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Design and Optimization of Solar Using MPPT Algorithm Controlled by Two-Wheeler HEV Using MATLAB Simulink

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***Abstract*— Now a days two-wheeler HEV is an excellent option for low and medium power application due to its high efficiency, high torque to inertia ratio, large energy volume and minimum maintenance. According to the study's results, the suggested control algorithm lowers power losses caused by high frequency switching by removing phase current sensors and regulating voltage source inverter (VSI) fundamental frequency switching. There are no additional controllers or electronics necessary to regulate the speed of the two-wheeler HEV.**

The VSI variable DC jumper voltage controls the speed. Soft-starting a two-wheeler HEV is possible using Maximum Power Point Tracking (MPPT). Our agricultural business is greatly dependant on rainfall. The system is totally powered by renewable energy, which is always available and unconstrained. Solar energy generation has advanced technologically, making the system more efficient. As a consequence, this technology might be utilised to solve the problem of load shedding in irrigation. In this way, solar power benefits farmers in decreasing their energy costs and obtaining a competitive advantage if excess electricity is sent to the utility grid. Brushless DC motors are simple, cost-effective, and efficient for a PV solar water pumping system. The Zeta Transformer is used to extract the most power from the SPV range.

This article also discusses the topic of developing a Solar Powered BLDC Motor to drive an Two wheeler Electric Vehicle, which is one of the answers to the impending issue. The strategy to picking the proper components for this application is explored, and each of them is simulated and submitted to numerous tests. The complete system, which included the solar module, batteries, a boost converter, and a two-wheeler HEV, was dubbed the Solar Powered two-wheeler HEV Driven Two wheeler Electric Vehicle.

Ground transportation fuel efficiency rules have been tightening across the globe during the last decade. Power-split hybrid technology is one of the most promising options to achieve those stringent requirements. " The Toyota Prius, for example, has effectively applied this technology and shown a fuel efficiency increase of over 60%. Due to the fact that trucks now account for more than two-thirds of light-duty vehicle sales in the United States, few hybrid electric light trucks are now on the market..

***Index Terms*— Electric Bike, BLDC Motor, Battery Management System (BMS), Battery Charging System, Motor Controller, Battery Thermal Management System.**

I. Introduction

The transportation industry is a significant source of worldwide energy consumption and greenhouse gas emissions. At a time when problems such as increasing greenhouse gas emissions and air pollution, as well as growing reliance on energy imports, are becoming more visible, the use of alternative fuels and power trains appears to be a key strategy for moving towards an environmentally friendly transportation system. Cities have seen significant transportation growth as a result of urbanisation, and as transportation development becomes more essential, there is a need for action to address transportation issues. One of the issues associated with urban areas is local air pollution and noise, which might be minimised by adopting zero-emission battery electric cars. By 2025, it is expected that 25 percent of all automobiles in the globe will be electric.

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Other vehicles An alternative fuel vehicle is one that runs on a fuel other than traditional petroleum fuels such as gasoline or diesel fuel. It also refers to any technology for powering an engine that does not rely solely on petroleum, such as an electric vehicle, a hybrid electric vehicle, solar powered, or hydrogen fuel. Because of factors like as environmental concerns, high oil costs, and the possibility of peak oil, many governments and car manufacturers throughout the globe have made the development of cleaner alternative fuels and improved power systems for vehicles a top priority. Electrically assisted bikes are often powered by rechargeable batteries, and their driving performance is controlled by battery capacity, motor power, road kinds, operating weight, control, and, most importantly, aided power management. This document presents a design study for an electric bike, which includes frame analysis, vehicle performance calculations, and test run results.

Steel, a traditional iron-carbon alloy, is one of the world's most widely used metals in sectors ranging from building to blacksmithing to sewing. Early steels had varying carbon content ranging from 0.07 percent to 0.8 percent, which was frequently added during the forging process using charcoal, with the latter being the threshold at which the alloy could be deemed true steel. Modern steel content is often limited to 2%, resulting in a material known as cast iron. Early variants of the alloy may be found in Egyptian and Chinese artefacts from about 900 B.C. and 250 B.C., respectively. Since then, there have been additional advances and the discovery of new elements.

One of the most significant technical triumphs around the end of the nineteenth century was the invention of vehicles driven by internal combustion engines (ICE). The availability of low-cost fuels, simplicity of use, enhanced dependability, and extended driving range all contributed to these cars' popularity. Cars driven by heat engines, on the other hand, have extremely low fuel economy (20-25 percent), and the burning of hydrocarbon fuels in these vehicles emits a lot of harmful pollutants. After more than a century, the automobile industry and the vast number of cars in use throughout the globe are producing severe societal and environmental issues. Along with the energy and heat producing sectors, the transportation industry is a significant contributor to air pollution. As illustrated in Fig. 1, the electricity and heat generating sectors account for 42 percent of worldwide CO2 emissions in 2015, while the transportation sector accounts for 24 percent [1]. Road transport accounted for 75% of all transportation emissions.

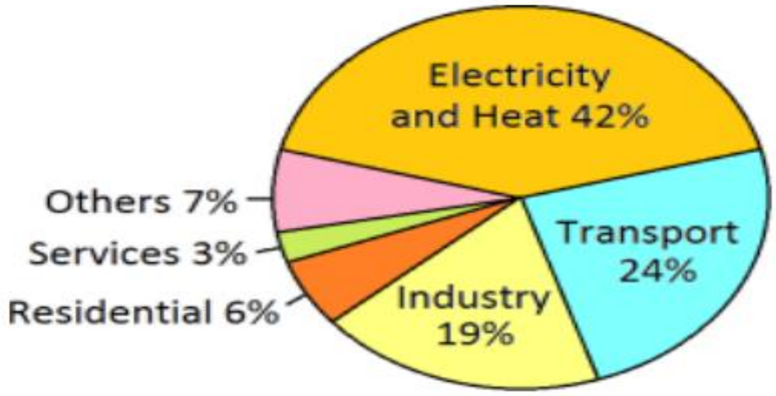

Fig. 1. World CO_2 emissions from fuel combustion by sector (IEA report 2017).

In addition to CO2, liquid fuel engine cars release nitrogen oxides (NOx), carbon monoxide (CO), sulphur oxides (SOx), and unburned hydrocarbons (CxHy) through the exhaust, as well as hydrofluorocarbon (HFC) emissions from leaky air conditioners. Although their proportions are minor in comparison to CO2, the effect of these emissions may be considerable since they have a larger Global Warming Potential (GWP) than CO2. The global warming potential of a gas measures its influence in comparison to an equal quantity of CO2. Various greenhouse gas (GHG) emissions from automobiles and their global warming potential (GWP). CO2 emissions account for about 95% of total GHG emissions from a passenger car.

Solar cell

Information source Solar cells are the primary component of photovoltaic boards. Although silicon is still employed in the majority of situations, other resources are widely utilised. Sunlight-based cells calculate the photoelectric consequence, or the capacity of a tiny semiconductor to transform electromagnetic aftereffects into electrical flow. By creating the architecture of the solar powered cell, it is possible to accurately separate the charged units created by incoming radiation and establish an electrical flow, as will be detailed in further detail below. To generate a p-n junction, two layers of silicon are doped with a trace quantity of soil particles. Supporters of the n-layer and acceptors of the p-layer When the two layers converge at the interface, electrons from the n-competent layer seep into the p-side, separating the givers behind an emphatically charged region.

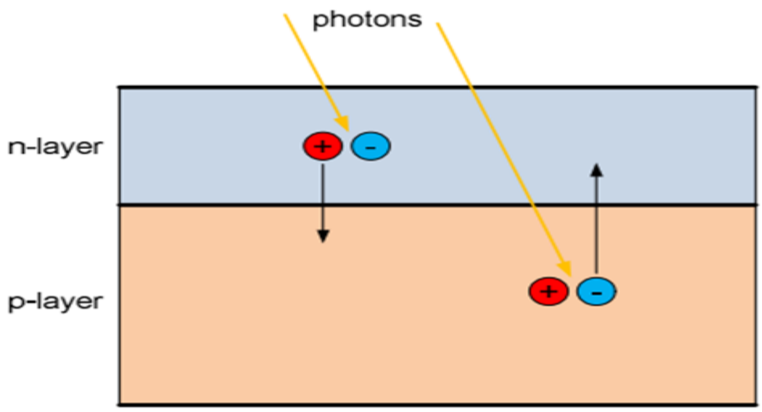

Fig.2 Solar Cells

PV System Modes of Operation

The most essential difference between grid-connected and freestanding PV systems is autonomy. The stand-alone system must have or expand the storage system in order to give high dependability and superior electrical quality. Batteries should come with a charge controller to keep them from exceeding limits that might damage them. One or more backup generators may be built to increase reliability.

Grid-connected systems do not need storage since they can take power from the grid when no producing capacity is available. Inverters are necessary to feed electricity to the grid or to AC loads since the PV system's output is DC.

