumulation of 50,000 miles. The traction battery packs were removed and laboratory tested when the vehicles were new, and at 10,000-mile intervals throughout on-road mile accumulation. The results of that testing combined with the data presented in the paper was serve to further answer the questions related to the rate of capacity, both in relation to time and temperature and remove even small variations in conditions between the packs. Battery tests performed include constant-current discharge capacity, electric vehicle pulse power characterization test, and low peak power tests. Results are compared within and between the two groups of vehicles over the test period. Specifically, the impacts on battery performance, as measured by laboratory and track testing, are explored as they relate to battery usage and variations in conditions encountered, with a primary focus on effects due to the differences between AC level two and DC fast charging. The contrast between battery performance degradation and the effect on vehicle performance is also explored (Wishar, 2015).

In order to enable robust fast charging of high energy EV cells, they presented a numerical study of the impacts of fast charging and energy density on cycle life of LiB. The model well captures the temperature-dependent aging behavior, more specifically, the existence of an optimal temperature for cycle life. The optimal temperature is found to be ascribed to the competition between SEI growth and lithium plating and therefore, is a strong function of charge rate and energy density. And they revealed that the optimal temperature was increase with the increase of charge rate and/or energy density. Raising the charging temperature therefore, it was an effective approach to mitigate lithium plating and enabling robust fast charging of EV batteries (Wang, 2018).

2.4. How fast battery charger works

An ideal battery would exhibit a long lifetime along with high energy and power densities, enabling both long range travel on a single charge and quick recharge anywhere in any weather. Such characteristics would support broad deployment of EVs for a variety of applications. Unfortunately, the physics of each of these requirements results in tradeoffs (Xiao Guang Yang, 2018).

The Fast charger developed by all charging system component operated by DC motor out of the vehicle by using the vehicle battery. The alternator mounted on the carriage will charge the battery & which in turn drive the DC motor. That means: Alternator produces the voltage and regulator achieves the proper voltage to be stored in batteries- Batteries to stir power- which start the engine.

In short, the fast battery charger assisted consist of following components DC motor, alternator, regulator, lump, ignition key, fuse and battery (Muhammad Umair Ali, 2018). For more details (see Figure 2.1).

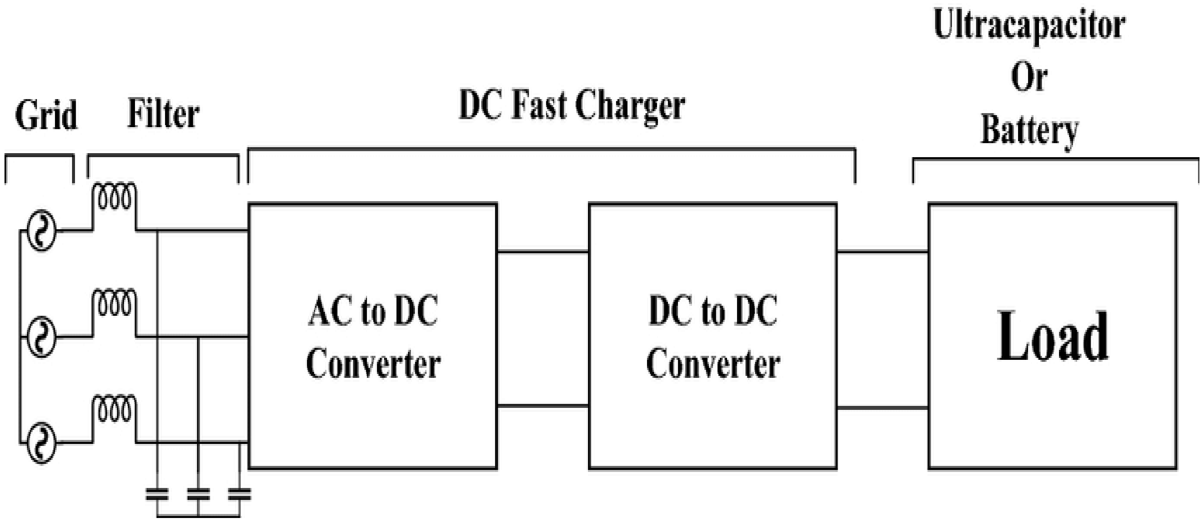


Figure 2.1. General Block Diagram of DC fast Charging Circuit

2.4.1. Importance of Fast Battery charging system

Fast charging, however, due to the higher charging rate and more frequent charging throughout the day, requires only a single battery per truck. This eliminates the need for additional batteries and greatly improves truck driver productivity because the time spent changing batteries in two and three shift applications is also eliminated. The battery utilization factor jumps to a full 100% (full utilization of the asset) with fast charging (Kutkut, 2006)

- Recharge the battery if it is rundown.
- Save a time and cost to re charge the vehicle battery.
- To keep vehicle program which caused by battery removing.
- It is also use as a battery charger.

2.4.2. What is value of producing this technology?

If one focuses attention on recharging an electric vehicle to enable the average daily drive of approximately 31.5 miles/day for a US driver at 10 kW charging, and given that typical EVs have efficiencies in the range of 240–300 Wh/mi with performance-based variations, this is still 1h of charging. Thus, if the vehicle is needed again, e.g., for an additional evening trip or emergency, it would be wise for alternative faster charging solutions to be available (Ryan Collin, 2019).

- To reduce Accident which is caused by battery problem on vehicle operation like stop in the road by 50%,
- To give good voltage for battery at a needed time and for engine system,
- To recharge the battery when the engine system is failed and need to crank again and again us needed,
- To reduce driver unneeded operation when the battery is run down,
- Durable and sustainable with little maintenance requirement,
- Strong to resist high applied force which is match with car strength and body weight valance.

2.5. Charging strategies and effects on infrastructure equipment

Effects on distribution infrastructure equipment, economic costs, and emissions from charging depend on EV penetration and charging strategies. Large-scale unbalanced deployment can have a detrimental impact on the electric grid; thus, grid stability becomes a challenging task (Krein, 2012).

2.6. Research gap

Some of the researchers have studied on the fast battery charging system. Most of them are concluded that Charger is a device that helps to recharge the battery when the battery is rundown. That means if it needs voltage to starting the engine, it is equipped with the all-engine charging system component. And also, Fast charger helps to recharge the Battery when we needed to check the engine is cracking or not. As observed through experience recharging the battery is difficult when the charging system of a vehicle is failed. Removing the battery and recharging it is an option but, it is not a solution for emergency case. The gap mainly identified is that inability to recharge fastly whenever the charging system is failed. This study has an intention to solve this problem. This can be done by design and functional modification of the recharging system by adding DC motor for fast charging of the discharged battery.

CHAPTER THREE

MATERIALS AND METHODS

3.1. Materials

In order to fulfill this thesis work, the following materials were required. Here are listed below:

3.1.1. Materials required

- Dc motor
- Regulator

3.1.2. Materials and equipment required for conducting an experiment DC motor

- Regulator
- Belt
- Generator
- Measuring instrument
- Fuse
- Wire

Table 3.1. Materials

No.	Items	Specification
1	Bolt with nut	¼’’ x 4” x 20*
2	Alternator	12V
3	Automotive wire	900 Amps, 50 square mm cables, 3.5 meters long
4	Button switch	XPB22-22B-11ZS
5	Wiper motor	ZD2433/ZD1433
6	Battery	KFG30Z
9	Regulator	SL 139G.2
10	Female connector	UPC:687152170289
11	Pulley	Grooves: 2; Length: 35.0 mm; Belt: 10.0 mm; Body Diameter: 53.0 mm; OD: 74.6 mm.
12	Ignition switch	No. P: 4, S.O.: Off-Start, Key Tr.: Yes C.C.R: 70A @ 12V, Application: Automotive D.B.P: 69mm, V.R.DC: 24V
13	Lamp	4W
14	Battery post connector	Material: Brass, Stainless Steel, Aluminium. Zinc. alloy
15	Belt	EPDM/CR/NR

Table 3.2. Tools & equipment

No.	Item	Quantity in number	No.	Item	Quantity in number
1	Wrenches	1	11	Socket & combination	1
2	Hammer	1	12	Ball pin & plastic	1
3	Pliers	1	13	Combination & long nose	1
4	Screw driver	1	14	Flat & Philips	1
5	File	1	15	Flat	1
6	Hacksaw	1	16	Blade 18	1
7	Chisel	1	17	Flat	1
8	Punch	1	18	Center & pin	1
9	Steel rule	1	19	Power hacksaw	1
10	Lazing machine	1			

3.2. Methods

In order to address the general and specific objectives of this work the following methods were taken into consideration.

A. Data collection and problem identification

The necessary data was collected by using primary or secondary data collection through visiting various automotive workshops and websites.

B. Literature review

Literature survey from different journals, periodicals, articles, etc. that can serve as a source for sharing various experiences previous research arts etc., related reference books, specification documents were referred.

3.3. Design concept

A new or fast battery charger of production and operation. The design of this fast battery charger is to modify the existing designs into a new idea by adding DC motor by using solid work and also the prototype were designed. adopting a new material and an installation method. Design is the creation of new and better charging system and improving the existing ones. The process of design is a long and time consuming one. From the study of existing ideas, a new idea has to be conceived. The idea is then studied keeping in mind its commercial success and given shape and form in the form of drawings.

There is classification of charging design on vehicle charging system by crank shaft pulley, out of vehicle charging system by using AC current (battery Charger) and new fast battery charging system on vehicle by using DC motor. The design of the Fast battery charging system is classified under developmental design because it is the improvement of the existing ones.

General Considerations on Fast battery charging system: -

- Type of load and stresses caused by the load. The load, on a Fast battery charging system may act in several ways due to which the internal stresses are set up.
- Motion of the fast battery charging system. The successful operation of any vehicle charging system. This fast battery charging system has constant rotary motion that helps to re charge the battery by a needed RPM that not is come over charging.

After reviewing the literature, design of the fast battery charging system prototype was carried out by using different materials listed in the previous table.

3.4. Project Description

Fast Battery charging system play significant role in transportation Authority. By minimize car accident which make road cording and closes the line by making crash on the road and minimize the traffic operation service on the field of transportation. In the normal charging system, the charging system of car is only engine operation charging system which makes accident when it was fail and make other problem like building crashing etc. For this we researched again fast Battery charging system that helps to store charge the battery on the vehicle to minimize the problem which is came by this. Because it is fast to charge and easy to recharge the battery on the vehicle at needed place and time.

Size

The Fast Battery charging system sizes currently available length of shaft is a light weight it is made from the normal engine component that on first we used it for charging system by changing the arraignment of system. That contains Ignition switch, Alternator, bolt, DC motor, belt, Regulator and fun.

