



Electro Mechanical Bicycle

Mr. Suraj Khanke¹, Mr. Rahul Upare², Miss. Mayuri Kurve³, Mr. Shubham Jaisingpure⁴

Student, Department of Mechanical Engineering, J.D.I.E.T, Yavatmal, M.S, India^{1,2,3,4}

Abstract: The Electric Bicycle System is a systems project that incorporates three different parts like 12 volt battery, alternator, DC motor. DC motor which is used to power an electric hub motor runs a bicycle. The purpose of the project is to show that it is possible and relatively simple, to build an electric bicycle by oneself. This project can be broken down into three separate categories: the lithium-ion battery, the alternator, the motor, and the motor controller. Each of these will be built upon and improved further by future students, one category at a time. The hope is that this design can become very efficient, cost-effective, and one day mass-produced, especially in developing countries where automotive transportation is an impossibility.

Keywords: Bicycle, Alternator, Battery, DC Motor, Speed, Weight, Torque, Free Wheel.

1. INTRODUCTION

When thinking of possible senior projects, we all decided that we wanted to do something that would somehow be beneficial to the planet. we decided that the electric bicycle would be the best fit. The electric bicycle offers a cleaner alternative to travel short-to-moderate distances rather than driving a gasoline-powered car. In recent years, the United States has increasingly encouraged a cleaner environment and less dependence on foreign oil. The price of crude oil has increased significantly over the past few years and there seems to be no turning back. The environment has also been more of a focus throughout the world in the past few years, and it seems that cleaner alternatives have been steadily on the rise with no end in sight. The electric bicycle is a project that can promote both cleaner technology as well as a lesser dependence on oil. It will run on clean electric power with the ability to recharge the battery separate ways: through by generating power through the pedals of the bicycle with the help of alternator. An extra benefit to building the electric bicycle is that it can also show the general public how much cheaper it would be to convert their regular bicycle into an electric bicycle rather than driving solely in their gas-powered vehicles. The greater importance of the environment in the world leads to an opportunity for students in our position. With the economy trying to get out of one of the worst depressions of the century, there are numerous opportunities for us to help out. This is our opportunity to contribute a greener and more efficient planet.

2. WORKING OF ELECTRO-MECHANICAL BICYCLE

The electro-mechanical bicycle basically works on two principle i.e newtons third law of motion and faradays law of electromagnetic induction.

According to newtons third law of motion:

Newton's Third Law – Moving Yourself

● For a system is to propel itself forward:

- The system must have a forward external force on it
- Newton's Third Law: A forward external force can be created by pushing backward on something else

According to Faraday's law of electromagnetic induction:

That a voltage is induced in a circuit whenever relative motion exists between a conductor and a magnetic field and that the magnetic of this voltage is proportional to the rate of change of the flux.

3. LIERATURE REVIEW

HENRY MUNSUN, a citizen of the United state, residing at Forsyth , in the country of rosebud and Montana ,have invented new and useful improvement in tater bicycle.

This invention relates to bicycles and the object of the invention is to provide a device of this character which can travel on both land with these and other objects in view which will appear as the description processes , the invention resides in the novel construction and arrangement of parts hereinafter fully described and claimed.

WHAT WAS NEW IN IT?

In a device for the purpose set third , the combination with a bicycle having the , battery , DC motor , alternator . this component are related to each other . The battery are fixed in carrier which are connected to DC motor .The DC motor are situated rear wheel and mounted hub shaft with the help of iron rod with bolt. the DC motor are freewheel are mounted on shaft which meshed with bicycle freewheel by the help of chain. This setup are fixed in lift side of bicycle. Another the right side of bicycle are alternator fixed. The alternator is the device which produces the DC current. This current are supplied to battery by the wire connection. The alternator are situated on rear wheel middle position with the help of iron rod



arrangement. The alternator shaft are joined or meshed with freewheel. This freewheel are connected with bicycle freewheel. This is the cyclic arrangement of electromechanical bicycle.



Fig. 1. electromechanical bicycle

4. BICYCLE

The most popular bicycle model and most popular vehicle of any kind in the world is the Chinese flying pigeon with some 500 million in service. A bicycle often called a bike , is a human –powered ,pedal-driven , single –trak vehicle , having two wheel attached to a frame , one behind the other . Abicycle rider is called acyclist, or bicyclist. Bicycle were introduced in 19th century in Europe and now number more than a billion world wide, twice as many as automobiles. They are the principal means of transportation in many regions. They also provide popular from of recreation and have been adopted for use as childrens toys, general fitness military and police application, carrier service and bicycle racing.

The basic shape and configuration of a typical upright, or safety bicycle , as change little since the first chain driven model was developed around 1885. But many detailed have been improve especially since the advent of modern material and computer aided design .These have allowed for proliferation of specialized design fo many types of cycling. The bicycle invention has had and enormous effect on society, both in terms of culture and advancing modern industrial methods several components that eventually played a key rule in the development of the automobile were initially invented for use in the bicycle, including to ball bearing, pneumatic tires, chain driven sprockets, and tension spoked wheels.



Fig. 2.Simple bicycle

5. BICYCLE CHAIN

Bicycle chains are emblematic of the DID brand, and we were founded originally for the production of bicycle chains. They have been used in many bicycles made in Japan and worldwide countries. Recently, our Hi Guard Chain (E) with an additional rust preventive treatment has favorable reputation by users. The bicycle chains have been continuously examined and improved in performance, quality and specifications as seen in the availability of current products. As a result, they are the lightest and most compact chains among products of the same size. Presently, they are used not only for bicycles but for many purposes such as the driving of vending machines and agriculture implements and for conveyor systems.

