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# DESIGN AND IMPLEMENTATION OF ELECTRIC ASSISTED BICYCLE WITH ATTACHED DYNAMO

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## ABSTRACT

***As we all know the fuel prices especially the petrol is rising steadily day by day. Again the pollution due to vehicles in metro cities and urban areas is increasing continuously. To overcome these problems, an effort is being made to search some other alternative sources of energy for the vehicles.***

***An electric bicycle is uses the same designs, geometries, and components as other bicycles, but also includes an added electric motor. This is fueled by a rechargeable battery, which gives riders an extra boost of power and ultimately provides a smoother, more convenient and less strenuous cycling experience. By eliminating many of the obstacles that keep people from cycling obstacles such as headwinds, steep hills, and bike commutes that leave riders tired, messy and sweaty electric bikes help make the freedom, exhilaration and satisfaction of cycling available and accessible to a wide range of potential cycles For many, electric bikes are an attractive alternative to both conventional bicycles and traditional automobiles, providing an environmentally friendly, fun, efficient, and convenient way to travel.***

***As part of dissertation work, the e-bicycle is fitted with a dc hub motor on back axle of a bicycle with power rating of 250W and with a travelling speed of around 25-30kmph. It is provided with a pair of lead acid batteries of 9Ah , the dynamo is attached with the back axle when the wheel is rotating then the dynamo can work. So, that energy will produce , accelerator and motor controller of 24v, 25 amp . There is also a provision for charging of the battery with 220-240V, AC wall outlet supply.***

## INTRODUCTION

Global warming and scarcity of traditional resources are becoming major problems in the current scenario. Due to the economic challenges India is facing in automotive sector the hybrid bicycle [1] market has a huge growth potential. People try to move towards "clean" energies. These facts among others will leverage the electric bicycle industry on the top of the agendas not only in India. Moreover the vision of an electric engine, which supports the muscular strength, became reality. Bicycles with such a supporting electric engine belong to the innovative vehicles, which are wholeheartedly suitable for everyday life. In face of continuous climate discussions and permanent traffic jams, electric bikes have the potential of solving such issues and making a more energy efficient and environment friendly mobility possible. Accordingly a continuous trend towards electric bicycles can be expected simultaneously in whole of India. So it

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becomes very necessary to manufacture the electric cycles so cheaply that the common people in our country can afford to buy it. The currently existing electric scooters are far more costly and due to budgetary constraints a middle class person cannot afford such a locomotive at his place. Along with the development of technologies the theory must be also implemented to design and manufacture a product that can be sold off at a greater frequency, which has a very low production cost and one that is of good quality. In order to implement all the above ideas, we planned to make the design and product in such a manner that it can be competed with the existing "e-Bikes" [9] in the market.

The basic idea is to attach a motor to the cycle for its motion. A motor that is powered by a battery and that can be switched on during difficult terrains and switched off and pedal to get the battery re-charged during motion in a flat terrain. The idea came into our mind as different stages of project planning, firstly we wanted to implement a simple moving system so the projection of cycle as a system came into our mind, and second stage was adding a necessarily useful component into it that can be beneficial in the future and for common people, falling into the current trend was that of hybrid system so we ended up planning to assemble a motor unit into the cycle drive. There were many issues that came up while making such a system major one of them being the power of the motor to be used, since no such previous systems were made we could not predict the type of motor which we should go for. Second thing being the weight factor, the addition of extra weight on to the system, which can cause discomfort to the rider while normal pedaling. Third was the type of battery to be used, we should go for a battery that has longer life, economically viable, and also has less maintenance issues. Fourth issue was that self-recharging a battery with a motor alternator unit that too with the simple cranking motion of the cycle was not viable, we had to utilize a mechanism that can come in handy here and that was by using the flywheel rotation technique.

## BLDC MOTOR

The BLDC motor is widely used in applications including appliances, automotive, aerospace, consumer, medical, automated industrial equipment and instrumentation.

The BLDC motor is electrically commutated by power switches instead of brushes. Compared with a brushed DC motor or an induction motor, the BLDC motor has many advantages:

- Higher efficiency and reliability
- Lower acoustic noise
- Smaller and lighter
- Greater dynamic response
- Better speed versus torque characteristics
- Higher speed range
- Longer life

This document initially provides a general overview to familiarize the reader with motor control fundamentals, terms and concepts, and applications. The latter portion of this document provides detailed descriptions of motor structure, working principle, characteristics and control methods.

### Stator

There are three classifications of the BLDC motor: single-phase, two-phase and three-phase. This discussion assumes that the stator for each type has the same number of winding. The single-phase and three-phase motors are the most widely used. Figure 5 shows the simplified cross section of a single-phase and a three-phase BLDC motor. The rotor has permanent magnets to form 2 magnetic pole pairs, and surrounds the stator, which has the winding.