3.5. Methods of data processing

Value chain for Fast battery Charger system Activity

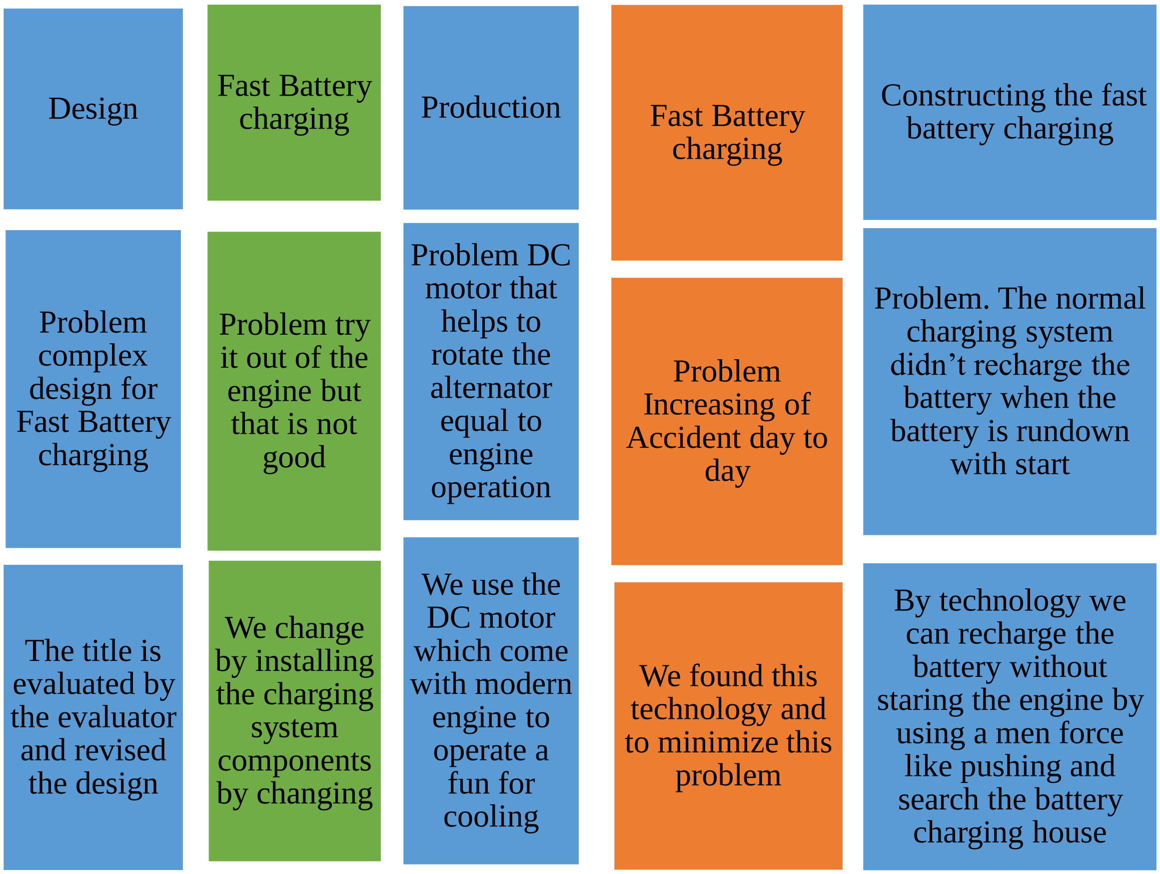


Figure 3.1. Value chain for Fast battery Charger system Activity

3.6. The selected electric DC motor specification

The Table 3.3 shows that specification for the DC motor. The specification describes the technical characteristics of DC motor and used in estimation of battery capacity as well as controller selection.

Table 3.3. Specification for selected DC motor

Parameters	Specification
DC motor type	Brushless DC motor
Maximum power output	0.627kw @ 1390 rpm
Minimum peak torque at start	27.44Nm
Maximum speed	1390 rpm
Maximum voltage	9V

Maximum current	32A
Minimum Efficiency	75%

3.7. Determining DC motor speed

Maximum angular velocity ω is achieved when no load is applied

$$\omega_m = \frac{E_b}{K_b} \tag{3.1}$$

Where:

ω_m = maximum angular velocity in rad/sec

E_b = back electromotive force in volt

K_b = back electromotive force constant in V/rad/sec

For the required DC motor for this research the back electromotive force constant (K_b) given by the manufacturer is 0.123 V/rad/sec.

$$e_b = V - Ia * Ra \tag{3.2}$$

Where:

V = supplied voltage to DC motor from the battery in volt.

I_a = armature current in ampere.

R_a = armature resistance in ohms.

To determine maximum current flow to the armature, the following equation is used:

$$P_{in} = P_{dev} + P_{loss} \tag{3.3}$$

Where:

P_{in} = power input from the battery in Watt.

P_{dev} = maximum power developed in Watt.

P_{loss} = power loss in armature.

$$V * I_a = P_{dev} + Ia^2 * R_a \tag{3.4}$$

$$V * I_a = P_{dev} + \text{percent of loss} * P_{dev} \tag{3.5}$$

In this thesis, since the maximum power required from DC motor is 565Watt, minimum efficiency required is 75%, so maximum power loss is 25%, the armature resistance is 0.20Ω and battery voltage is 24V then from the equation 3.5 it becomes:

$24 \times I_a = 627 + 0.25 \times 627$

$$I_a = \frac{783.75}{24}$$

$$= 32.65A$$

The maximum current required by DC motor to obtain maximum power was 32.65A.

Then E_b was calculated from equation 3.2 as follows:

$$E_b = 24 - 32.65 \times 0.20$$

$$= 17.47V$$

Finally, the no load maximum angular velocity was calculated from equation 3.1 as follows:

$$\omega m = \frac{17.47}{0.12}$$

$$= 145.58 \text{ rad/sec}$$

Maximum no load revolution per minute (Nm max) was calculated as follows:

$$N_{m\ max} = \frac{\omega\ X\ 60}{2л}$$

$$= \frac{145.58 \text{ X } 60}{2л}$$

$$= 1390 \text{ rpm}$$

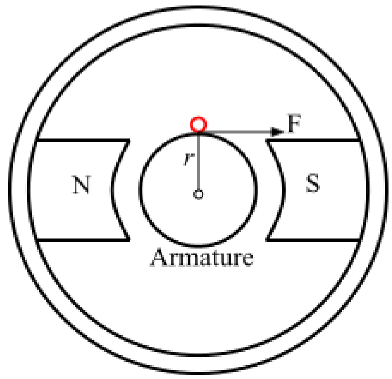
3.8. Torque in DC Motor, Armature Torque and Shaft Torque

The torque is defined as the turning moment of a force about an axis. It is measure by the product of the force (F) and perpendicular distance (r) of the line of action of force from the axis of rotation. The torque is measured in Newton-meters (Nm)

$$\tau = F*r \tag{3.6}$$

3.8. 1. Armature Torque of DC Motor

In a DC motor, a circumferential force (F) at a distance r which is the radius of the armature is acted on each conductor, tending to rotate the armature. The sum of the torques due to all the armature conductors is known as armature torque (τa).



Where, P = Number of poles,

r = Radius of the armature,

l = Effective length of each conductor,

Z = Total number of armature conductor,

A = Number of parallel paths,

i = Current in each conductor,

B = Magnetic flux density,

Φ = Flux per pole.

Therefore, Force on each conductor is $F = Bil$,

Torque developed by one conductor = $F*r$,

$\therefore$ Total armature torque, $\tau_a = (Z*F*r) = ZBilr$

Since,

Current in each conductor, $i = Ia/A$,

Magnetic flux density, $B = \Phi/a$.

Where:

a = cross-sectional area of flux paths at radius $r = 2\pi rl/P$

$$\therefore \tau a = Z*\Phi/a*Ia/A*l*r = Z*\Phi(2\pi rl/P)*Ia/A*l*r,$$

Then, $\tau a = PZ/(2\pi A) * \Phi IaNm$ (3.7)

he expression in the equation (2) is known as the armature torque of DC motor.

For a given DC motor, the $(PZ/2\pi A)$ is a constant.

Hence, $\tau a \approx \Phi Ia$ …………………………………………………………….. (3.8)

Therefore, the armature torque developed in a DC motor is directly proportional to the flux per pole and the armature current. Also, the back emf of a DC motor is given by,

$Eb = NP\Phi Z/60A$.

Then, $P\Phi Z/A = (60*Eb)/N$ ………………………………………….…………(3.9)

From equation (3.12) and (3.13), we get,

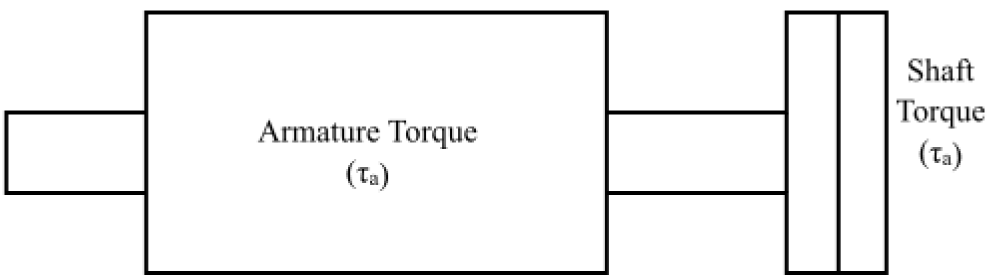
$\tau a = 1/2\pi * (60*Eb)/N * Ia$

Then, $\tau a = 9.55* (EbIa)/N$ Nm ……………………………………………….(3.10)

3.8.2. Shaft Torque of DC Motor

The torque in a DC motor which is available at the shaft of the machine for doing useful work is called as shaft torque (τsh).

In a DC motor, the total torque developed in the armature of the motor is not transferred to the shaft of the motor as a part of it is lost in overcoming the mechanical losses in the machine. Hence, the shaft torque is somewhat less than the armature torque.



If the speed of the motor is N rpm, then the output shaft power (in watts) of the DC motor is given by,

$Psh = 2\pi N\tau sh/60$

Then, $\tau sh = 9.55*\tau sh/N$ Nm ……………………………………………………………(3.11)

Also, the difference of the armature torque and the shaft torque is known as lost torque.

Lost Torque = $\tau a - \tau sh$ = 9.55 * (mechanical losses)/N ……………………………..…….(3.12)

3.9. Determining pulley or gear ratio

The gear ratio of a chain drive is given by:

$$G_r = \frac{N_1}{N_2} \quad (3.13)$$

Where:

N_1 = speed of rotation of smaller sprocket in rpm.

N_2 = speed of rotation of larger sprocket in rpm.

$G_r = \frac{1390}{294}$

$= 4.73 \approx 1:5$

3.10. Determining Battery capacity

The battery chosen for this project was a battery which is on the vehicle.

The power required from battery by DC motor was not under 9volt.

$$P_{batt} = \frac{Pm_{max}}{\eta m} \quad (3.14)$$

Where:

P_{batt} = power required from battery

$P_{m\ max}$ = maximum power of DC motor

η_m = DC motor efficiency

$P_{batt} = \frac{627}{0.75}$

$= 836$Watt.

The power required by DC motor from battery is 836 Watt, but there is a lighting system accessory such as head, tail, brake and turn signal lights. By assuming power required by lighting accessories (Pl) is 50 Watt, therefore, maximum power required from battery is the sum of Pbatt (836 Watt) and Pl (50 Watt) which is equal to 886 Watt required from battery to start the system.