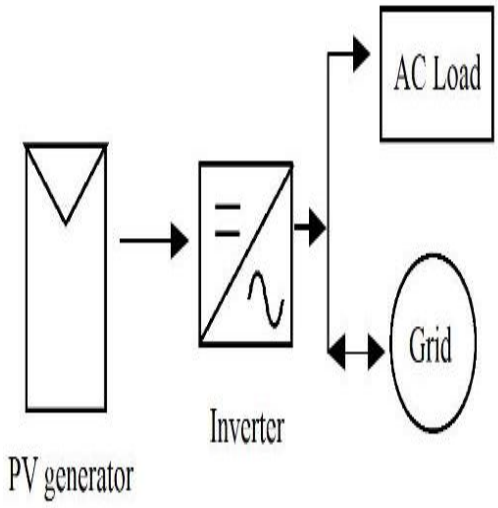

Fig.3 Diagram of a Grid-Connected PV System

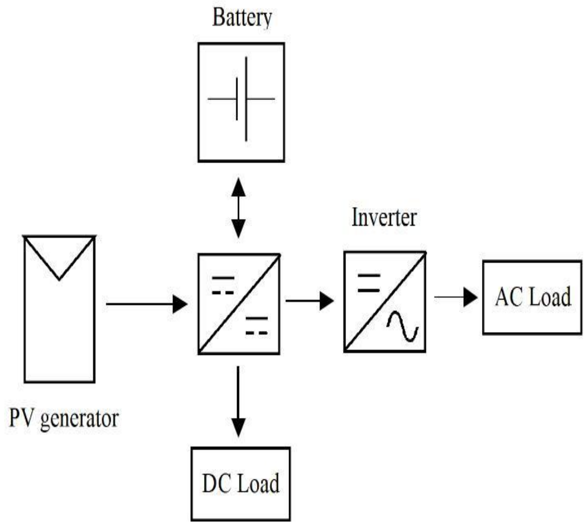

Fig.4 Diagram of a Standalone PV System

Solar Battery

Lead-corrosive batteries are used in a variety of applications, although they are almost always used for starting or deep cycle control in some capacity. There is a huge discrepancy between the amount of power that it conveys and the amount of power that it needs to communicate. The solar cell, a device that converts sunlight directly into electricity, is one of the most prevalent types of renewable energy. Solar cells are around the size of an adult hand and have an Octagonal form with blue-dark shading. Sun-oriented cells are always utilised in combination with sun-based batteries. Solar-powered modules are the major components. A solar-powered board is made up of a number of sun-powered cells that are assembled together.

Electric Vehicle Types

(a) Hybrid Electric Vehicles (HEV)

HEVs combine a gasoline engine with an electric motor to provide more power while using less fuel. Although HEVs contain a battery and an electric motor, they are neither rechargeable or plug-in. Regenerative braking is employed to recharge the batteries in this case. Hybrid fuel-saving technologies are regarded to have the ability to enhance fuel economy dramatically. The hybrid version of the 2014 Honda Accord scored a combined mpg (mpg) of 47 when compared to the non-hybrid variant. If you travel 12,000 miles per year and spend $4 per gallon for petrol, you will save $575 each year.

Pros: Longer range and reduced emissions while travelling at moderate speeds.

Cons: Higher upfront expenses, low emissions at high speeds.

Figure 5 Electric Two Wheeler

(b) Plug-in electric vehicle

Electricity stored in the rechargeable battery packs of a plug-in electric vehicle (PEV) powers or aids the wheels via the use of any external power source, such as a wall socket. PHEV (plug-in hybrid electric vehicles) and electric vehicle conversions of hybrid electric vehicles (HEVs) and conventional internal combustion engine (ICE) cars all fall under the umbrella term "PEV."

Many automakers have at least one hybrid or electric vehicle (HEV). It is designed to address the current problem of battery energy storage. In a hybrid vehicle, the electric power may be derived from the engine. Series and parallel hybrids are the two types of HEVs. All of the engine's electrical needs are met by the batteries in a series hybrid. All of the motor's power comes from the battery. Using a parallel hybrid, both the engine and the motor work together to provide the necessary propulsion power. Motor and engine provide torque equal to their product if multiplied. As the engine's power travels through the gearbox, the motor acts as a generator. Series and hybrid cars may both regenerate energy when braking or decelerating.

Despite this, HEVs still emit carbon dioxide. A solution to some of these problems may be found in the form of plug-in hybrid electric vehicles (PHEVs). The battery is charged by electricity from the mains. Thus, users may use AC power to recharge the battery at their convenience.

1.5 The Motor

For electric vehicles, there are a variety of motors to choose from:

(a) Direct Current Motors

In motor control, it is a classic motor that has been in use for a long time. In electromechanical shunting, all the energy is transmitted to the rotor by means of fixed brushes rubbing the copper parts of the commutator. A limited lifetime and frequent maintenance are required. But it's good for low-power applications. In electric wheelchairs, wheelchairs with transporters, and micro cars, it's been utilised for years. Most golf carts nowadays are powered by DC motors. In this case, the output is less than 4 kW.

(b) Motor (Induction)

There are many different types of AC motors, but this is one of the most common. Other applications in which it is used include air conditioning, elevators and escalators. Induction motors are used in many of the higher-power electric cars (above 5kW). Torque and speed control are usually provided via a vector drive.

(c) Permanent Magnetic Synchronous Motor

An induction motor's stator is identical to this one. Permanent magnets are used to hold the rotor in place. It acts as an induction motor except for the air gap created by permanent magnets. Pulse Width Modulation generates a sine wave as the driving voltage (PWM).

(d) DC Brushless Motor

Since the field (low-power winding) is constant when the primary winding (high-power winding) is rotating, the conventional DC motor has mechanical performance. After "turning the motor inward", the permanent magnet excites the magnetic field in the rotor, while a high-power winding is placed on the motor's stationary side Despite its longer lifespan, the motor is much more expensive than a DC motor.

II. PROPOSED SCHEME AND MODELLING

Solar PV cells are used to convert solar energy into electrical power. Photovoltaic cells form solar ranges, in series or in parallel, to increase the output voltage or current. An equivalent circuit of a real photovoltaic cell, containing an Iph current source, where Rsh is the parallel resistance and Rsh is the series resistance.

We decided to make the SPV array somewhat more powerful than the BLDC motors, ensuring that the proposed system runs smoothly despite the power losses. As a result, the SPV array's chosen capacity is Pmpp = 1000 W, which is somewhat more than the motors' requirements, and all of its parameters are defined appropriately. According to the MPP, the voltage rating of the BLDC motor, which is equivalent to the voltage rating of the VSI DC jumper, defines the voltage of the SPV range at the MPP. As shown in Table I, there are a number of factors that must be considered while building a proper SPV array.

Table 1 Design of SPV Array

Peak power	Pm (W) 330
Open circuit voltage	Vo (V) 44.5
Short circuit current	Is (A) 8.83
Number of modules in a cell	Nss 72
Series resisitance (Ω)	0.101
Parallel resistance (Ω)	1200

Solar photovoltaic (SPV) energy has grown in popularity as a renewable source of energy with a wide range of applications. A cost-effective application of SPV energy in recent years has been water pumping in rural areas and provincial territories. 1,2A three-phase induction (IM) pumps for water system and local usage are frequently equipped with 1,2A three-phase induction pumps because of their appropriateness for applications in polluted and disconnected zones, ease of use, consistency of quality, and minimal support needs, A DC motor is also used in 5-7, but it is not recommended for water pumping because to the high maintenance requirements imposed by the proximity of brushes and commutator. Nevertheless, the experts have chosen to employ a PMSM drive where a powerful submersible water pumping system is introduced 8-10 owing to the difficult control of an IM and the greater proficiency of a PMSM than an IM. Water pumping using an SPV array and synchronous resistance motor is discussed in the book (SRM).

The SRM has been shown to function well for a limited range of sun oriented insulation levels. Another reason why SRMs have been overlooked for SPV display constant water pumping is due of their high torque swell and acoustic commotion problems, according to the report.