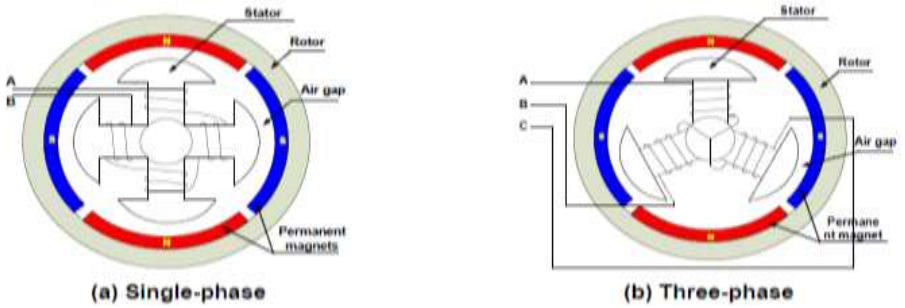


**Fig.1 Simplified BLDC motor**

A single-phase motor has one stator winding—wound either clockwise or counter-clockwise along each arm of the stator to produce four magnetic poles as shown in Figure 5(a). By comparison, a three- phase motor has three winding as shown in Figure 5(b). Each phase turns on sequentially to make the rotor revolve.

There are two types of stator winding: trapezoidal and sinusoidal, which refers to the shape of the back electromotive force (BEMF) signal. The

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shape of the BEMF is determined by different coil interconnections and the distance of the air gap. In addition to the BEMF, the phase current also follows a trapezoidal and sinusoidal shape. A sinusoidal motor produces smoother electromagnetic torque than a trapezoidal motor, though at a higher cost due to their use of extra copper winding. A BLDC motor uses a simplified structure with trapezoidal stator winding.

**Rotor**

A rotor consists of a shaft and a hub with permanent magnets arranged to form between two to eight pole pairs that alternate between north and south poles. Figure 6 shows cross sections of three kinds of magnets arrangements in a rotor.

There are multiple magnet materials, such as ferrous mixtures and rare-earth alloys. Ferrite magnets are traditional and relatively inexpensive, though rare-earth alloy magnets are becoming increasingly popular because of their high magnetic density. The higher density helps to shrink rotors while maintaining high relative torque when compared to similar ferrite magnets.

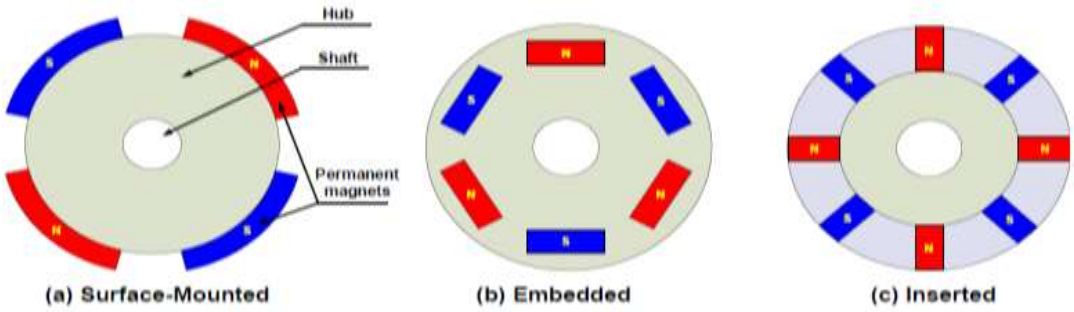


**Fig.2 Rotor magnets cross sections**

## BATTERY


**Battery type** : 12 volts 9 Amps
**Minimum quality** : 2 pieces
**Capacity(Ah)** : 9000Ah

## CONSOLE

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The most basic functionality of the console is to display how much battery power is left. Otherwise, how would you know how many more kilometers are available for you to enjoy the electric assistance before you will need to go back to the stone age and start pedaling without any assistance.

## THROTTLE

The throttle mode is similar to how a motorcycle or scooter operates. When the throttle is engaged the motor provides power and propels you and the bike forward.

## DYNAMO

A cycle dynamo is an electric motor in which mechanical energy is converted into electrical energy works on the principal of faraday laws of electromagnetic induction.