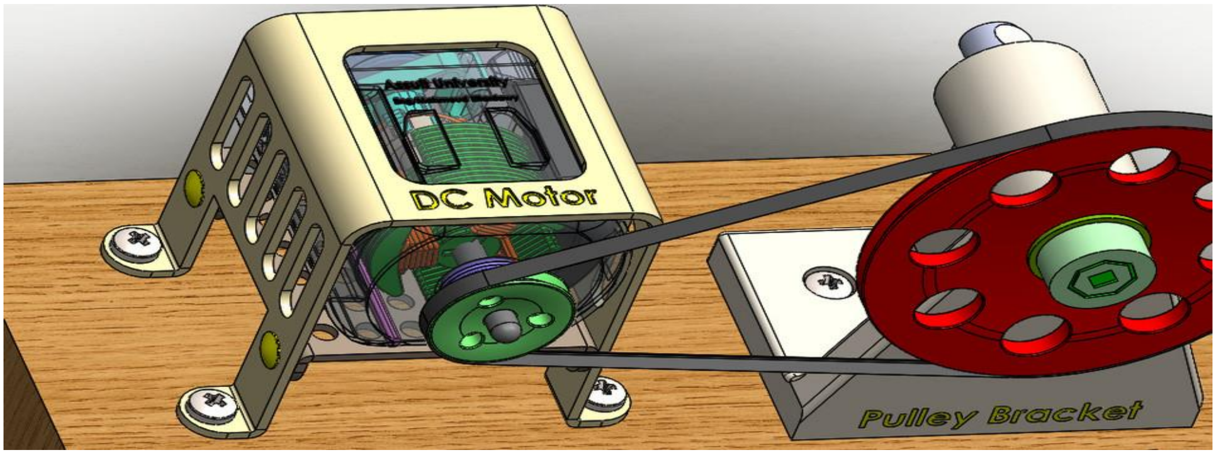


Figure 3.2. DC Motor with pulley

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1. Manufacturing process

Manufacturing process is a method of producing products in a simple and economical way. In its broadest meaning, it is the process of converting raw materials into products. It encompasses the design and production of goods using various production methods and techniques. Manufacturing activities must be responsive to several demands and trends:

- A product must fully meet design requirements and specifications
- A product must be manufactured by the most economical methods in order to minimize costs.
- Quality must be built into the product at each stage from design to assembly rather than relying on quality testing after the product is made
- In highly competitive environment, production methods must be sufficiently flexible so as to respond to changing market demands, type of product, production rate, production quantities and on time delivery to the customer

There are different manufacturing processes in manufacturing industry like casting, forming, metal fabrication, machining and so on. Among the manufacturing processes mentioned; forming, metal fabrication and machining are used to fabricate this project.

- Forming (Cutting and Bending)
- Metal fabrication
  - Welding (SMAW)
  - Fastening
- Machining
  - Grinding
  - Drilling
  - Finishing methods

4.2. Manufacturing procedures of the Fast battery charging system parts

The manufacturing procedure of the machine parts follows the following steps

Part-1: Rectangular frame (Qt=1)

- Select mild steel rectangular pipe with dimension of (25 x25 x 1.5 x 600) mm Qt=2 and 25x25x1.5x25mm Qt=2 for the frame
- Measure, layout and cut to size using machine tools like tape rule, hacksaw, file
- Welding rectangular pipes by shielded metal arc welding joining mechanism.
- Finish the welded frame.

4.3. Component parts and Assembling procedures of the Fast battery charging system

4.3.1. Description of component parts

a. Battery

The battery supplies current to energize the alternator. During charging, the battery changes electrical energy from the alternator into chemical energy. The battery's active materials are restored. The battery also acts as a "shock absorber" or voltage stabilizer in the system to prevent damage to sensitive components in the vehicle's electrical system

Figure 4.1. Battery

b. Ignition Switch

When the ignition switch is in the ON position, battery current energizes the alternator

Figure 4.2. Ignition switch

c. Alternator

The charging system converts mechanical energy into electrical energy when the DC Motor is running. This energy is needed to operate the loads in the vehicle's electrical system. When the charging system's output is greater than that needed by the vehicle, it sends current into the battery to maintain the battery's state of charge. Proper diagnosis of charging system problems requires a thorough understanding of the system components and their operation.

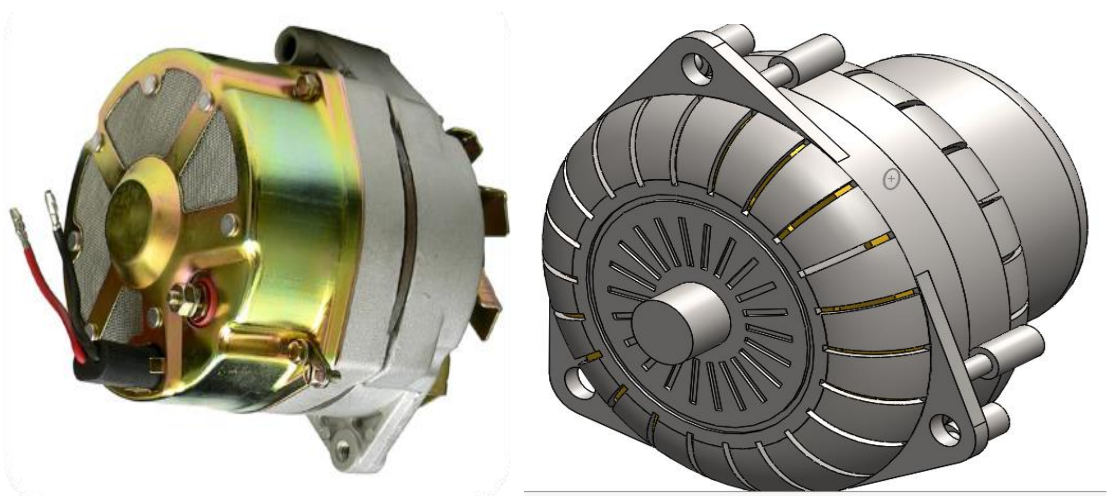


Figure 4.3. Alternator

d. Fuse board

A fusible link as well as separate fuses is used to protect circuits in the charging system

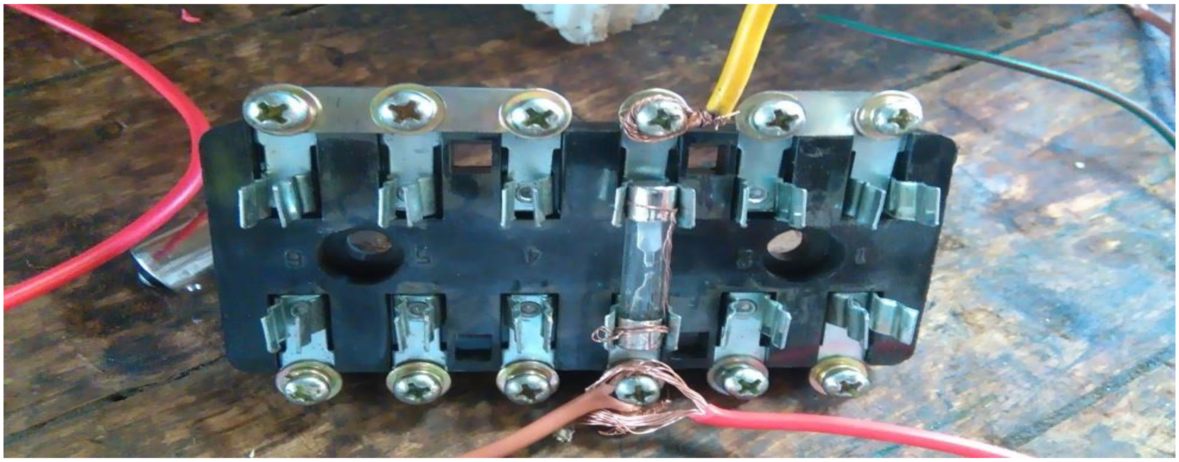


Figure 4.4. Fuse box

e. Regulator

Several types of alternator regulators that are mounted outside the alternator have been used. The regulator limits alternator voltage by controlling the amount of current flowing in the alternator field or the regulator reduces the field current. This prevents excessive voltage.

Figure 4.5. Regulator

f. Motor

DC motors can develop rated torque at all speeds from standstill to rated speed**.**

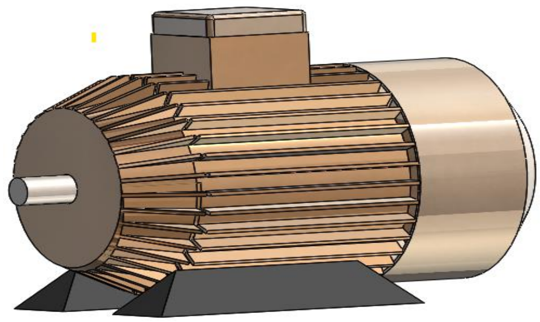


Figure 4.6. Motor

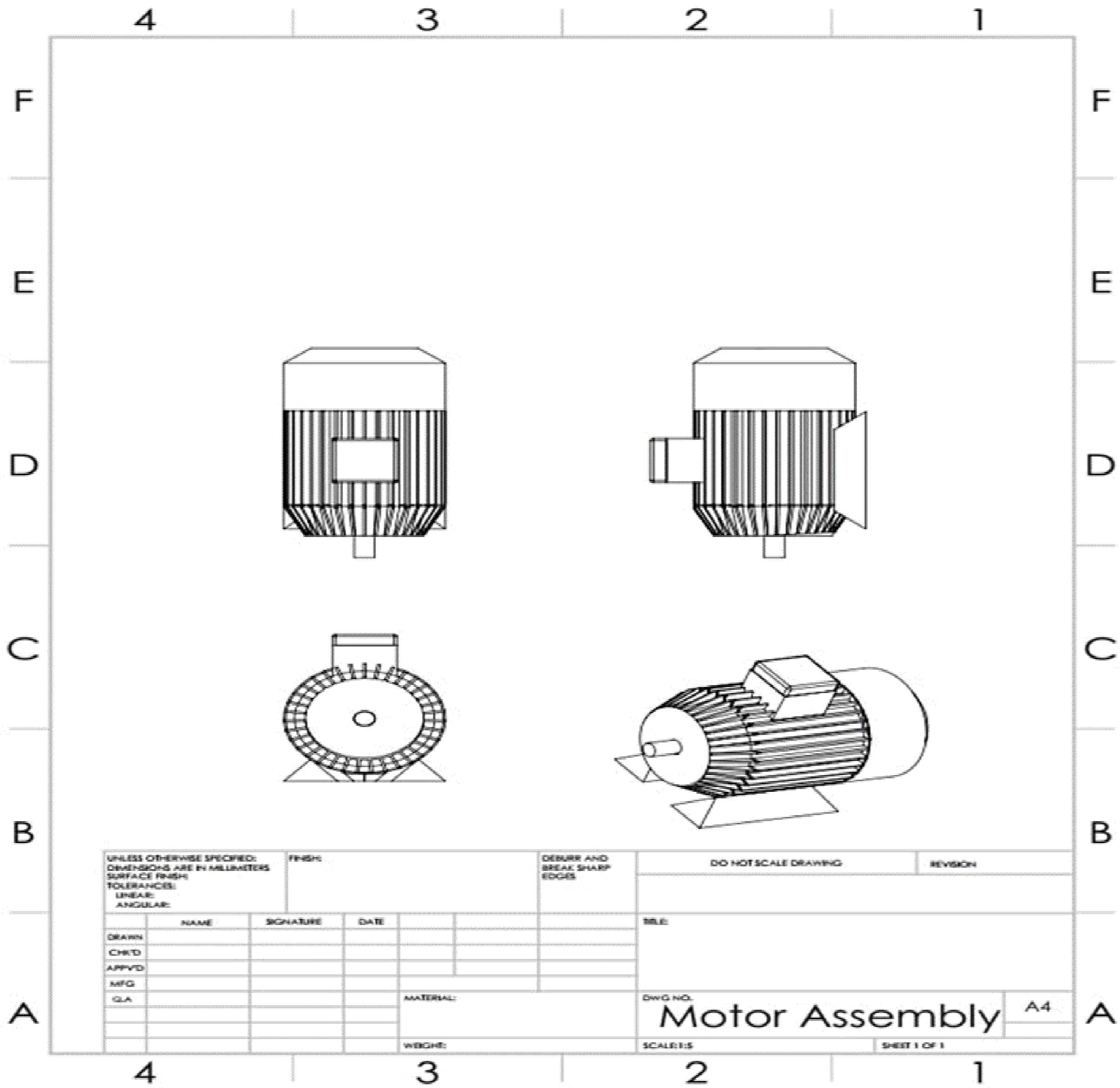


Figure 4.7. Assembly of portable fast battery charging Motor

g. Pulley

The pulley is one pulley in a set that drives the belt system of a vehicle. The pulley regulates the belts that connect to the AC motor and are used to produce movement to the power train components.