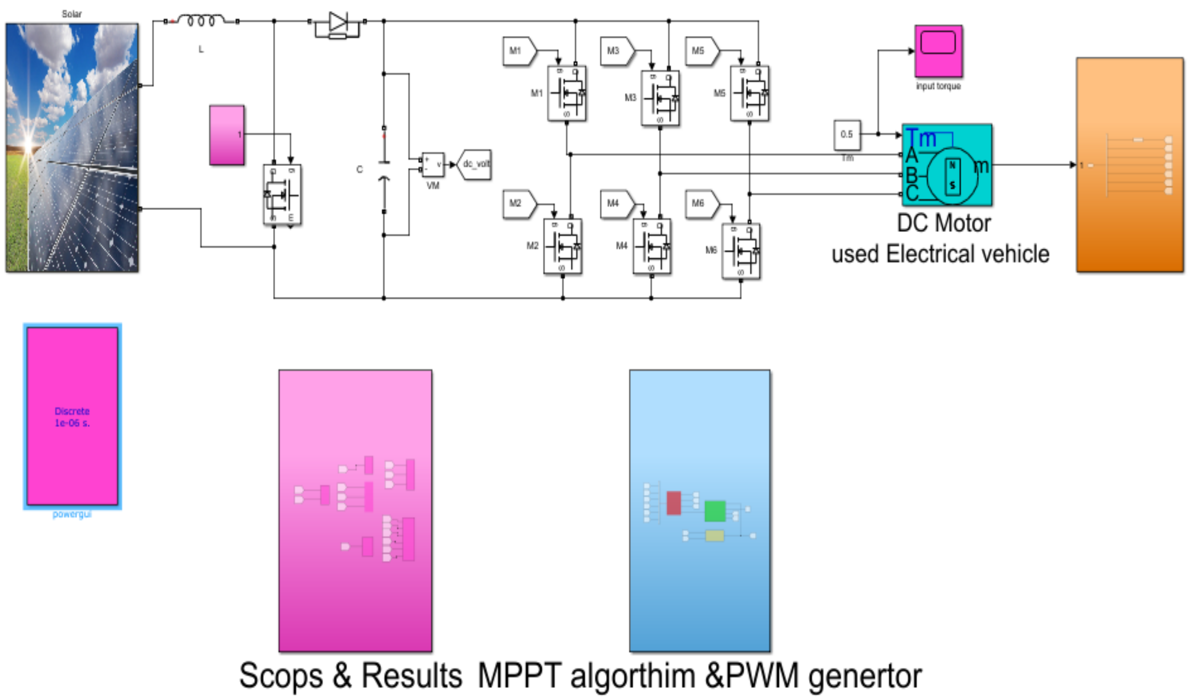

Fig 6 Electrical vehicle Model of the Proposed System using DC motor in Simulink

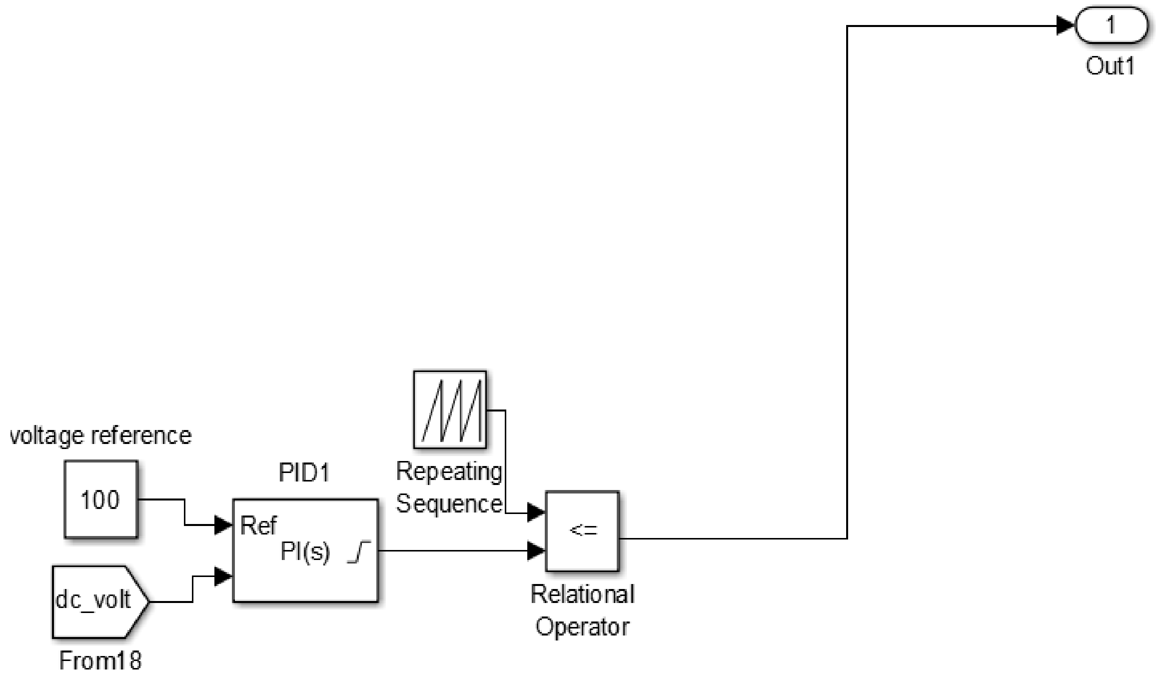

Fig 7 PID Controller

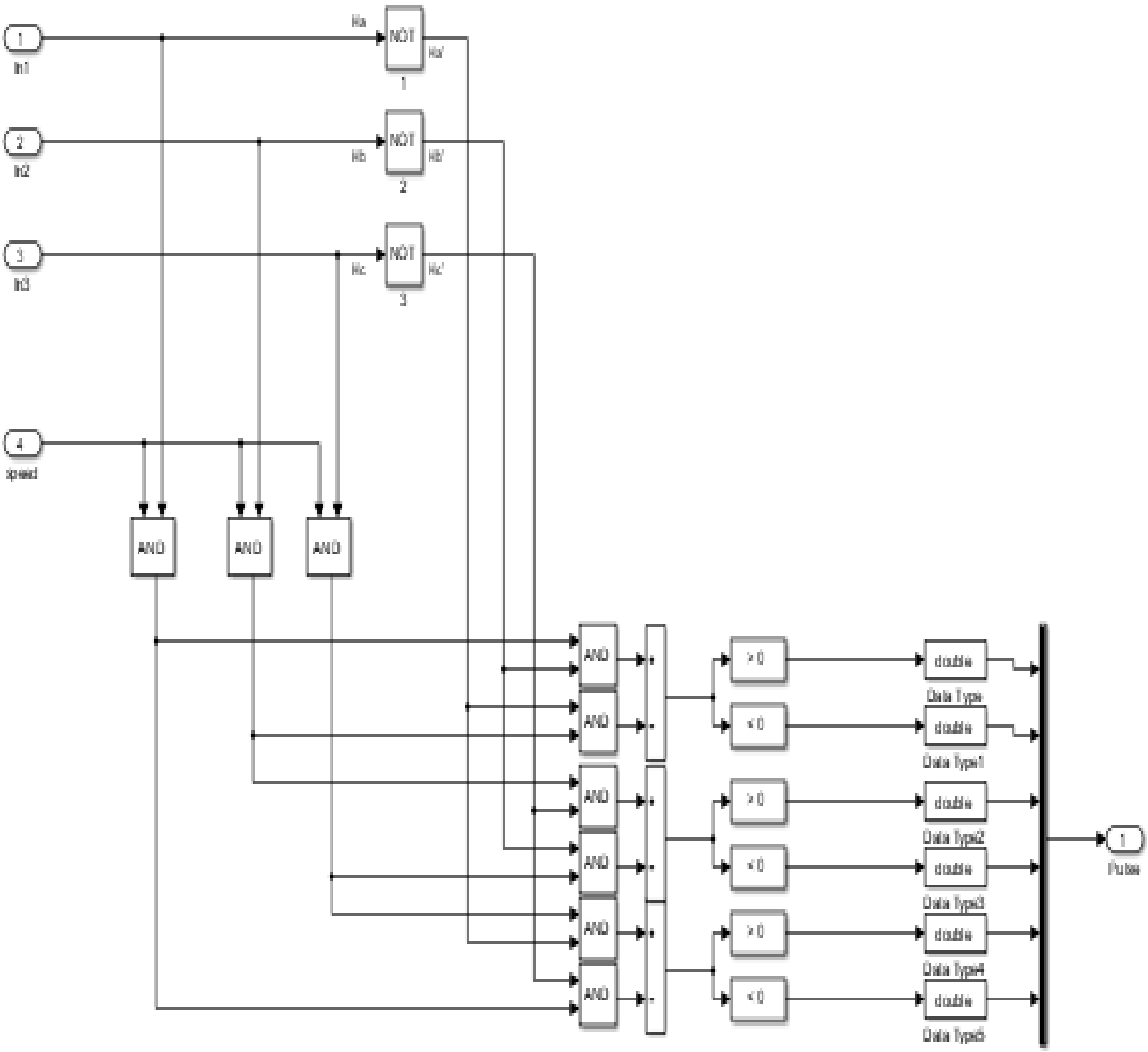

Fig 8 Switches

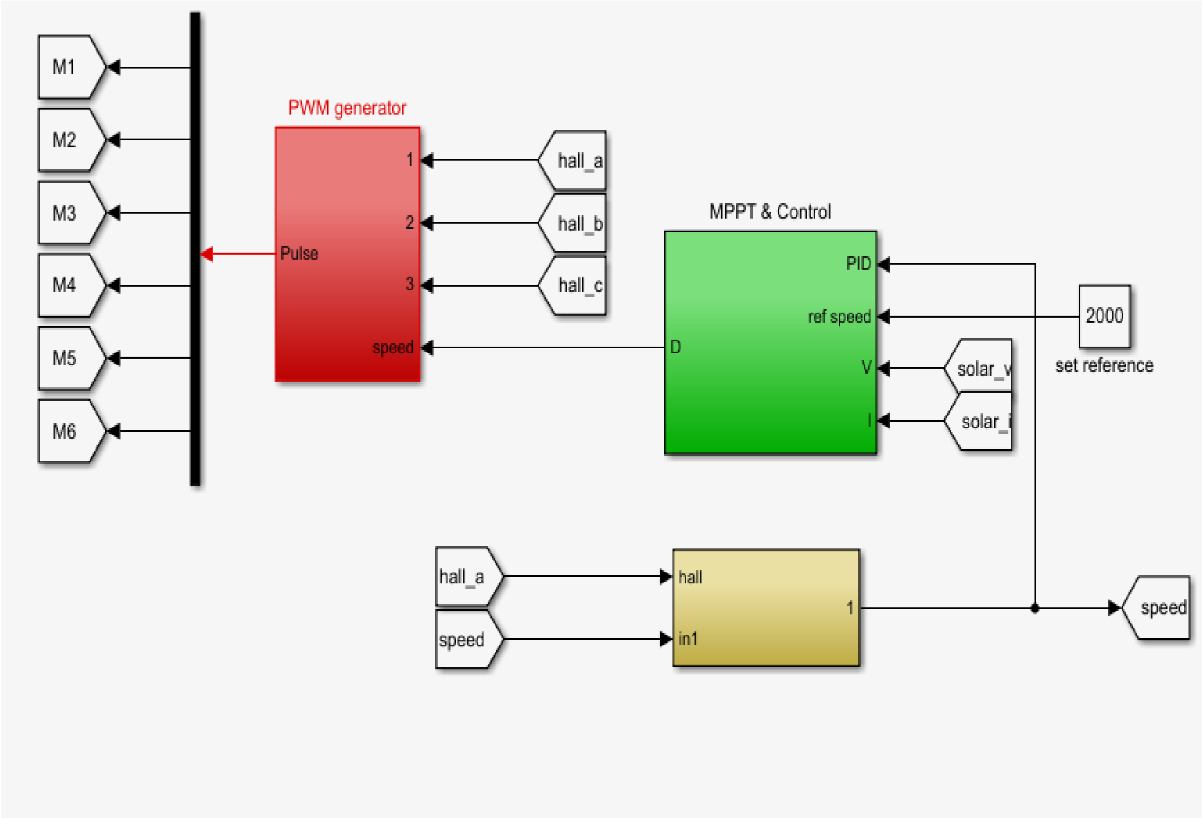

Fig 9 PWM and MPPT Subsystem

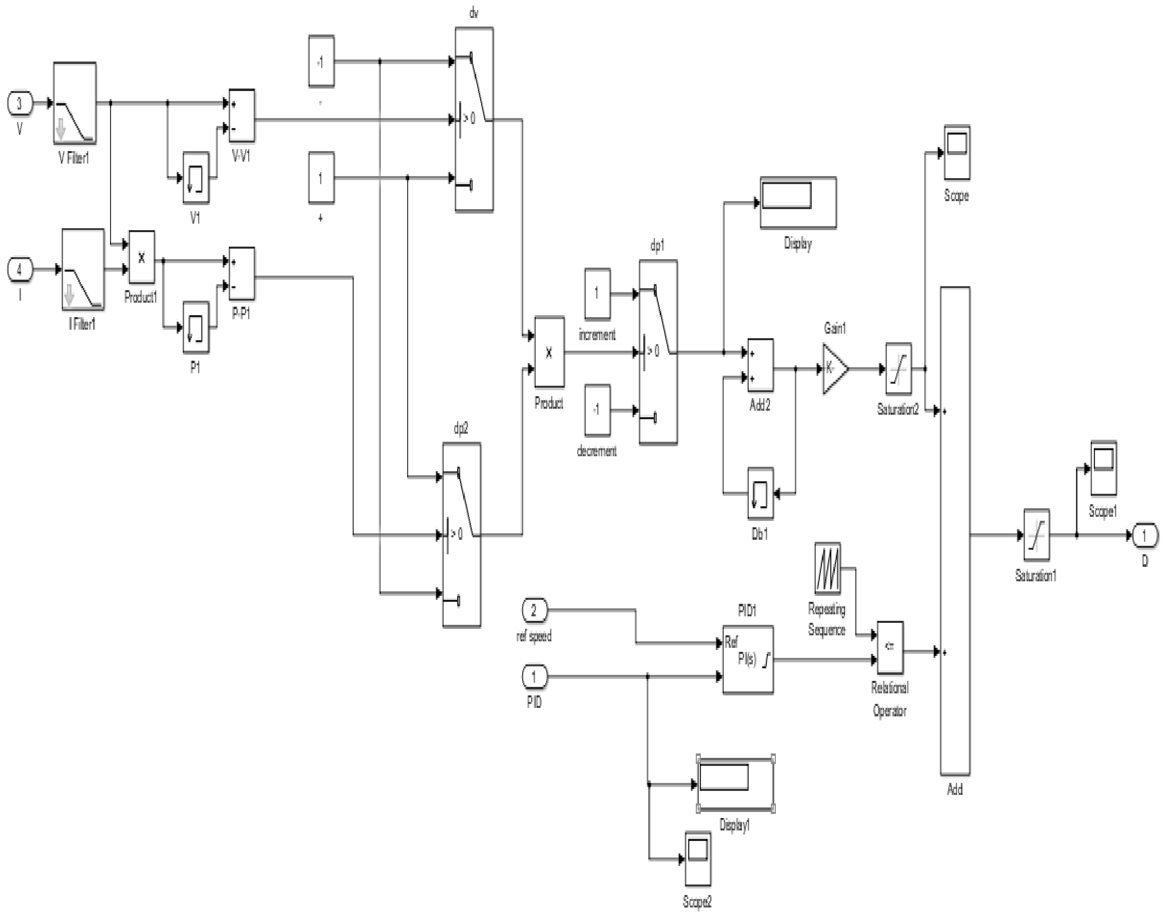

Fig 10 MPPT Subsystem

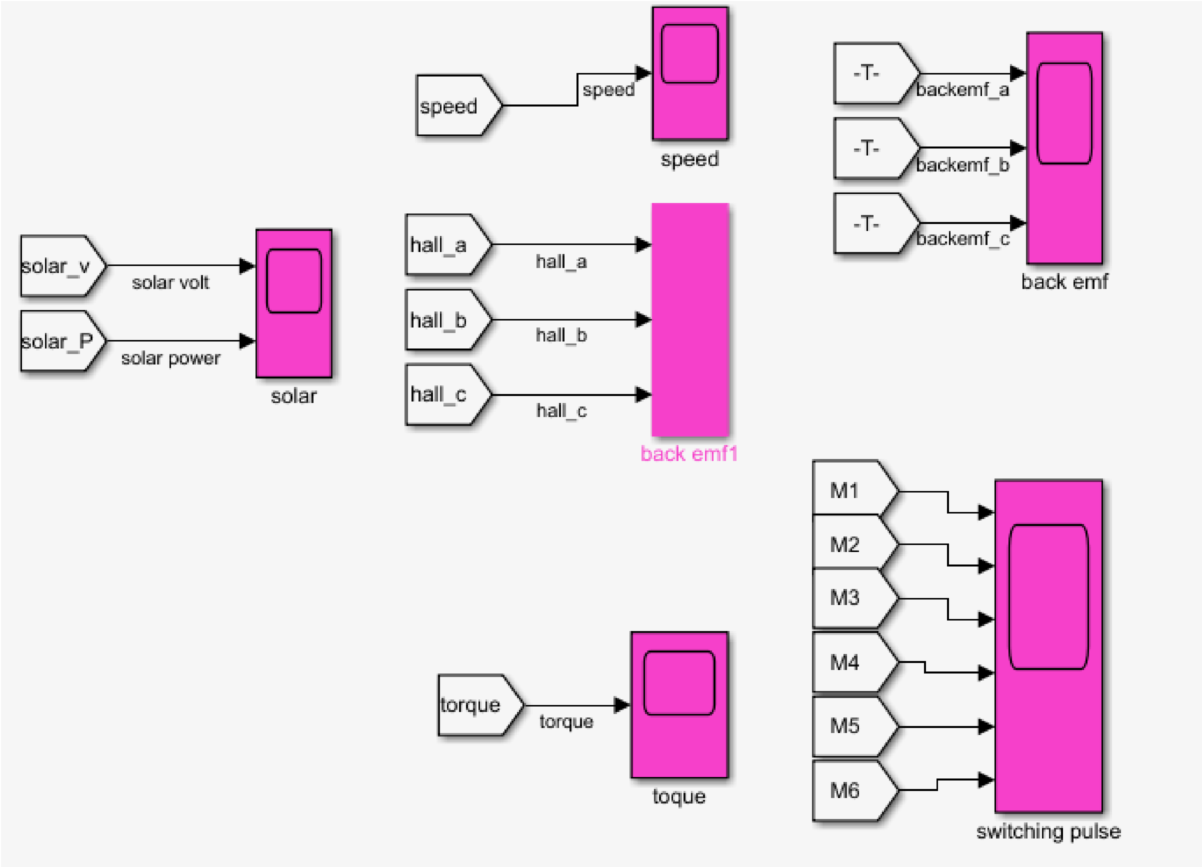

Fig 11 Scoops of Simulink model

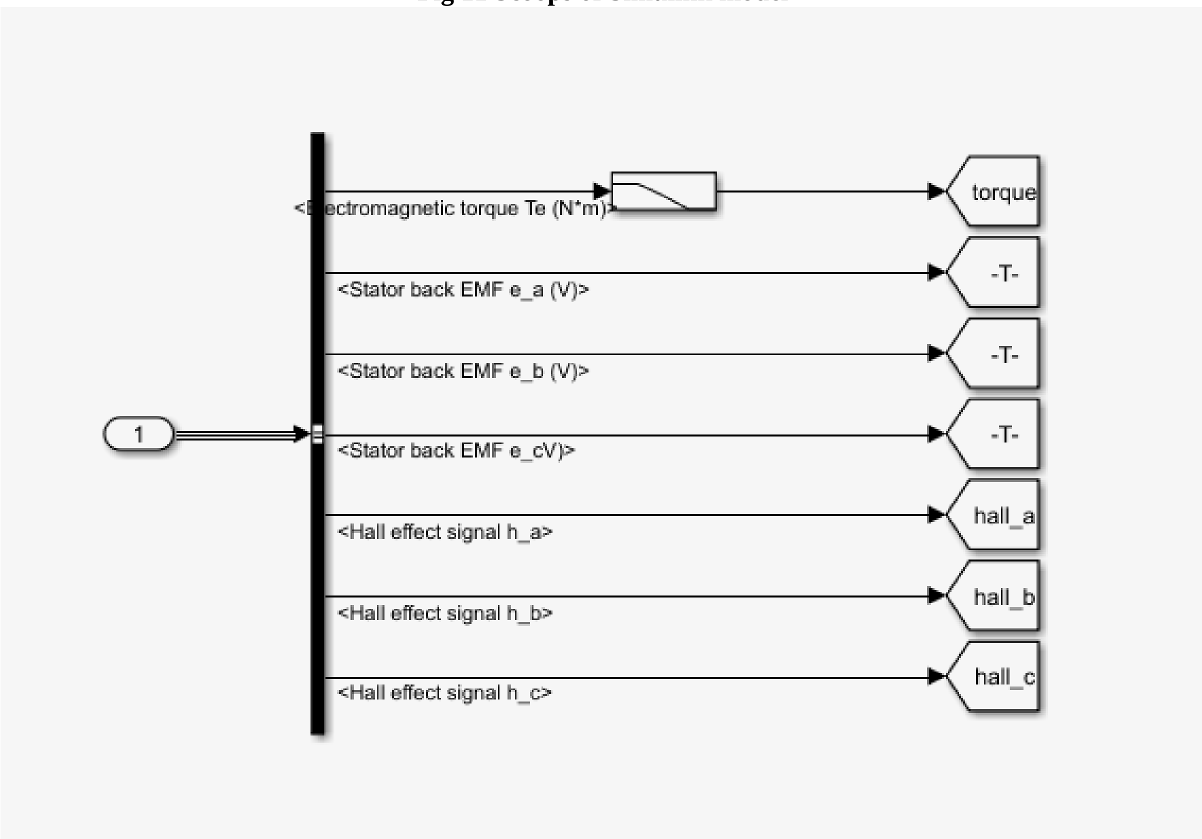

Fig 12 Bus selector

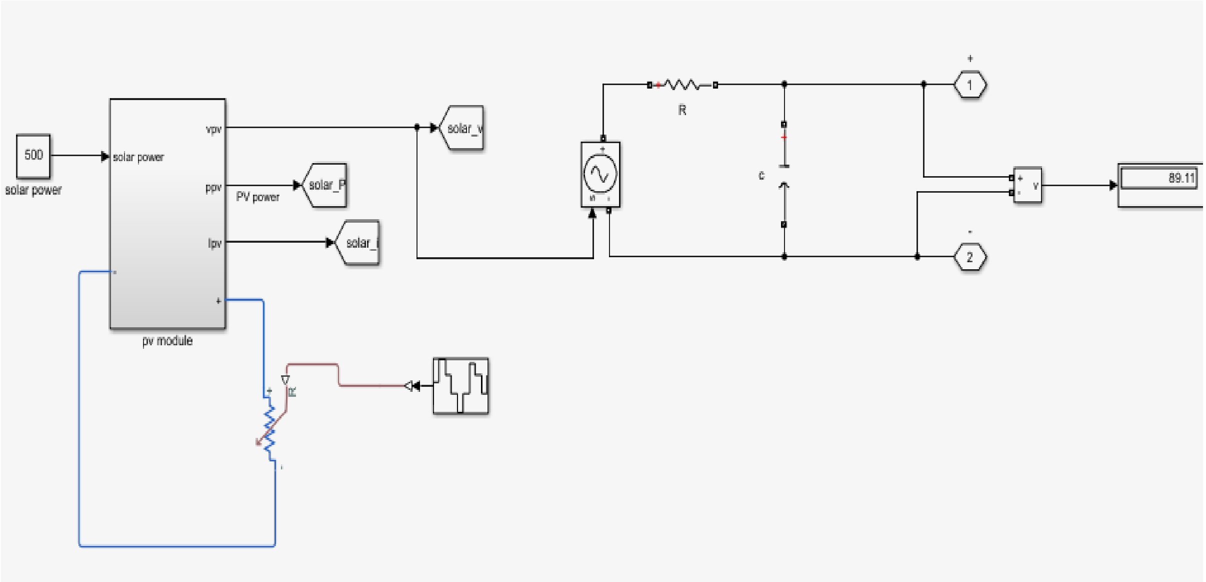

Fig 13 Solar Sub System

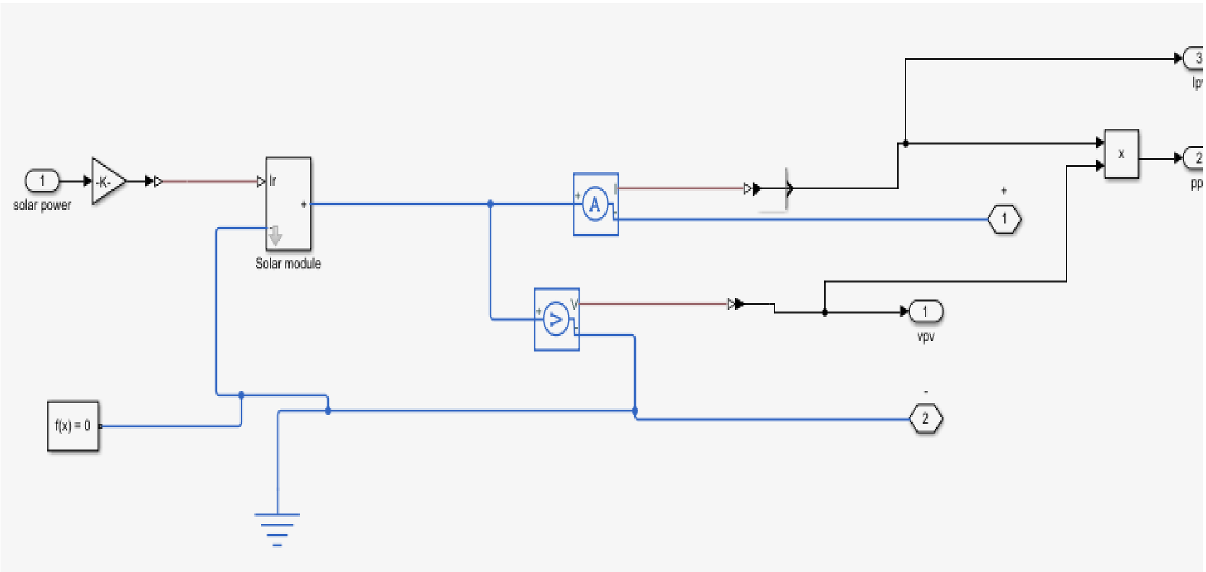

Fig 14 PV module

Volt Battery

There are new issues for electric power networks as car electrification grows and evolves. An increase in the number of electric vehicles (EVs) might lead to network issues such as high bus voltage and congestion on the lines. To get past these issues, we'll need to experiment with electric vehicles. Our ability to anticipate future demand is critical to the success of these systems. However, accurate EV load forecasting methods may be utilised to acquire this information. Several data mining methods and their ability to predict EV loads are being investigated in this research project.