## PARTS OF DYNAMO

1. DC motor
2. Adopter
3. Light
4. Rotating edge knob

## DC MOTOR

A **DC motor** is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field winding. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

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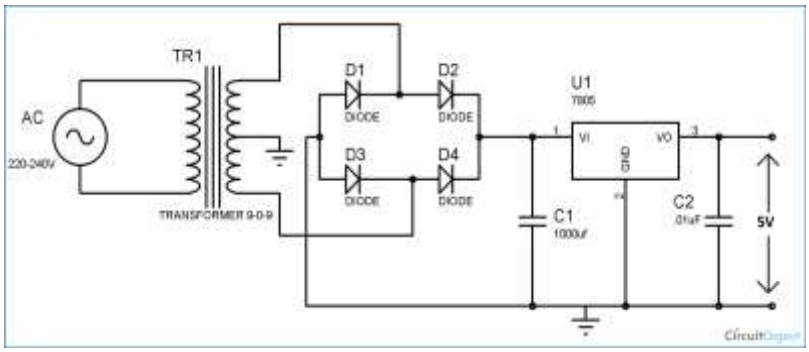
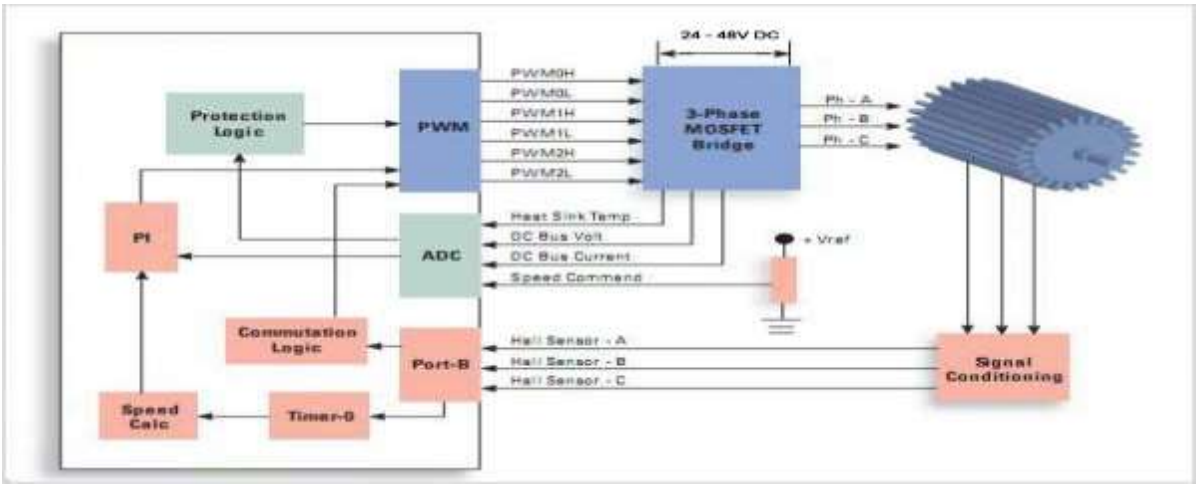
## ADAPTER




An **adapter** is a physical device that allows one hardware or **electronic** interface to be adapted (accommodated without loss of function) to another hardware or **electronic** interface. In a computer, an **adapter** is often built into a card that can be inserted into a slot on the computer's motherboard.

An AC-to-DC power supply adapts electricity from household mains voltage (either 120 or 230 volts AC) to low-voltage DC suitable for powering consumer electronics. Small, detached power supplies for consumer electronics are called *AC adapters*, or variously *power bricks*, *wall warts*, or *chargers*.

## CONTROLLER




Typically includes detection, A/D conversion, and output comparison components. For a low-end system, the ultra-low power micro controller is available while the C2000 digital signal processor can be used for a complex system with more features.

## PWM INVERTER

Nowadays most of the inverters available in the market utilizes the PWM(Pulse Width Modulation) technology.The inverters based on PWM technology are superior in many factors compared to other inverters designed using conventional technologies. The PWM based inverter generally use MOSFETs in the output switching stage.In such cases the inverters are generally termed as PWM MOSFET inverters.The inverters based on PWM technology has a lot of protection and control circuits compared to the traditional inverters.

PWM or Pulse width Modulation is used to keep the output voltage of the inverter at the rated voltage(110V AC / 220V AC) (depending on the country) irrespective of the output load.In a conventional inverter the output voltage changes according to the changes in the load.To nullify effect caused by the changing loads,the PWM inverter correct the output voltage according to the value of the load connected at the output.This is accomplished by changing the width of the switching frequency generated by the oscillator section. The AC voltage at the output depend on the width of the switching pulse.The process is achieved by feed backing a part of the inverter output to the PWM controller section (PWM controller IC).Based on this feedback voltage the PWM controller will make necessary corrections

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in the pulse width of the switching pulse generated at oscillator section.This change in the pulse width of the switching pulse will cancel the changes in the output voltage and the inverter output will stay constant irrespective of the load variations.