Figure 4.8. Pully

4.3.2. Assembling procedures

To design the prototype, this thesis has four main component parts such as; DC motor, Alternator, Regulator As a needed if a DC motor assembling procedure is as follows

- Install DC motor on the fixed sheet metal or flat wood
- Connect positive terminal from battery to switch
- Connect the DC motor positive terminal from switch
- Give the ground to DC motor
- Switch ON and see. Then, generate DC motor in case of connecting with battery terminal if the battery voltage is greater than 9 v.

4.3.3. Assembling procedures by adding Alternator

The assembling procedures are as follows:

- Don’t remove and disconnect any wire from the Alternator be use the first charging system installation.
- Connect positive terminal from battery to switch
- Install Alternator motor on the fixed sheet metal or flat wood
- Install the DC Motor at the side of Alternator
- Connect the DC motor Pulley and Alternator pulley by using belt.
- Connect the DC motor positive terminal from switch

- Give the ground to DC motor
- Switched ON. Then, generate Ac motor in case of connecting with pulley in Dc motor

4.3.4. Assembling Procedures of portable fast battery charger

- Prepare project material and check numbers of items and correct qualities of quested on requisition paper
- Construct and prepare the box of assembling component
- Assembling and tight alternator and DC motor with a prepare angle as driving belt of two parts with each other
- All component parts (battery, regulator, fuse with fuse box, button switch, indicator lamp and all need projects) are assembling bolt and nuts with a prepare place in a preparing project box.
- Install all electrical devices is leading by instructional sketching electrical diagram of portable emergency battery charger project manual.
- Check and install, if the components left and improper installing position, eg, keep and correct install of battery fit in the preparing supporting metal with gasket or plastic sealing matter.
- Connect positive battery cable first and negative battery cable second without of loose connection from device parts
- Finally, get the result practically and check either functional or not.

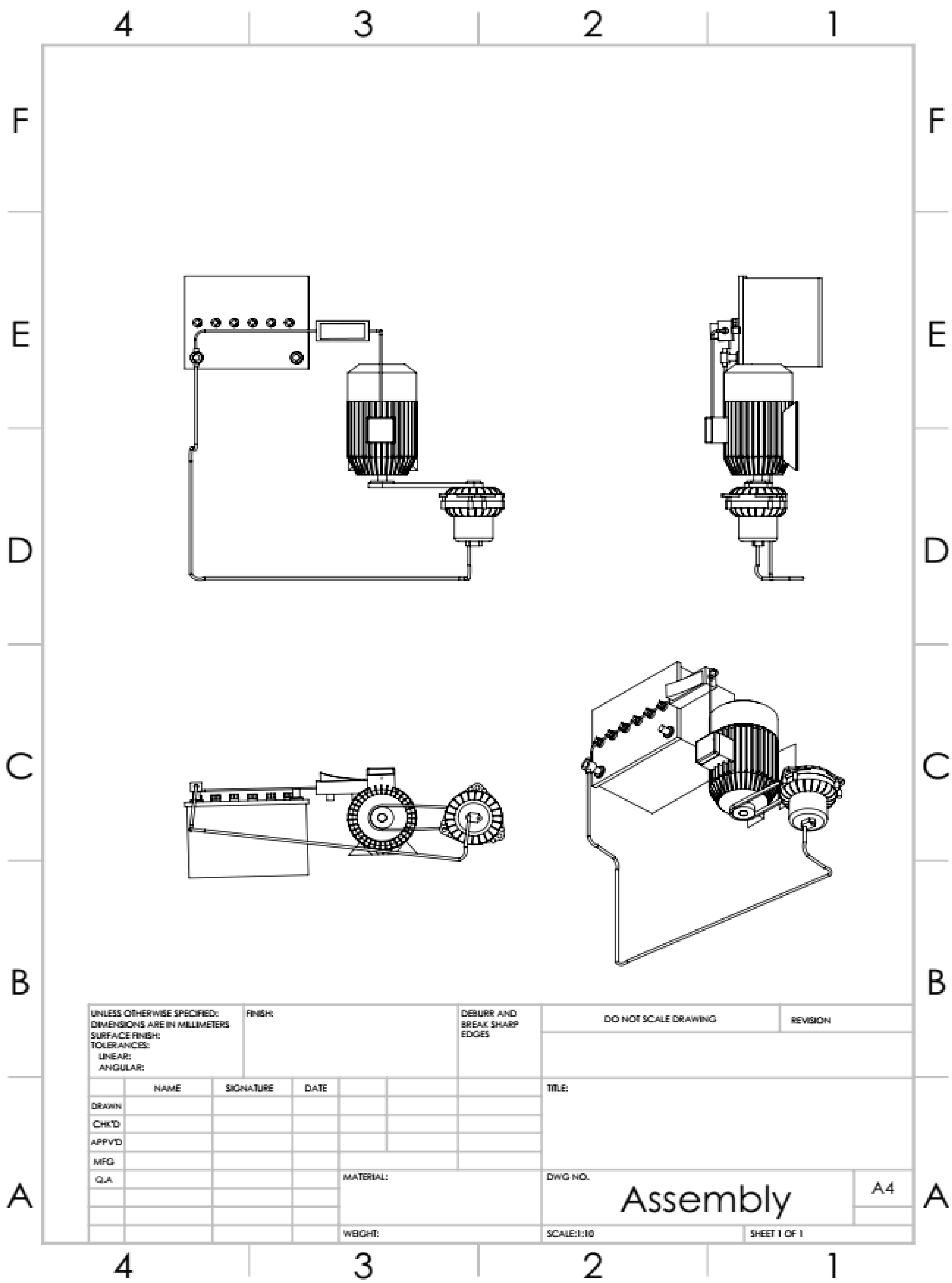


Figure 4.9. Assembly of portable fast battery charging

Here are the assembled parts of portable fast battery charger, both in prototype and solidwork:-

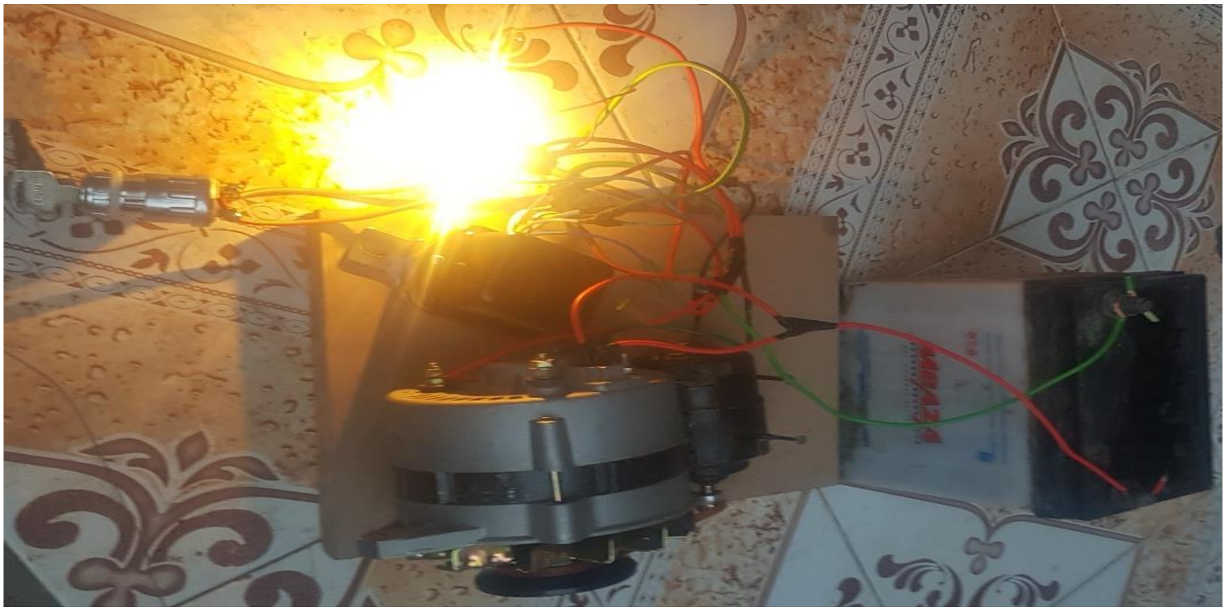


Figure 4.10. Assembled parts of portable fast battery charger prototype

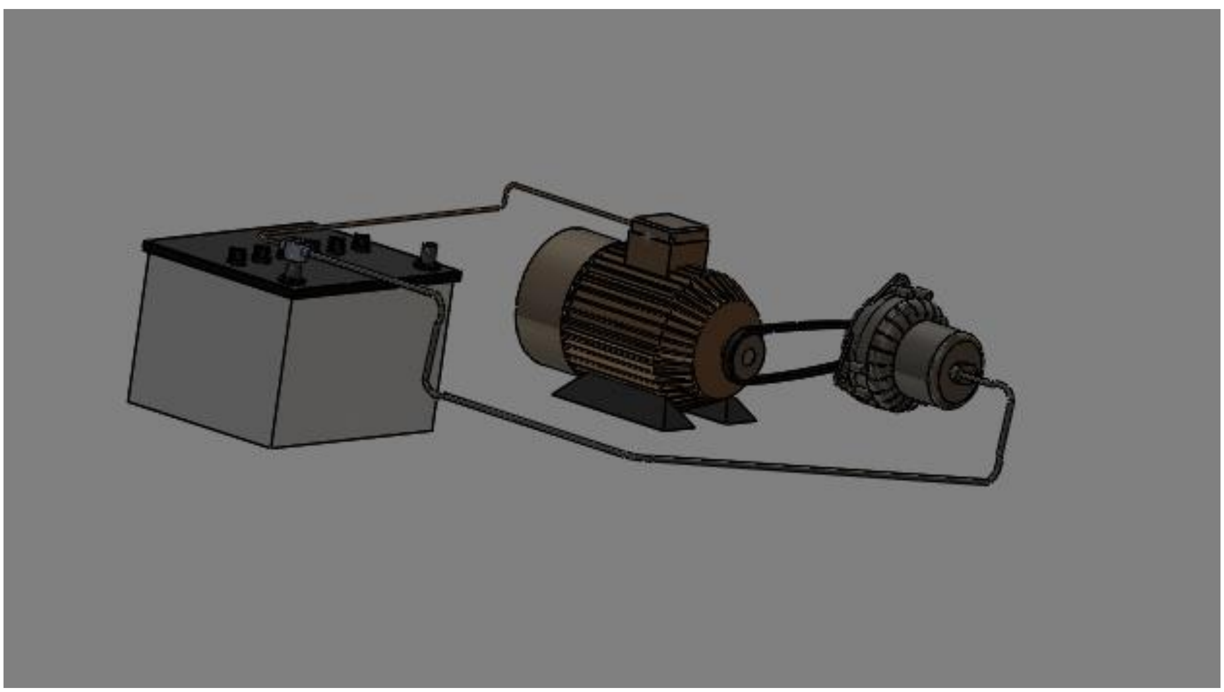


Figure 4.11. Assembled parts of portable fast battery charger by using solidwork

4.3.5. Operational procedure of portable fast battery charger and flow of voltage

- Don't remove and disconnect any wire from the Alternator be use the first charging system Installation.