Electric cars are vehicles that use an electric motor instead of an internal combustion engine to power their engines (ICE). The motor is powered by batteries. Batteries need to be recharged on a regular basis by connecting them to a power source (120 V or 240 V). Most people don't realise how long electric automobiles have been around. Joseph Henry invented the first direct current electric motor in 1830. (DC). As far back as 1835, Professor developed the first documented electric automobile in Groningen. Of 1834, Thomas Davenport and Moses Farmer in the United States created the first electric cars. In my youth, there were no rechargeable batteries available (batteries). Before Gaston Plante and Camille Faure's development of the storage battery, an electric automobile was not a viable option (both Frenchmen). Traditional gasoline or LPG-powered automobiles have a far less effect on the environment than ZEVs (LPG). With fewer moving parts, electric vehicles need less maintenance. Engines and exhaust systems don't need oil changes, calibration, or timing. Automobiles fueled by electricity are also more environmentally friendly and quieter than those fuelled by gasoline. (PDF) EVs.

There is a hybrid option for electric automobiles (HEVs). Fuel-burning engines may be used to replenish batteries in a hybrid electric vehicle (HEV), which features an electric drivetrain comparable to that of an electric vehicle. Hybrid electric vehicles profit from the fact that fuel-burning engines perform at their best within a restricted range of operating conditions (speed and load). Engine emissions are lowest when the vehicle is in its most efficient mode of operation.

While driving, the engine of the automobile is subjected to a wider range of speeds and loads than it would be if it were constantly working at its optimal efficiency, resulting in lesser capacity and greater emissions.

Electric propulsion trains, which are more efficient while operating at a single speed, have a lower efficiency loss at changing speeds and loads. Trains powered by electricity. To maximise battery charging efficiency, a HEV may employ its gasoline-powered engine to supplement the vehicle's electric drive system as required. In comparison to a vehicle powered only by a gasoline engine, emissions are significantly reduced, and fuel efficiency may be significantly improved. Consequently, the range of electric vehicles driven only by batteries is extremely limited. Hybrid technology allows for a larger operating window. When in a densely populated or polluted location, a hybrid automobile may operate solely on batteries before switching to its engine. Parallel hybrids and series hybrids are two of the most frequent types of electric vehicles.