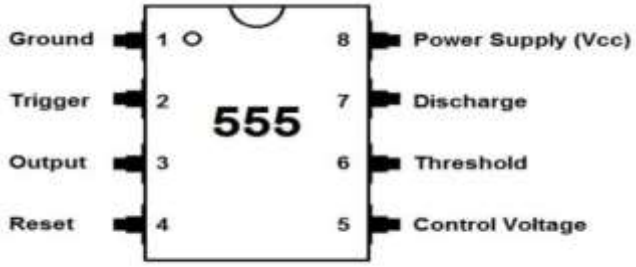
## CONVERTER

In electronics, an analog-to-digital converter (ADC, A/D, or A-to-D) is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. Typically the digital output is a two's complement binary number that is proportional to the input, but there are other possibilities.

There are several ADC architectures. Due to the complexity and the need for precisely matched components, all but the most specialized ADCs are implemented as integrated circuits (ICs). These typically take the form of metal–oxide–semiconductor (MOS) mixed-signal integrated circuit chips that integrate both analog and digital circuits.

A digital-to-analog converter (DAC) performs the reverse function; it converts a digital signal into an analog signal.

## 555 TIMER




Pin Description of 555 Timer

555timer is an integrated circuit which contains 8 pins and the description of each pin is given in the pin description. This timer is used in the pulse generation, oscillators and in different timer circuits. The 555timer produces time delays in the oscillator, also in flip flop elements and the 555 timer contains three modes which are A stable, Bi stable and Mono stable modes. The following diagram shows the 555 timer integrated circuit.

## MOSFET

A MOSFET driver IC is a high-gain amplifier that uses a low-voltage input to switch on/off discrete power MOSFETS in high-voltage applications. MOSFET driver ICs are commonly used to switch MOSFETS in a half-bridge circuit. The MOSFET driver IC controls switch timing to ensure that only one transistor conducts at a time, preventing potentially damaging shoot-through current.

In applications where multiple power supplies are connected in parallel (e.g., backup power supplies), ORing Schottky diodes are commonly used for protection. However, if a large current is required, the diode forward-voltage drop causes significant power loss, which means a heat sink is required. For these applications,it is better to use a MOSFET instead of a Schottky diode. MOSFETS, which have a lower on-resistance than Schottky diodes, produce less heat and therefore do not need heatsinks, making the overall solution size smaller.

ORing MOSFET controllers provide the control logic required for this type of circuit. Single and dual drivers, along with secondary-side synchronous drivers, provide even greater efficiency for isolated designs. We provide evaluation kits and reference designs for quick prototyping and design verification. Industry-leading features of our MOSFET driver ICs include fast delay times, small package sizes, high efficiency, and better reliability.

## BREAKING SYSTEM

## MECHANICAL BREAKING SYSTEM

A **bicycle brake** reduces the speed of a bicycle or prevents it from moving. The three main types are: rim brakes, disc brakes, and drum brakes. There have been various types of brakes used throughout history, and several are still in use today.Most bicycle brake systems consist of three main components: a mechanism for the rider to apply the brakes, such as brake levers or pedals; a mechanism for transmitting that signal,such as Bowden cables, hydraulic hoses, rods, or the bicycle chain; and the brake mechanism itself, a caliper or drum, to press two or more surfaces together in order to convert, via friction, kinetic energy of the bike and rider into thermal energy to be dissipated.

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## ELECTRICAL BREAKING SYSTEM

The electric current controlling the brake through the electromagnet is provided from a brake controller which provides the control current from the towing vehicle. There are different types of brake controllers on the market, each with their own advantages and disadvantages.The current controlling the brakes from the towing vehicle is originating in the battery/alternator of the towing vehicle via the brake controller and then transferred via wiring through the electric brake pin in the trailer connector through the trailer wiring to the electromagnet and back through the trailer wiring to the trailer connector and to the towing vehicle chassis/frame through the ground pin in the trailer connector.To minimize interference between vehicle lighting and brakes the circuits shall be as separated as possible.

## CONCLUSION

The issues associated with electric bicycles may be addressed by custom-designed drives that are most efficient over a given operating cycle. These include city bicycles, hill bicycles, distance bicycle, and speed bicycles.

The results of the studies listed here can serve as a platform to improve electric bicycle performance if new drive systems are designed around key parameters that will results in improvement of the system performance. Furthermore, they can be used for comparison of existing drives in a systematical, comprehensive, and technical way.

It is suitable for both country and city roads, that are made of cement, asphalt or mud. This bicycle is cheaper, simpler in construction& can be widely used for short distance travelling especially by school children, college students, office goers, villagers, postman etc. It is very much suitable for young, aged, handicap people and caters the need of economically poor class of society.

It can be operated throughout the year free of cost .the most important feature of this bicycle is that it does not consume valuable fossil fuels thereby saving crore of foreign currencies. It is eco friendly & pollution free, as it does not have any emissions. Moreover it is noiseless and can be recharged with the AC adapter in case of emergency. The operating cost per kilometer is minimal, around Rs.0.70/km. It can be driven by manual pedaling in case of any problem with the charging system. It has fewer components. Can be easily mounted or dismounted, thus needs less maintenance

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