- Use the step of assembling procedure of the upper one
- Install regulator on the out-put positive terminal AC motor. Because regulator limits ualternator voltage by controlling the amount of current flowing in the alternator field.
- Connect positive terminal from out-put of AC motor to positive terminal battery. But there is diode between two terminals because of the current is flow only from Alternator to battery.
- Give the ground to AC motor
- Switch ON and see. Then, generate Ac motor in case of connecting with pully in Dc motor
- Measure the voltage and current between positive terminal and negative terminal by using voltmeter.
- Alternator motor supply voltage more than battery drop out voltage.

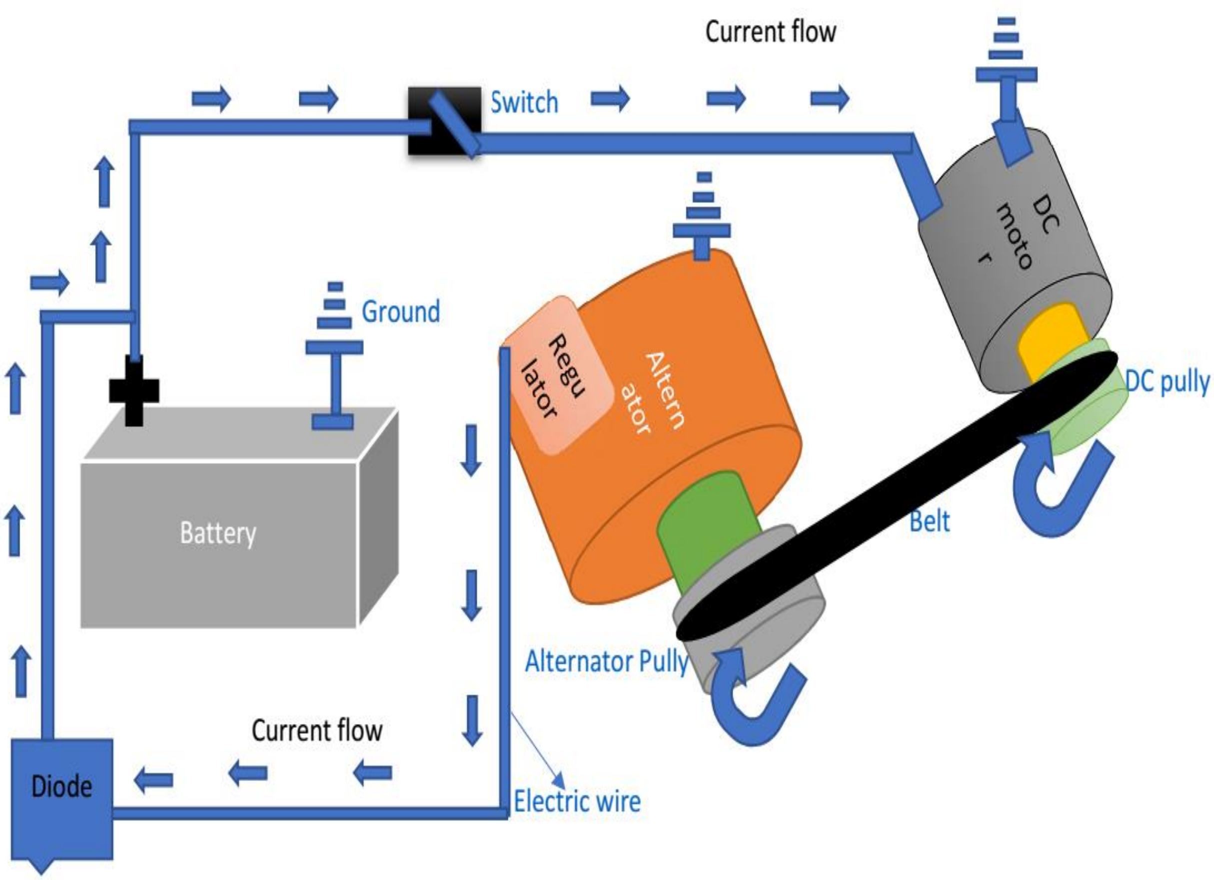


Figure 4.12. Operational procedure of portable fast battery charger and voltage flow

4.4. Charging System Voltage Drops

To check voltage drops as preventive maintenance:

- Combined voltage should be less than 0.5 volts
- Positive circuit with 10 amps flowing: no connection should have more than 0.3-volt drop
- System with an ammeter: 0.7-volt drop limit
- Small amount of voltage drop through the fuse link is normal.

A battery charger is a device used to put energy into a cell or (rechargeable) battery by forcing an electric current through it. Lead-acid battery chargers typically have two tasks to accomplish. The first is to restore capacity, often as quickly as practical. The second is to maintain capacity by compensating for self-discharge. In both instances optimum operation requires accurate sensing of battery voltage.

4.5. Result and self-check

Our engine needs an electric power from the battery in order to recharge the battery. It means that, if the battery has greater than or equal to 9 volts. So, to run the DC motor, our battery needs greater than 9 volts of power.

If the battery power less than 11.7 volts, it must not to crank the engine. So, we used to DC motor in order to recharge by itself.

Table 4.1. Voltage Vs time description table

Voltage (Volt)	9	9.15	9.225	9.3….	10.5	11.8
Time (min)	0	1	1.5	2…….	10	20

The above table showed that if the charging time increases the amount of produced voltage also increases. 0.075Volt were produced at every 0.5min. duration of charging time.

Therefore, it is a part of an ultra-fast charging system station of vehicle battery in the duration of less than 5 min.

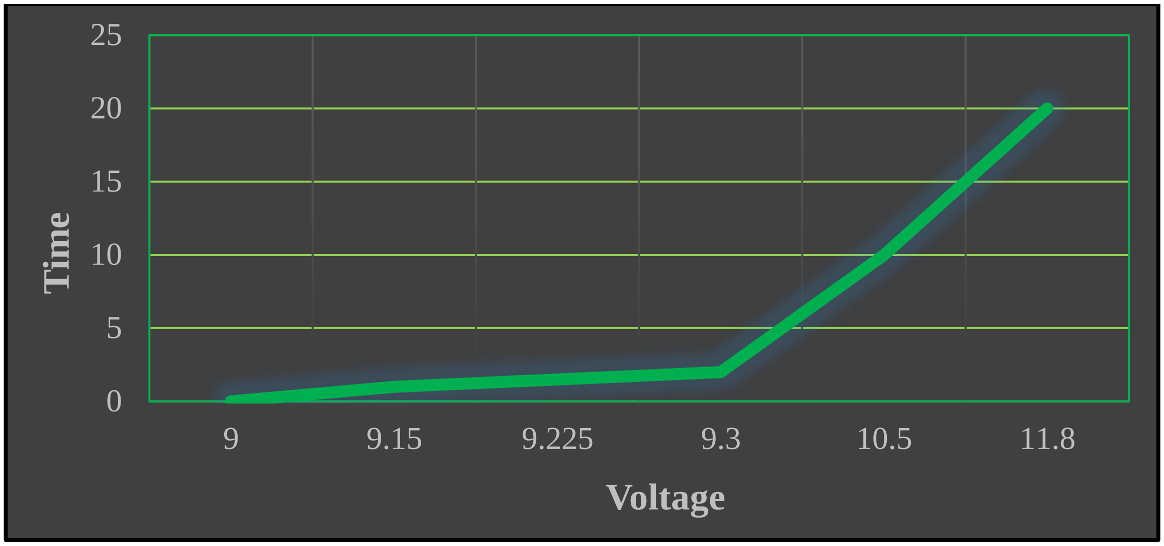


Figure 4.13. Voltage Vs time description

4.5.1. Voltage Output Test

Test Procedure:

- ✓ Start the DC wiper motor
- ✓ Raise middle speed to 2,000 rpm while lowering battery voltage
- ✓ Read amount of current put into battery
- ✓ Maximum output will be more than gauge shows
- ✓ Move amp probe to B+ wire

To estimate accurate output:

- ✓ Testing by using an amp clamp
- ✓ Place it around all of wires from battery terminal

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

Electrification of transport is undisputable one of the key strategies to address climate change. The need to reduce range anxiety and meet customer expectations has driven many manufacturers to target fast charging capability as a critical design feature for EV battery.

This paper presented a review of fast charging technologies, explained the issues associated with fast-charging, including impacts on the battery systems regarding heat management and limitations, presented solutions, and proposed new areas of research for future solutions. Petroleum based transportation will not sustain the globe in the decades' ahead, thus, advanced technologies are needed that will move the world towards sustainable electrified transportation. Slow EV battery charging times is one of the significant concerns with EVs. Widespread consumer acceptance requires that recharge times are comparable with the time it takes to fill up an ICEV's gasoline tank. This paper emphasized that fast and safe charging systems that do not damage the batteries, and do not negatively affect the electric grid must be developed. With continued charging research, technologies will be refined and standards will be developed, which will encourage the increased adoption of EVs, leading to a more sustainable energy future.

According to findings revealed about fast Battery charging system by adding DC Motor in general the following conclusions are drawn:

- Many alternative electrode materials have been proposed that could potentially improve fast charging capabilities of Li-ion cells, however much remains to be studied regarding their stability, possible degradation mechanisms, ease of manufacture, and cost.
- Many studies on fast charging protocols have been of empirical or experimental nature, and therefore their performance has only been assessed for a limited range of cell chemistries, form factors, and operating conditions.

- Few charging optimization studies to date have addressed the special case of low temperature fast charging, which will be increasingly important as deployment of EVs accelerates in colder climates.
- In one ten-minute charge cycle, a fast charger can provide enough energy to allow a passenger EV to operate for one hundred miles. This fast charge capability can help to enable rapid growth of the EV market by minimizing vehicle downtime.
- If one fast charger can impact the psychology of a set of fleet drivers, a full build-out of EV fast charge infrastructure will enable a wide adoption of EVs. Fast charging opens the horizon of the new age of EVs.
- Fast charging can speed up charging time with better efficiency and increase filling capacity.
- If the charging time increases the amount of produced voltage also increases. 0.075Volt were produced at every 0.5min. duration of charging time.
- It is necessary to have an appropriate battery chemistry and thermal management at the BEV that assure the performance and lifetime when high C rates are employed at fast and ultrafast charging process
- Considering the wide range of voltage systems and energy battery capacity of passenger EVs, modular design and the use of several units seems to be the best design approach for DC Chargers, obtaining high efficiency and flexibility.
- Improvements in battery chemistries and development of high duty electric vehicles could increase the average charging power levels required increasing the average power of the modules employed for the construction of DC chargers.

5.2. Recommendations

To make this device as mechanically and financially efficient as possible, the following recommendations are offered:

- Expensive import of training models and more wastage of vehicles power source are other problems in TVET institutes in Battery service garage and higher institute;
- Here in TVET, we have many dead vehicles that are not being used and are parked at one place hence making the campus less attractive since they are even old;

- So, it’s better to recycle of battery charged in order to get something new out of them that can help reduce the expensive importation from other countries.

Prototype, a higher-rated circuit breaker should be implemented between the controller and the battery. Furthermore, adding features such as a light, digital battery indictor, and reverse polarity alarm would increase marketability.

Since this thesis work was strictly concerned with the battery performance, I hereby highly recommend further development of this kind of model with more sophisticated features than this and any further development plan for a portable emergency battery charger model is hereby welcomed.

5.3. Future work

It is difficult to do this thesis since no body has done it which makes it difficult for me but, now it is already proposed in this thesis so as this work is the first work many more things and modifications can be done while the references obtained are related issues.