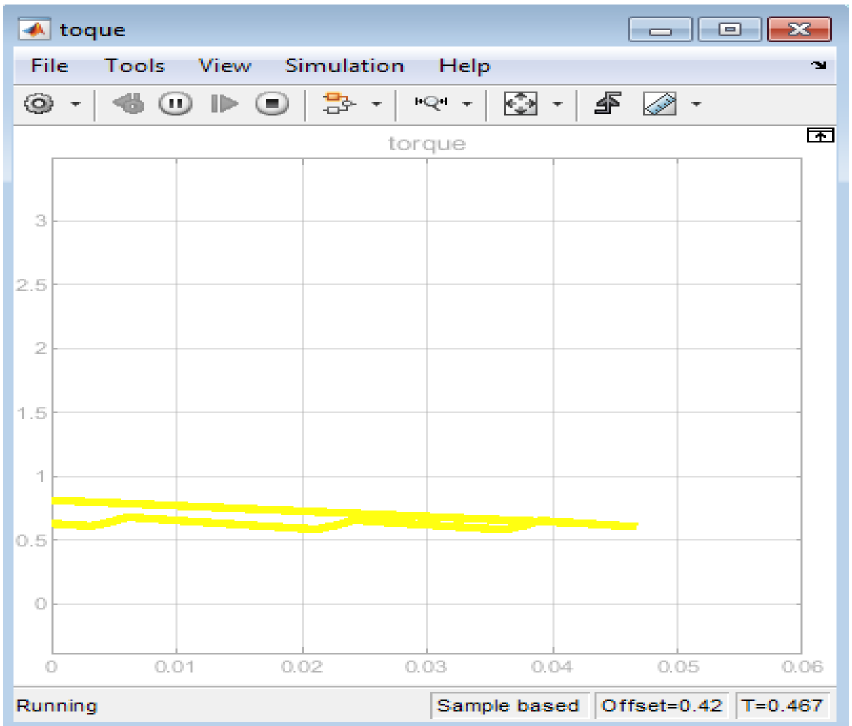

Fig 15 Torque of motor

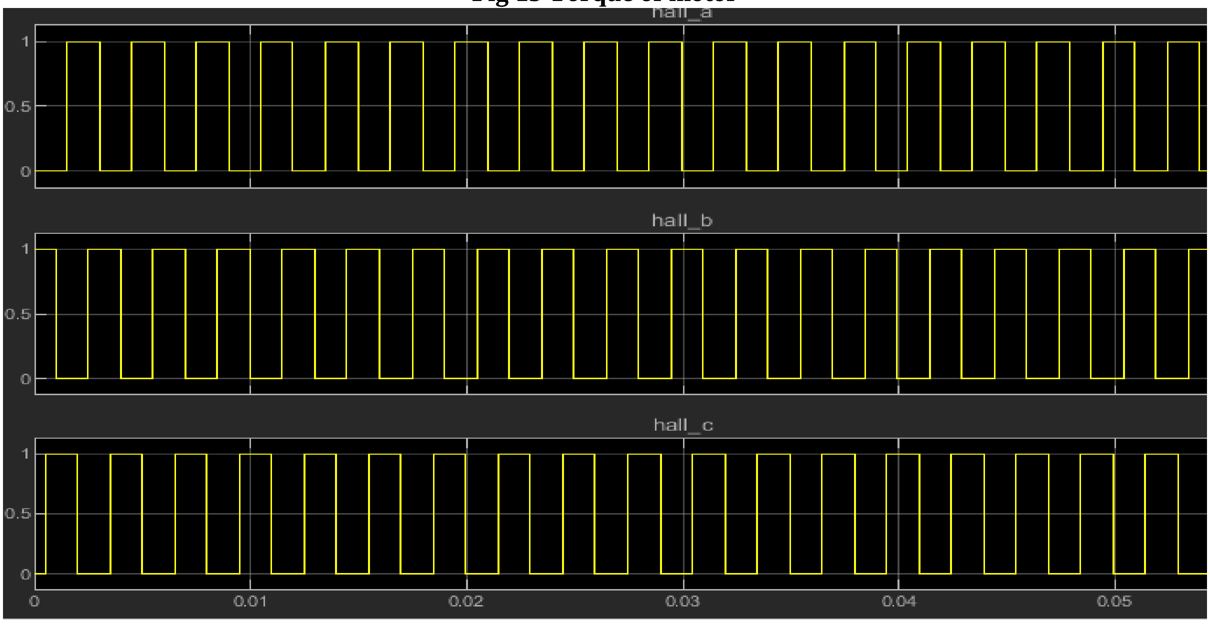

Fig 16 Back EMF Hall _a, Hall_b, Hall_c

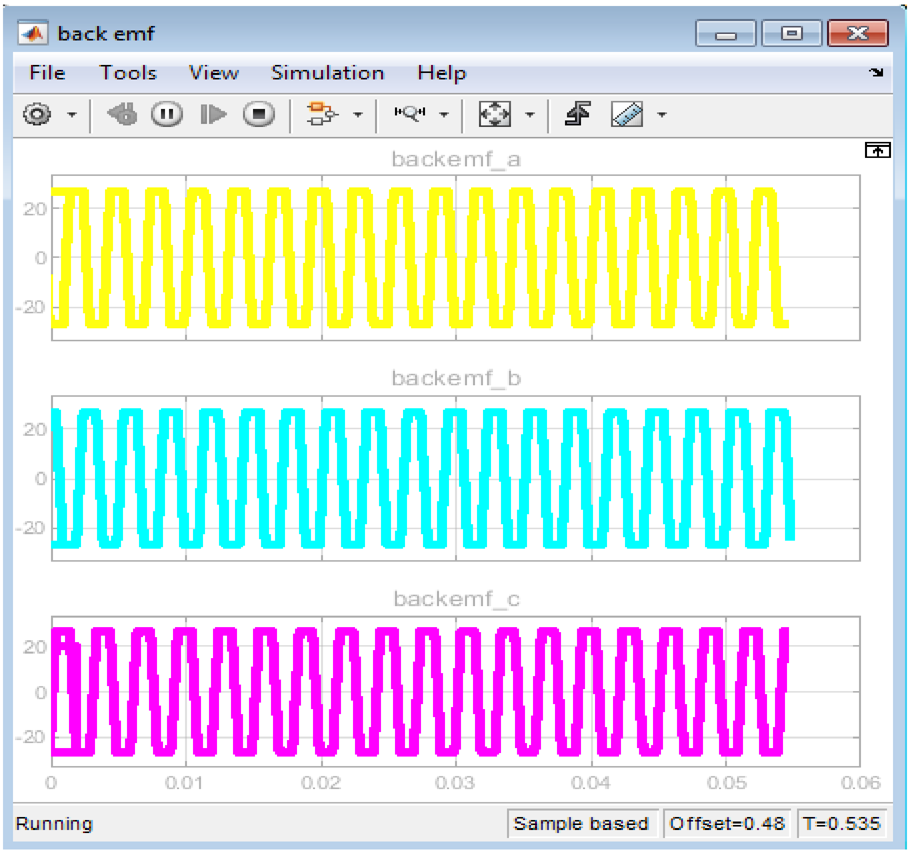

Fig 17 Back EMF_a,b,c sequential pulse

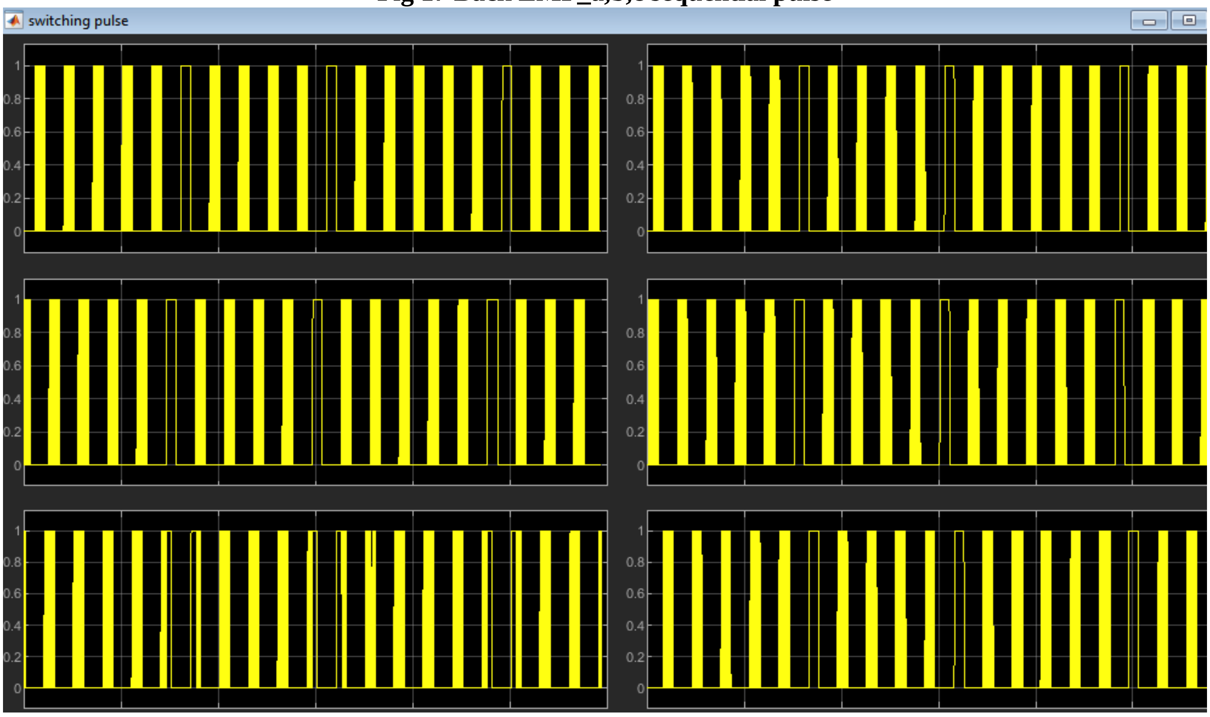

Fig 18 Switching pulse Electric motor

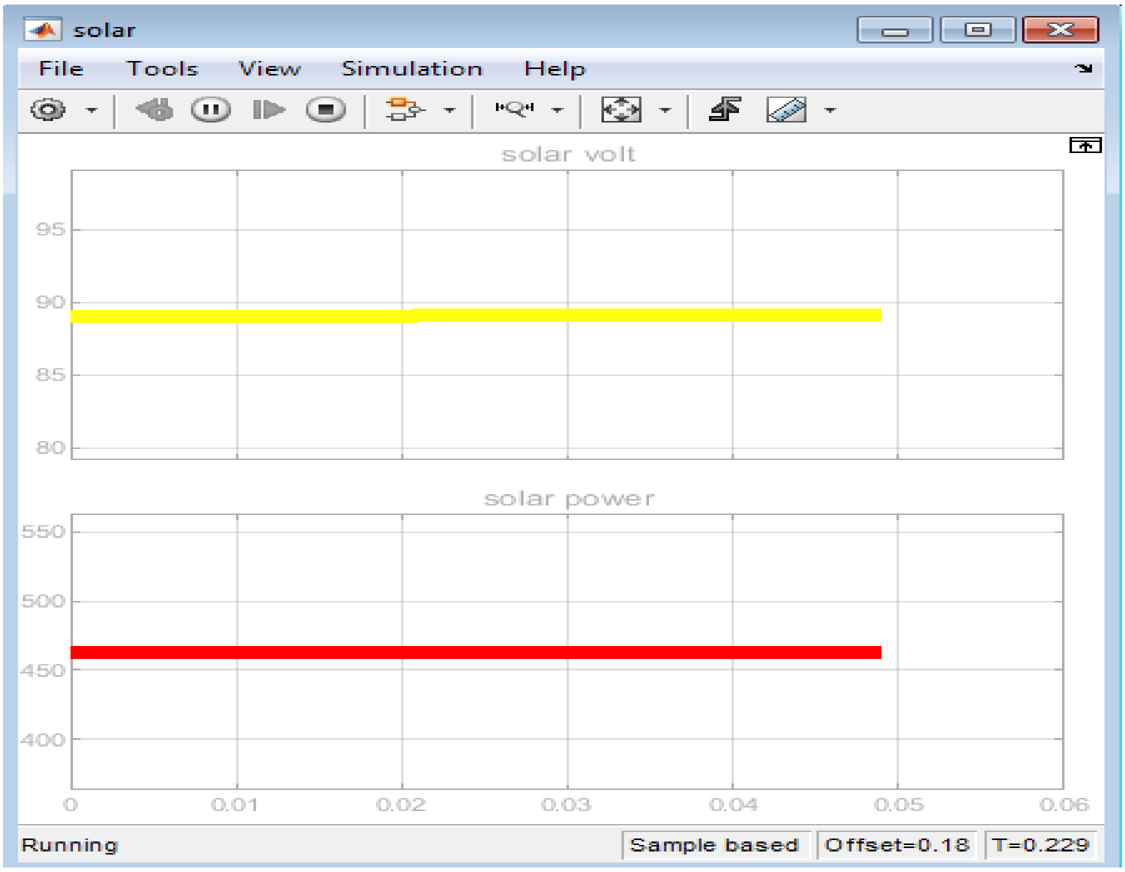

Fig 19 Solar Volt and Solar power

III. Hybrid EVs

A hybrid electric vehicle (HEV) is a kind of hybrid vehicle that combines a conventional internal combustion engine (ICE) system with an electric propulsion system (hybrid vehicle drivetrain) (hybrid vehicle drivetrain). The presence of the electric powertrain is designed to deliver either greater fuel efficiency than a normal car or higher performance. There is a number of HEV kinds and the degree to which each operate as an electric vehicle (EV) also varies. The most prevalent type of HEV is the hybrid electric automobile, but hybrid electric trucks (pickups and tractors), buses, boats and airplanes all exist.

Modern HEVs make use of efficiency-improving technology such as regenerative braking which convert the vehicle's kinetic energy to electric energy, which is stored in a battery or supercapacitor. Some variants of HEV employ an internal combustion engine to operate an electrical generator, which either recharges the vehicle's batteries or directly powers its electric drive motors; this combination is known as a motor–generator. Many HEVs decrease idle emissions by shutting down the engine at idle and restarting it when required; this is known as a start-stop system. A hybrid-electric generates fewer tailpipe emissions than a comparable sized gasoline automobile as the hybrid's gasoline engine is generally smaller than that of a gasoline-powered vehicle. If the engine is not utilized to move the vehicle directly, it may be geared to operate at optimum efficiency, further increasing fuel economy.