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APPENDIXES

Appendix A: Actual and compiled data in the Table form

Table A.1: Materials

No.	Items	Specification
1	Bolt with nut	¼’’ x 4” x 20*
2	Alternator	12V
3	Automotive wire	900 Amps, 50 square mm cables, 3.5 meters long
4	Button switch	XPB22-22B-11ZS
5	Wiper motor	ZD2433/ZD1433
6	Battery	KFG30Z
9	Regulator	SL 139G.2
10	Female connector	UPC:687152170289
11	Pulley	Grooves: 2; Length: 35.0 mm; Belt: 10.0 mm; Body Diameter: 53.0 mm; OD: 74.6 mm.
12	Ignition switch	No. P: 4, S.O.: Off-Start, Key Tr.: Yes C.C.R: 70A @ 12V, Application: Automotive D.B.P: 69mm, V.R.DC: 24V
13	Lamp	4W
14	Battery post connector	Material: Brass, Stainless Steel, Aluminium. Zinc. alloy
15	Belt	EPDM/CR/NR

Table A.2: Tools & equipment

No.	Item	Quantity in number	No.	Item	Quantity in number
1	Wrenches	1	11	Socket & combination	1
2	Hammer	1	12	Ball pin & plastic	1
3	Pliers	1	13	Combination & long nose	1
4	Screw driver	1	14	Flat & Philips	1
5	File	1	15	Flat	1
6	Hacksaw	1	16	Blade 18	1
7	Chisel	1	17	Flat	1
8	Punch	1	18	Center & pin	1
9	Steel rule	1	19	Power hacksaw	1

10	Lazing machine	1			

Table A.3: Specification for selected DC motor

Parameters	Specification
DC motor type	Brushless DC motor
Maximum power output	0.627kw @ 1390 rpm
Minimum peak torque at start	27.44Nm
Maximum speed	1390 rpm
Maximum voltage	9V
Maximum current	32A
Minimum Efficiency	75%

Table A.4: Voltage Vs time description table

Voltage (Volt)	9	9.15	9.225	9.3….	10.5	11.8
Time (min)	0	1	1.5	2…….	10	20

Appendix B: Different graphs and figures

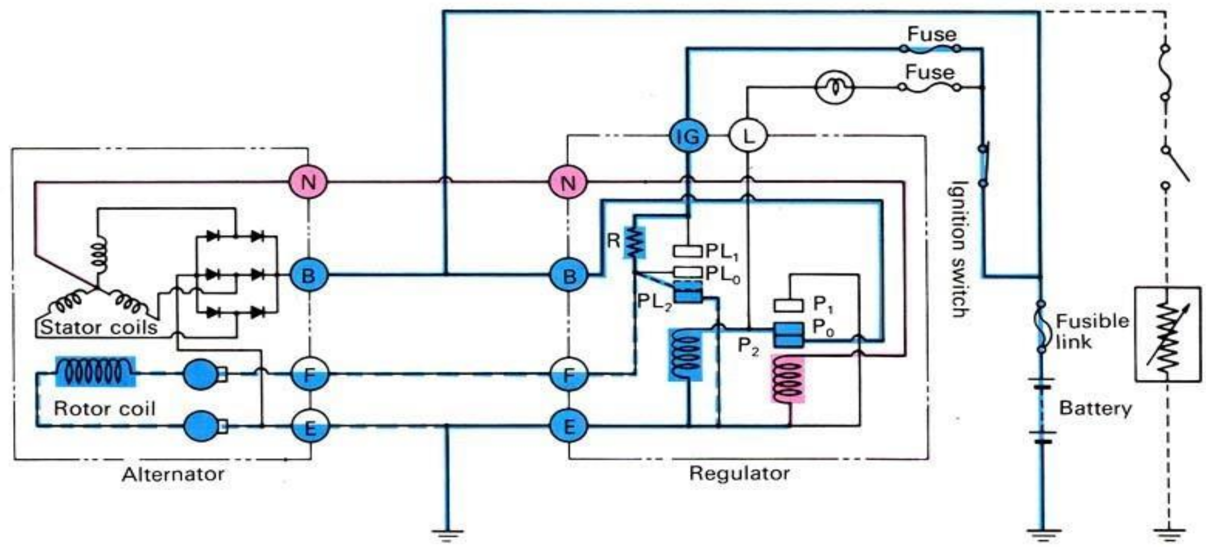

Figure B.1: Block Diagram of Fast Charging Circuit

Design	Fast Battery charging	Production	Fast Battery charging	Constructing the fast battery charging
Problem complex design for Fast Battery charging	Problem We try it out of the engine but that is not good	Problem DC motor that helps to rotate the alternator equal to engine operation	Problem Increasing of Accident day to day	Problem The normal charging system didn’t recharge the battery when the battery is rundown with start
The title is evaluated by the evaluation community andwe revised the design	We change by installing the charging system components by changing	We use the DC motor witch come with modern engine to operator a fun for cooling	We found this technology and to minimize this problem	By technology we can recharge the battery without staring the engine by using amen force like pushing and search the battery charging house

Figure B.2: Value chain for Fast battery Charger system Activity

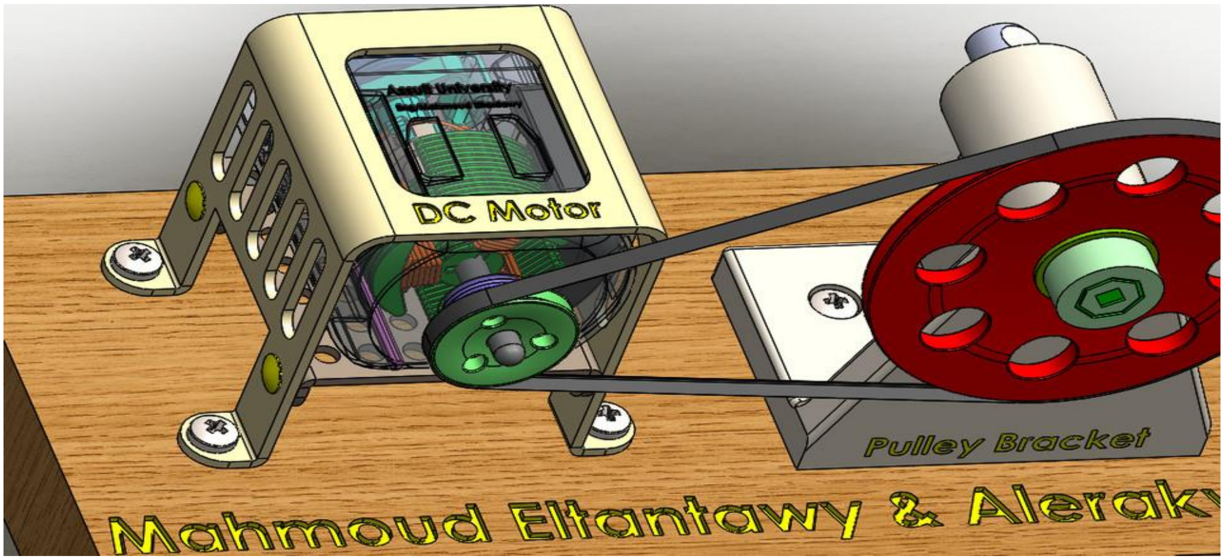

Figure B.3: DC Motor pulley and alternator

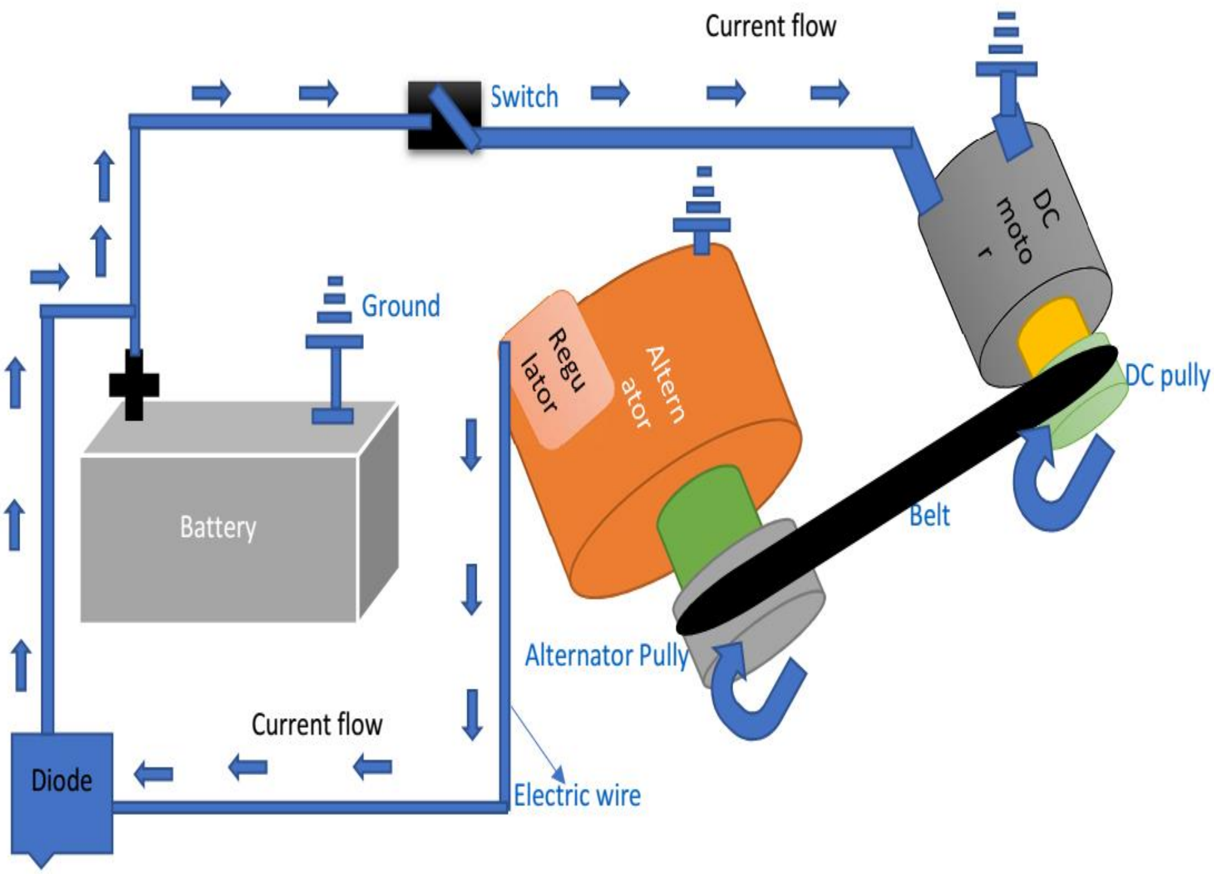

Figure B.4: Operational procedure of portable fast battery charger and voltage flow

Figure 4.1. Battery

Figure 4.2: IG

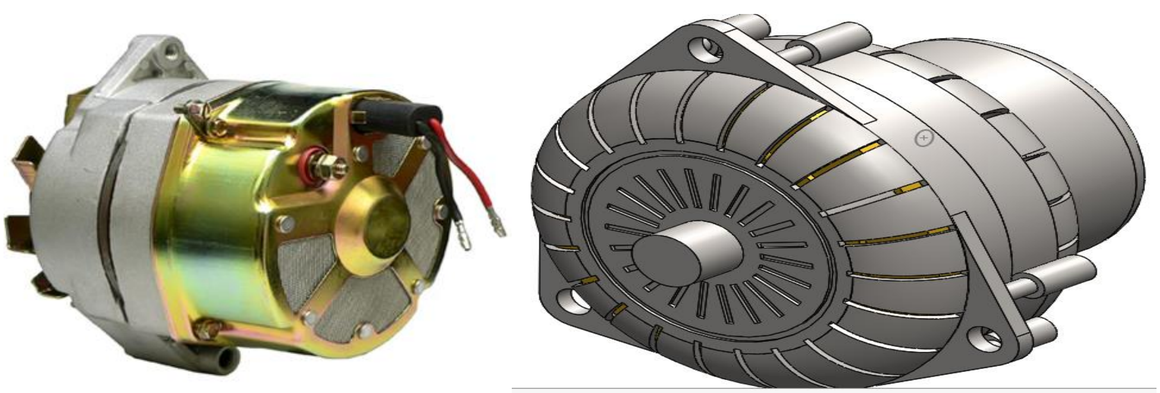

Figure B.7: Alternator

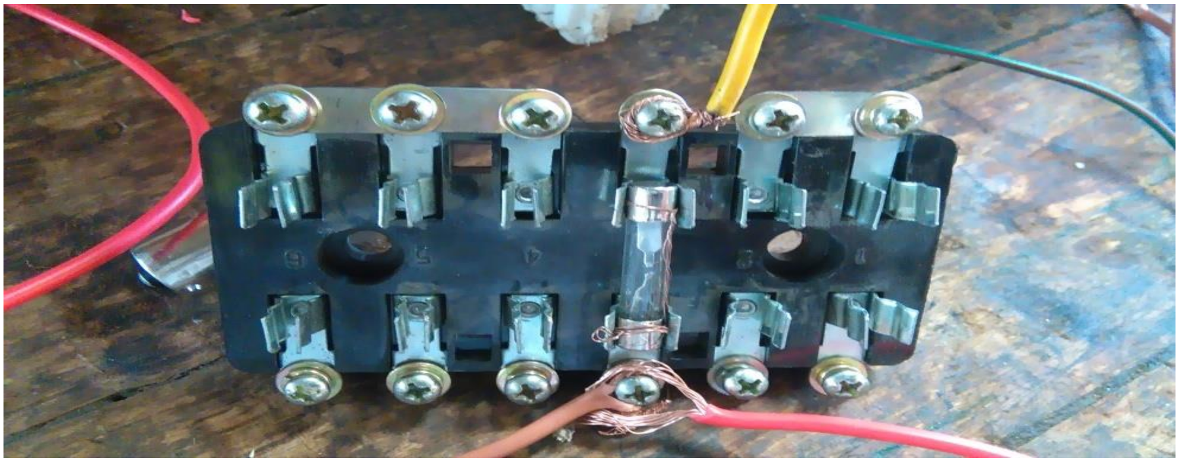

Figure B.8: Fuse box

Figure B.9: Regulator

Figure B.10: Pully

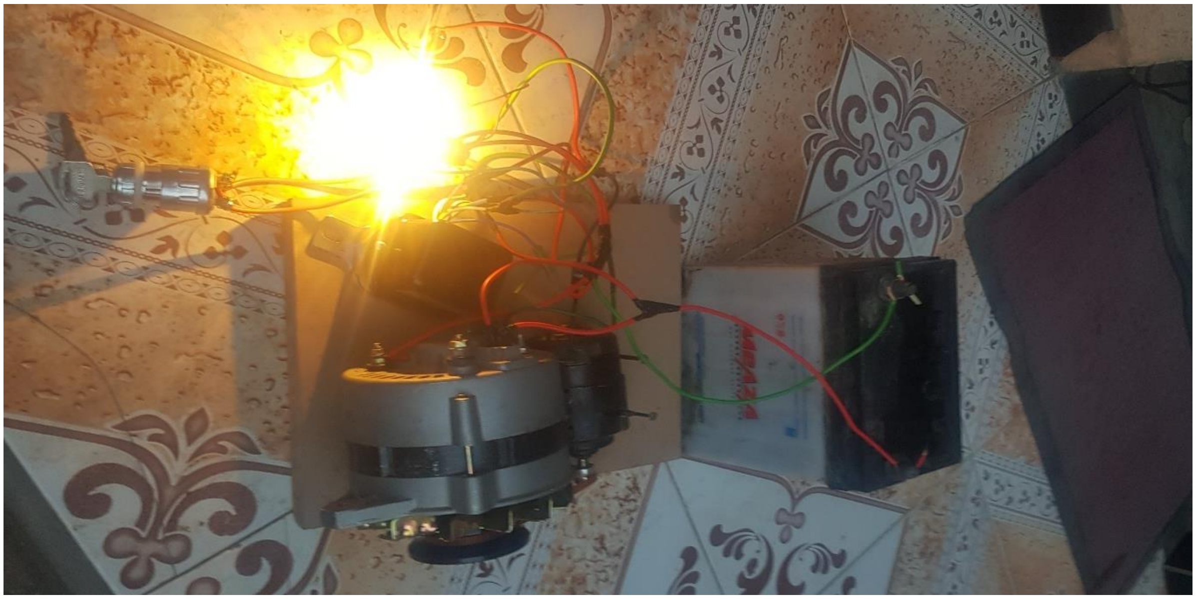

Figure B.11: Assembled parts of prototype

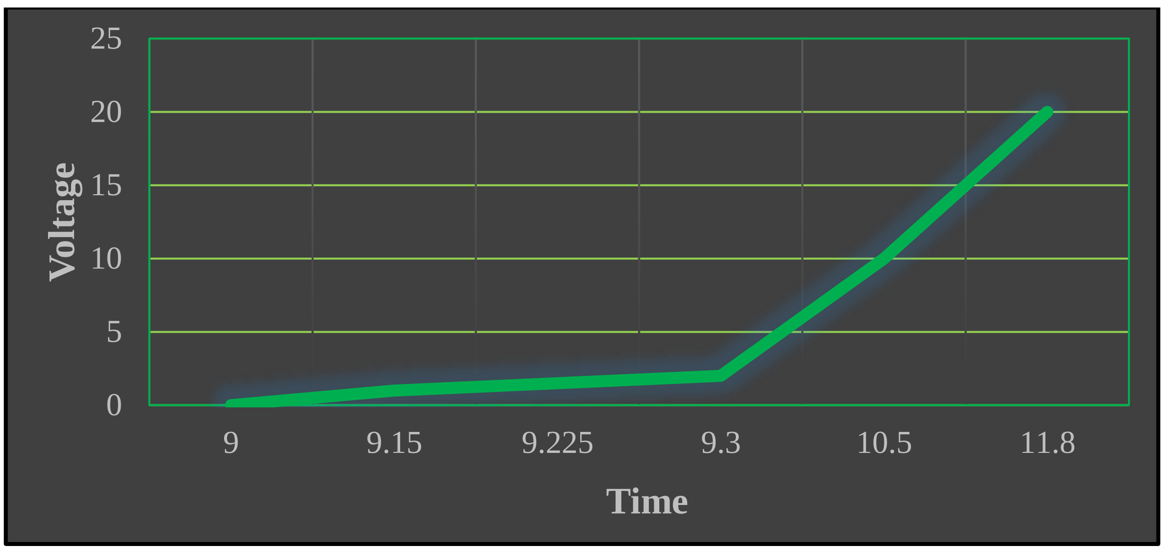

Figure B.12: Voltage Vs time description graph

Appendix C: Solidwork Pictures and Assembly