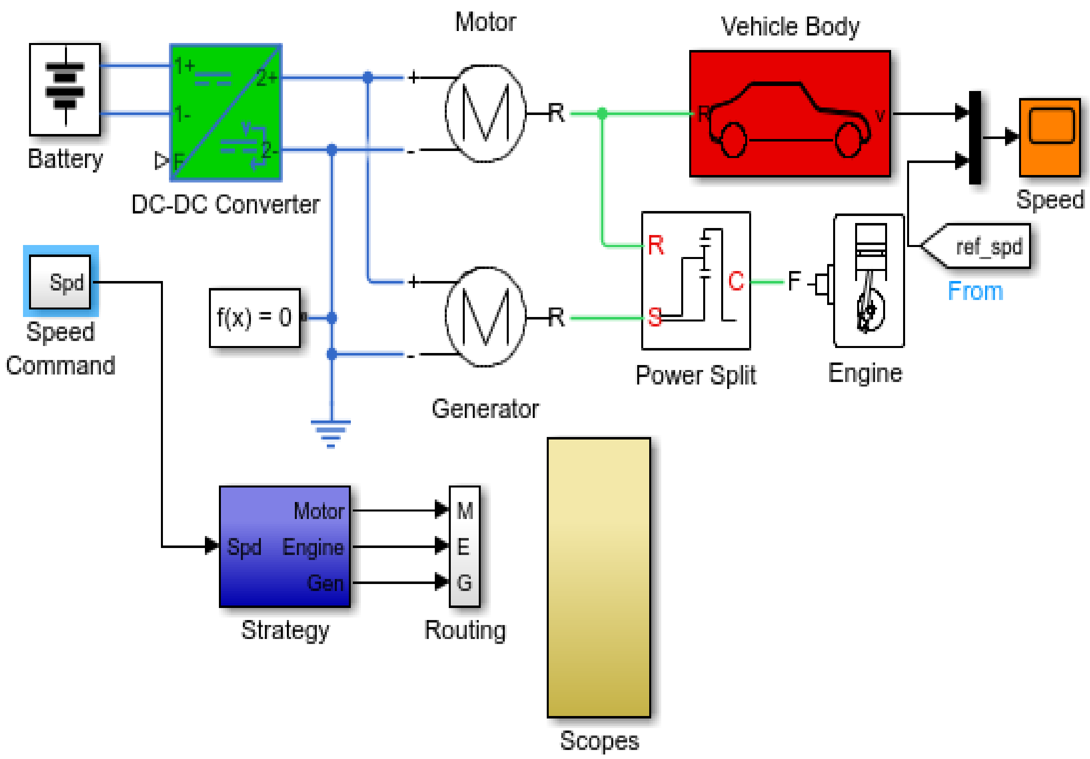

Fig20:- Hybrid Electrical Vehicle

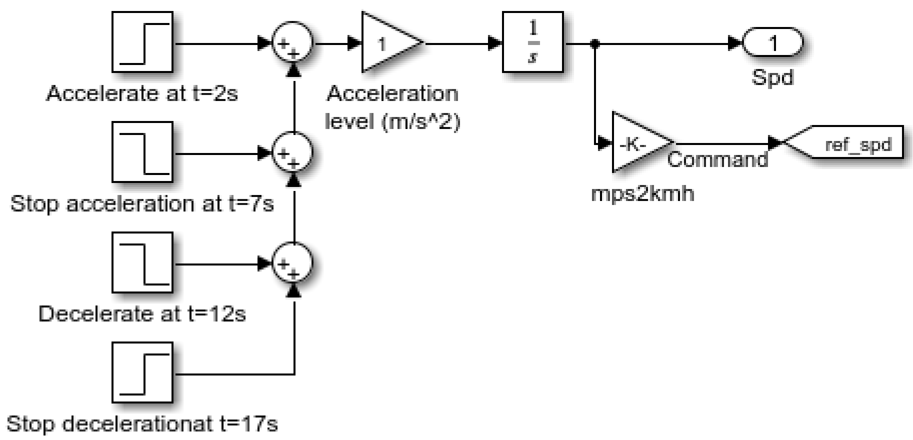

Fig 21 Accelerate of speed

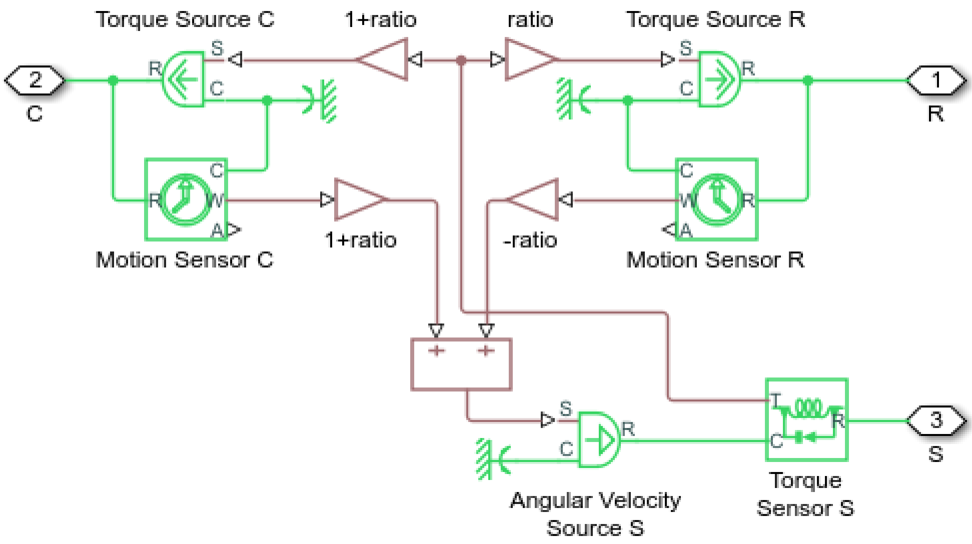

Fig 22 Power Split

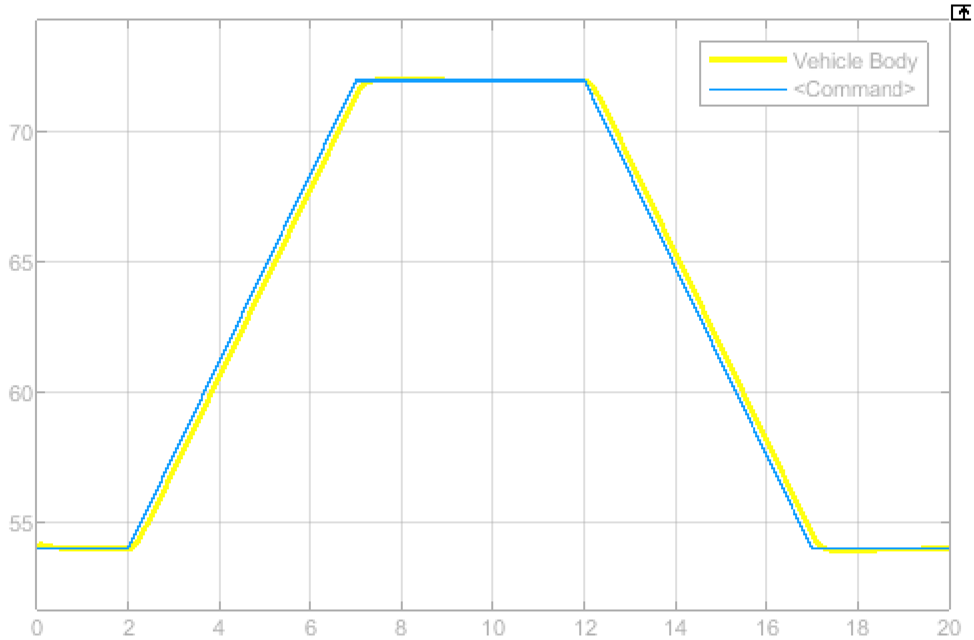

Fig.23 Electrical Vehicle Speed

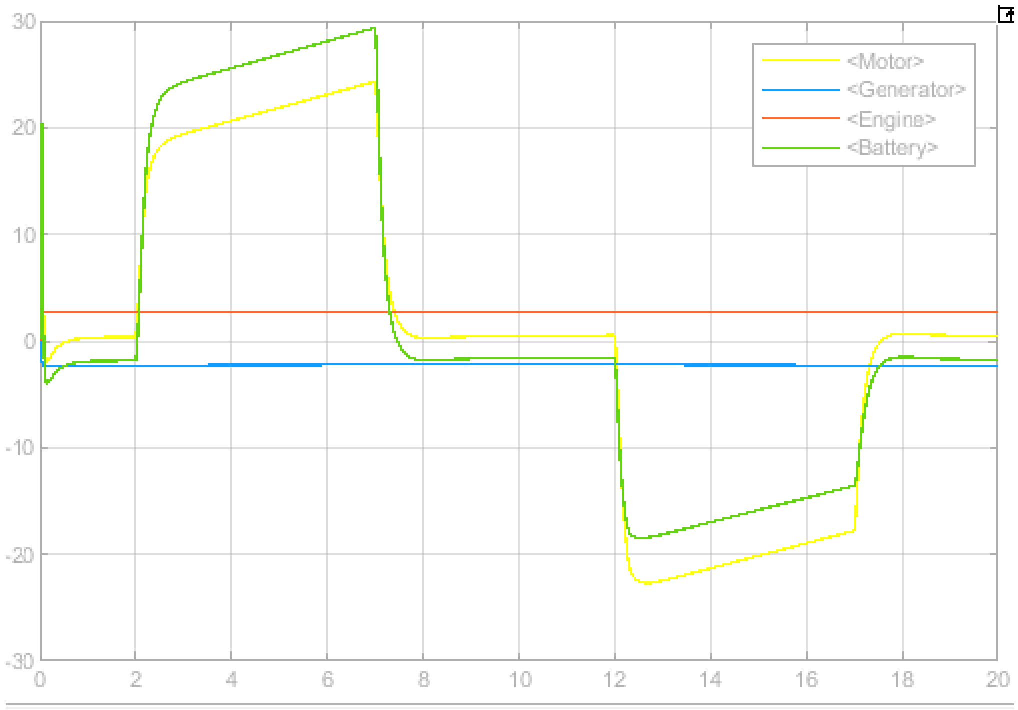

Fig. 23 Power (KW)

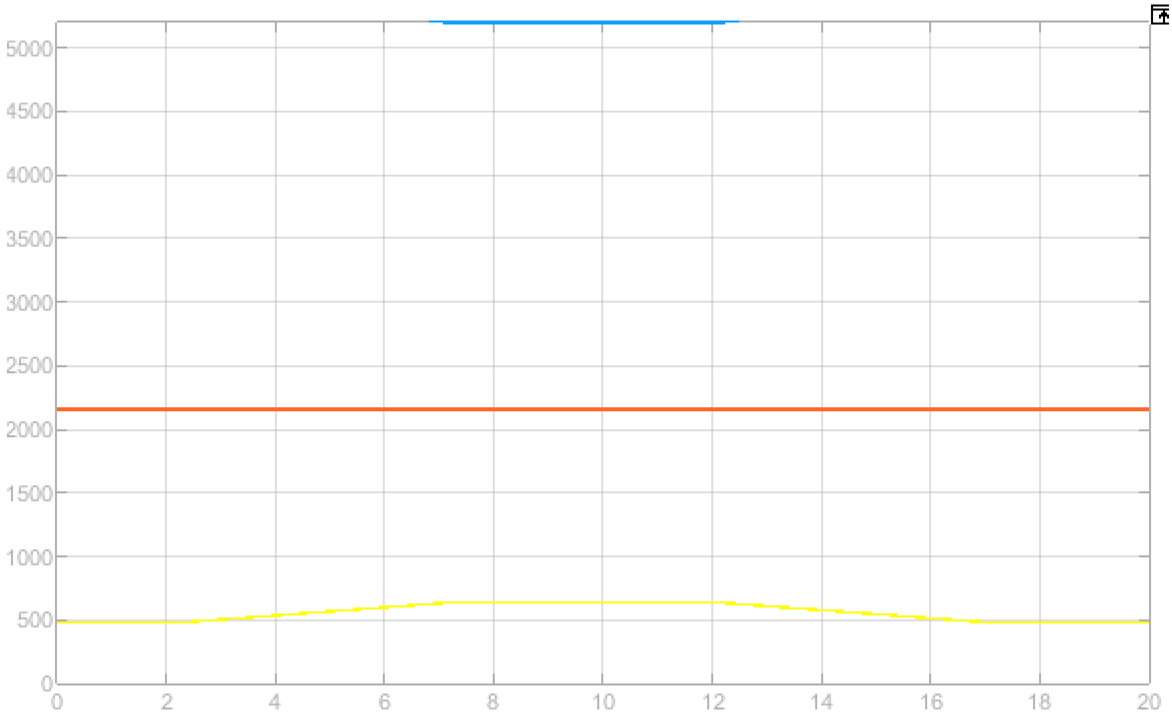

Fig 24 Shaft of speed

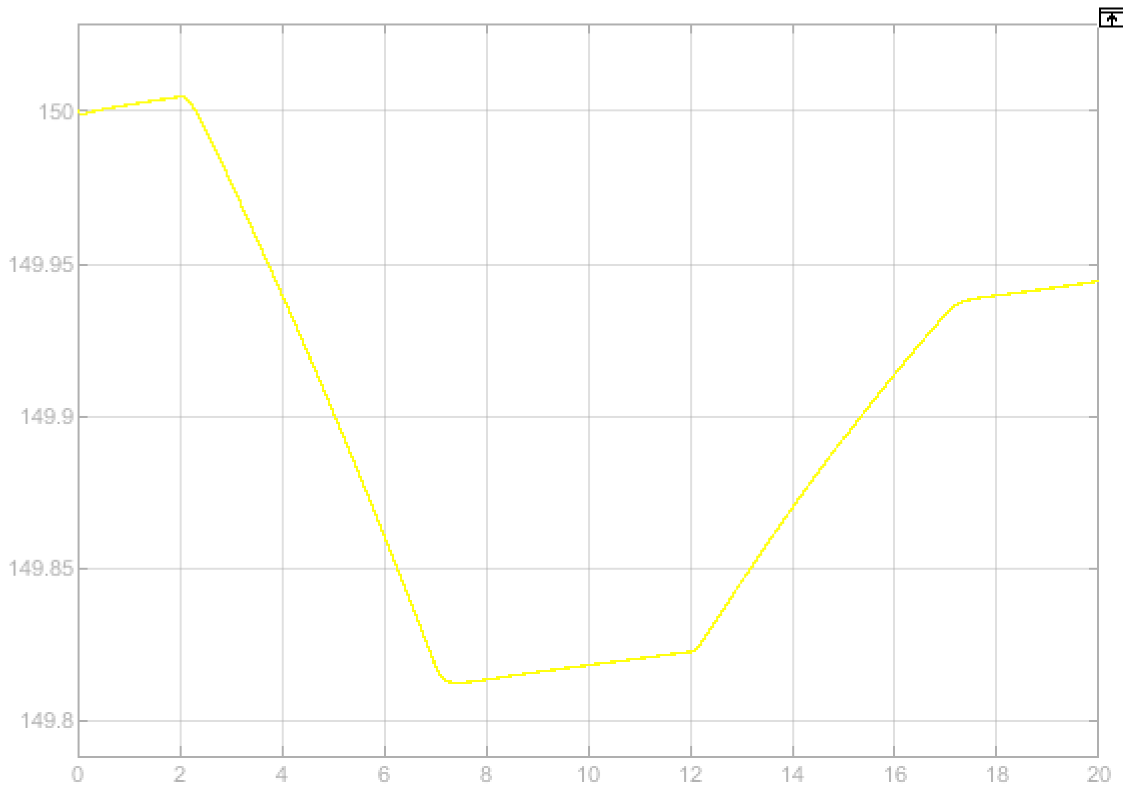

Fig. 25 Battery Charging

IV. CONCLUSION

We came to the conclusion that environmental and economic factors are the driving forces for the rise of electric vehicles. In metropolitan areas, an electric bike would be a more environmentally friendly alternative to a traditional motorcycle, and it would also be one of the cheapest modes of transportation. For point-to-point travel, an electric bike is more convenient. The contract power capacity is reduced by a BLDC motor. The battery management system (BMS) should be utilised to prolong the battery life i.e. health and to maintain the state of charge and also to regulate the temperature of the battery to increase the battery life. Improve battery performance by gathering data on its current level of charge and health.

Electric vehicles' primary energy storage component is its battery, which must be recharged using a battery assisted charging system to prevent the battery from being overcharged. You don't have to spend a lot to go about on an electric bike. People of any age may utilise it for shorter distances. The electric bike's most important characteristic is that it doesn't use fossil fuels, which means it produces no pollution. Secondly, it is pollutant free, environmentally beneficial, and quiet to use. Because it has fewer parts and can be disassembled into smaller ones, its operating costs per kilometre are lower, and as a result, it requires less maintenance. Electric two-wheelers that are both efficient and pleasant have been achieved.

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