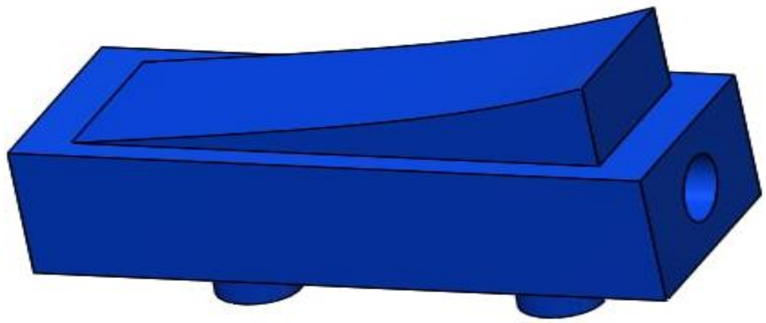

Figure C.1: IG

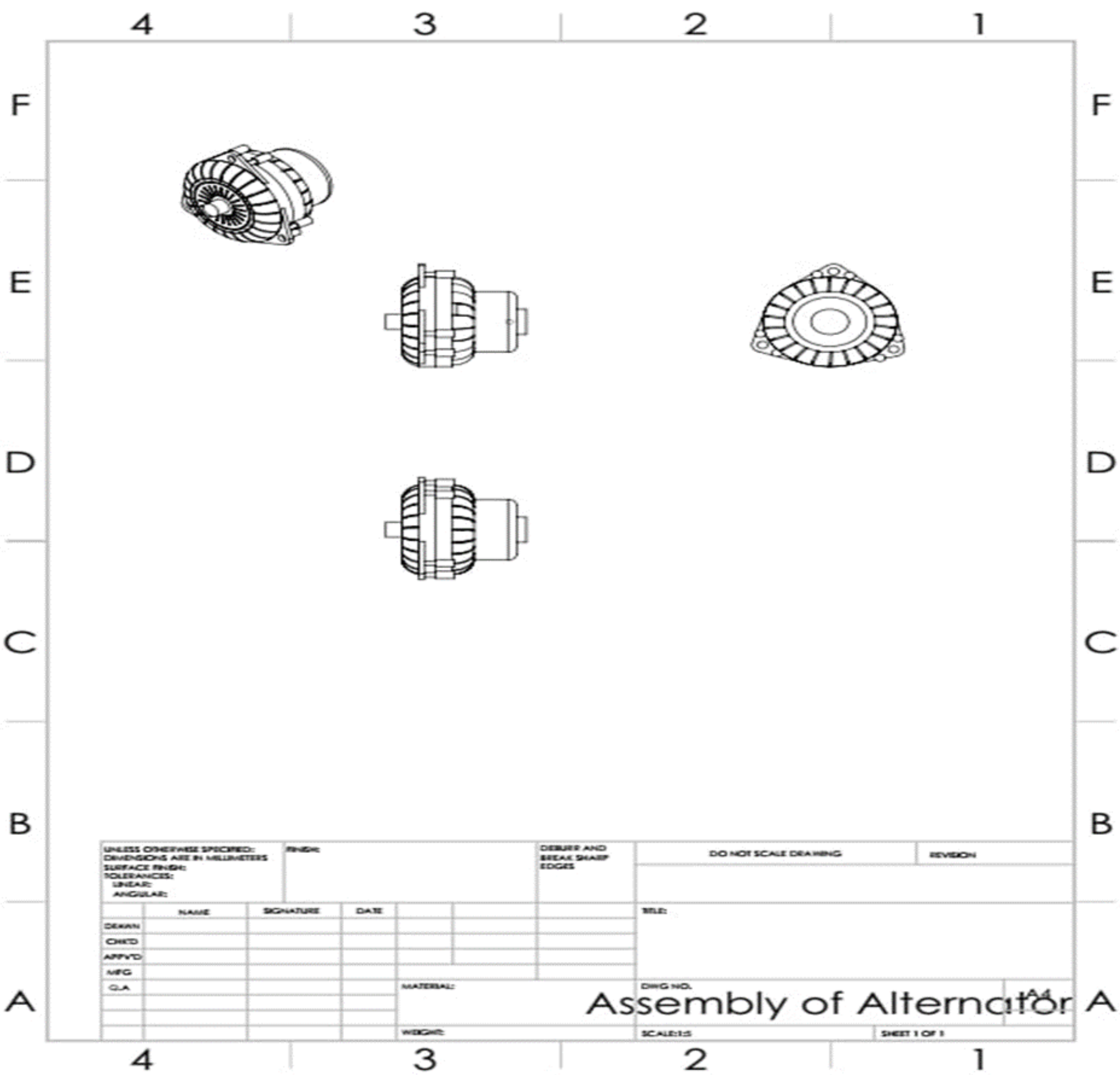

Figure C.2: Assembly of Alternator

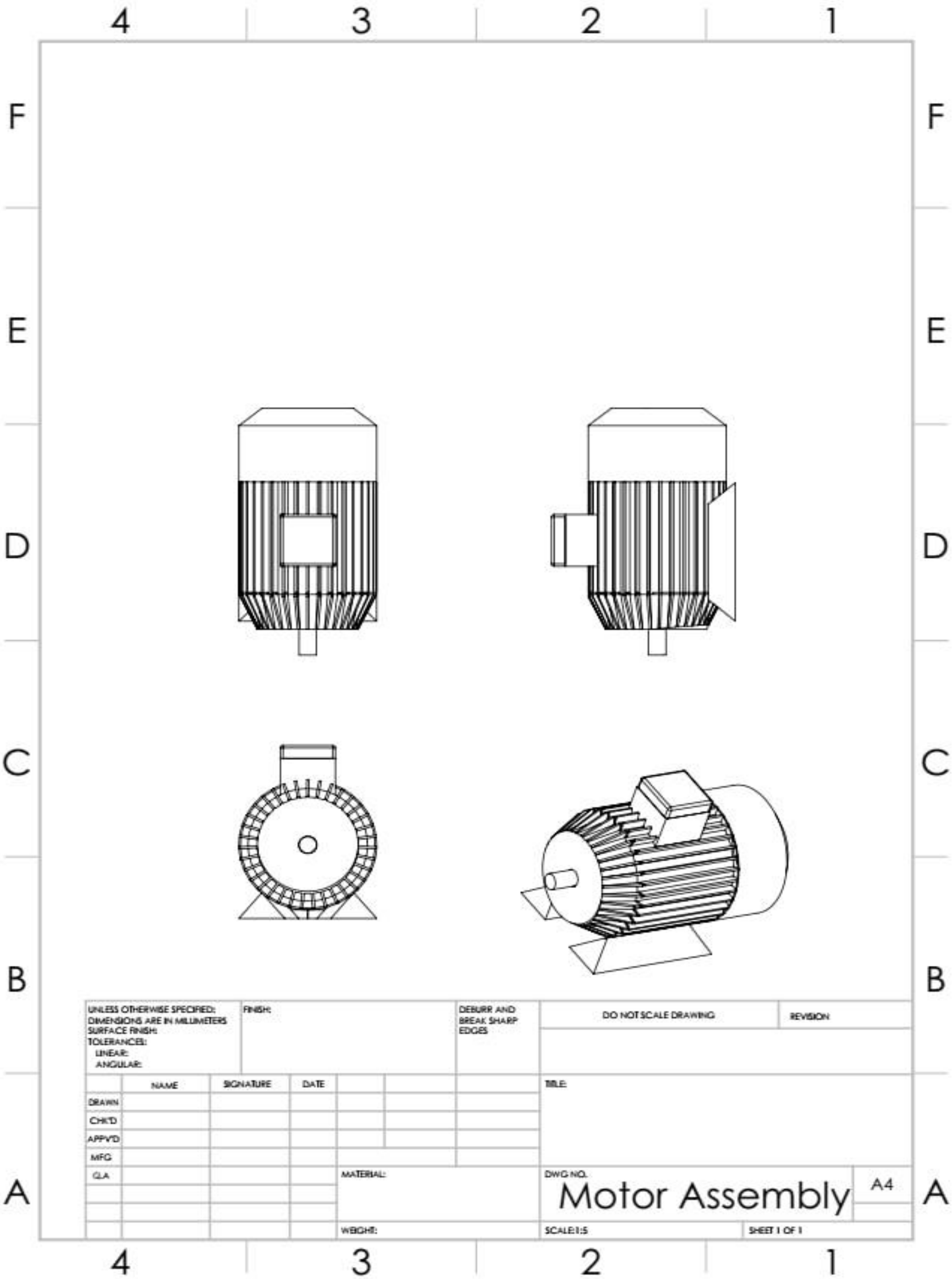

Figure C.3: Assembly of Motor

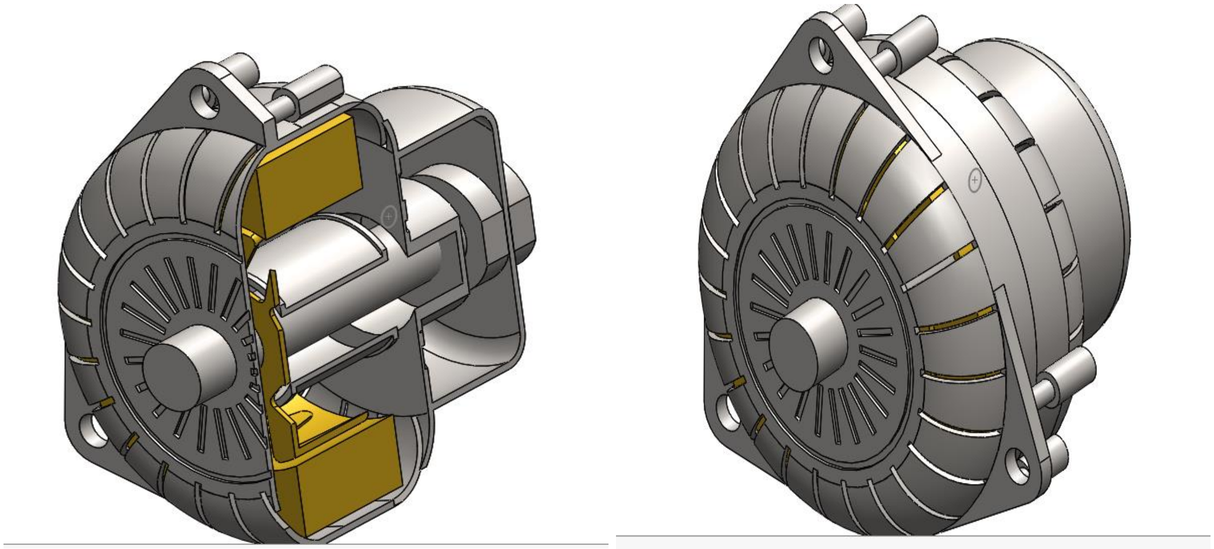

Figure C.4: Alternator

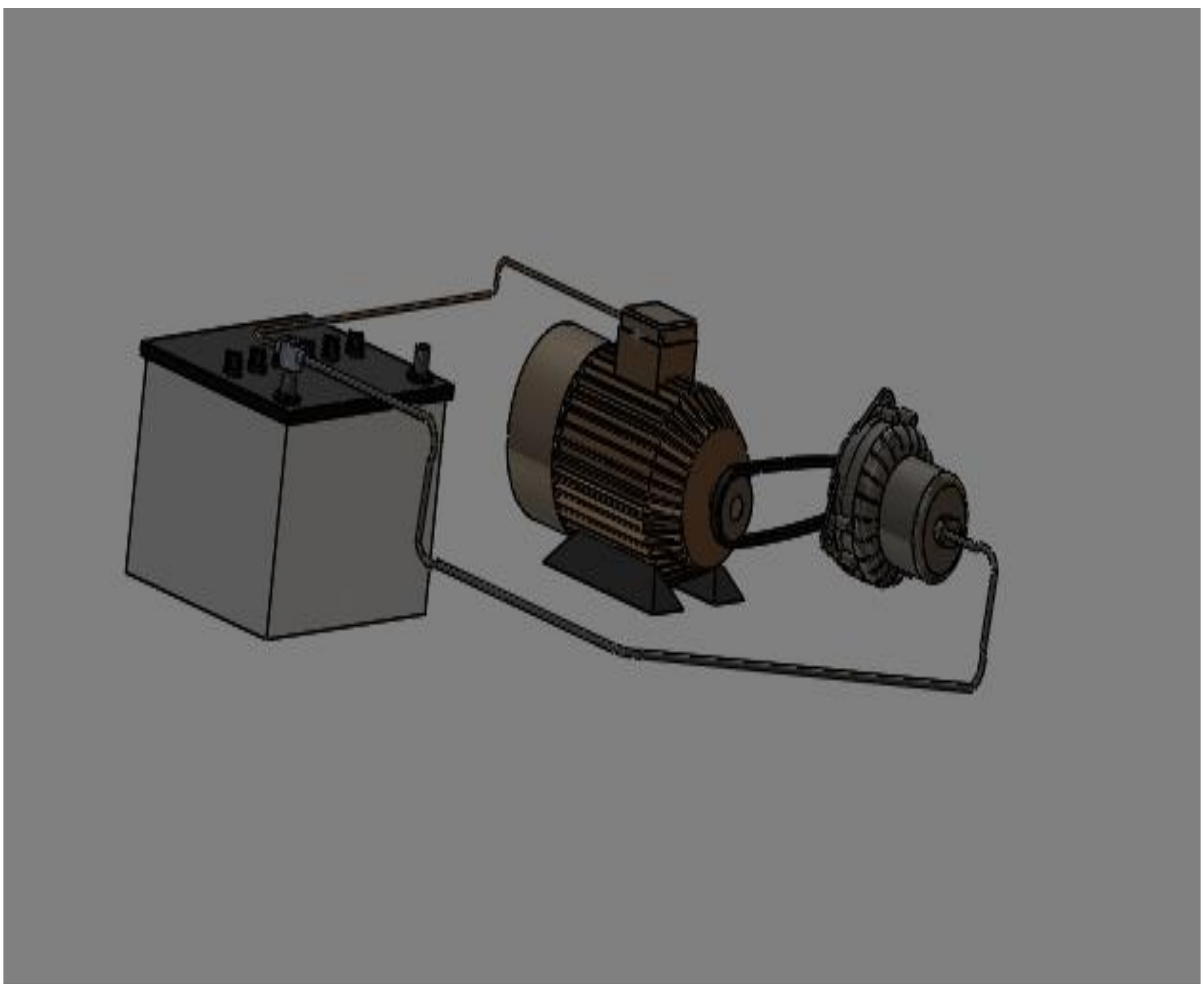

Figure C.5: Solidwork assembled parts

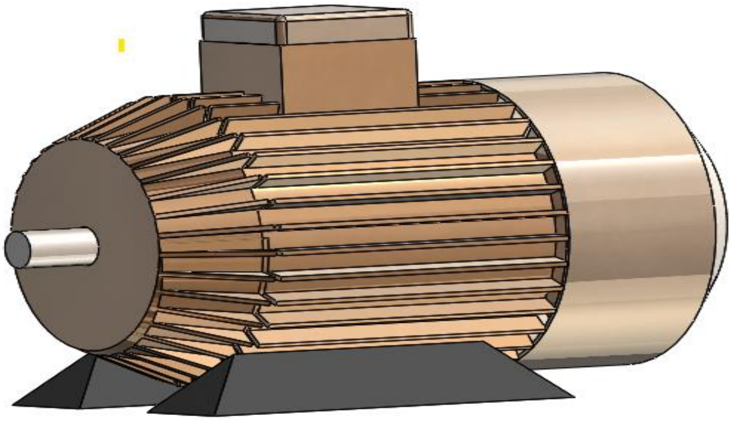
Figure C.6: Photo of Motor