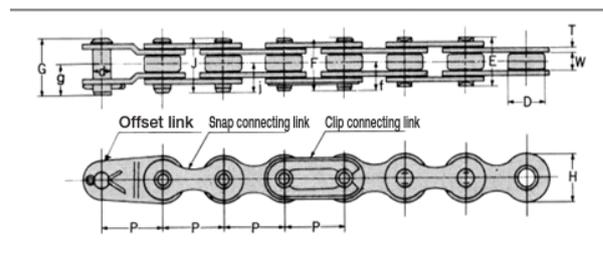


Fig.3. Bicycle Chain.

Note: 1. Bolt connecting link is the standard connecting link for the track racer chain. 2. M and (E) models are high anti-tight type. 3. The values of avg. tensile strength are for chains

6. FREE WHEEL

IN mechanical or automotive engineering, freewheel and over running clutch is a device in a transmission that disengages the driveshaft from the driven shaft when driven shaft rotates faster than the driveshaft. An overdrive is sometimes mistakenly called freewheel, but is otherwise unrelated.

The condition of a driven shaft spinning faster than the driveshaft exist in most bicycle when the rider holds his or her feet still, no longer pushing the pedals. In a fixed gear bicycle without freewheel the rear wheel would drive the pedal around.

An analogous exist in an automobile with a manual transmission going downhill or any situation where the driver take his or her foot of the gas pedal, closing the throttle ;the wheel want to drive the engine, possibility at higher RPM. In a two stroke engine depend fuel or oil mixture for lubrication, a shortage of fuel to the engine would result in a shortage of oil in a cylinder, and the piston would seize after a very short time causing extensive engine damage. Saab used a freewheel system in their two-stroke model for this reason and maintained it in the saab 96 V4 and early saab 99 for better fuel efficiency.



Fig.4.Free Wheel.

7. ALTERNATOR

>>Charging system

The charging system has three major components. The Battery, Alternator, and the Regulator.

- This alternator works together with the battery to supply power when the vehicle is running.
- The output of an alternator is direct current; however AC voltage is actually created and then converted to DC as voltage leaves the alternator on its way to the battery and the electrical loads

>>Charging system circuit

- Four wires connect the alternator to the rest of the charging system.



Fig. Alternator.

- B is the alternator output wire that supplies current to the battery.
- IG is the ignition input that turns on the alternator/regulator assembly.
- S is used by the regulator to monitor charging voltage at the battery.
- L is the wire the regulator uses to ground the charge warning lamp.

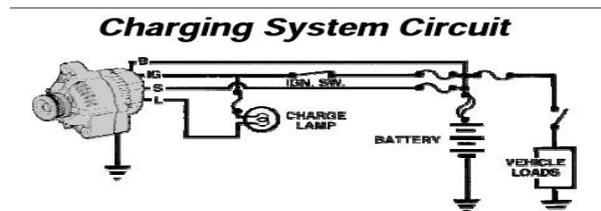


Fig.5. Charging System Circuit.

>>Alternator overview The alternator contains:

- A rotating field winding called the rotor.

- A stationary induction winding called the stator.
- A diode assembly called the rectifier bridge.
- A control device called the voltage regulator.
- Two internal fans to promote air circulation.

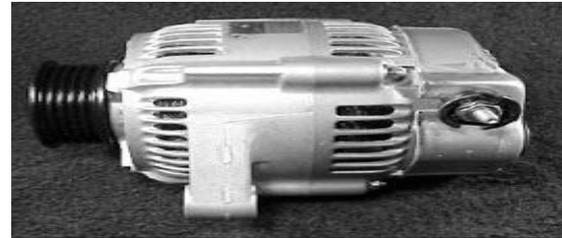


Fig.6. Alternator Side View

8. LITHIUM ION BATTERY

This project revolves around supplying and utilizing energy within a high voltage battery. It demands for a battery with longer running hours, lighter weight with respect to its high output voltage and higher energy density. Among all the existing rechargeable battery systems, the lithium ion cell technology is the most efficient and practical choice for the desired application. The battery chosen for this project was a high capacity lithium ion battery pack designed specifically for electric bikes by Golden Motor Technology Co Ltd. Aluminum casing is provided to house the internal components of the battery yet remains at a reasonable weight below 12.12 pounds. The battery is rated is at 48V, 12AH. A maximum electrical output results at an approximate constant speed of 50km/h (31mph). The amount of charging cycles of the battery is greater than 800.



Fig.7.Lithium Ion Battery

Lithium ion batteries are one of the most popular types of battery for portable electronics. Although slightly lower in energy density than lithium metal, lithium-ion is safe, provided certain precautions are met when charging and discharging. With its many advantages over other conventional types of batteries, the lithium ion battery was the optimum choice for an electric powered bicycle.

9. BRUSHLESS DIRECT CURRENT MOTOR

Choosing a motor was the first step in creating an appropriate system for the electric bike. Initially, the



project was to be driven by DC micro motors that were configured to turn a sprocket. The sprocket is used to transmit rotary motion between two shafts. To change gears and speeds of the bicycle, the diameter of the sprocket needs to be changed. Instead of having multiple sized sprockets in parallel, the initial idea was to place multiple micro motors in parallel to increase the amount of current supplied to the sprocket for more output power. This system seemed to be over complicated and the micro motors would not supply enough power and torque to support a bicycle at high speeds.

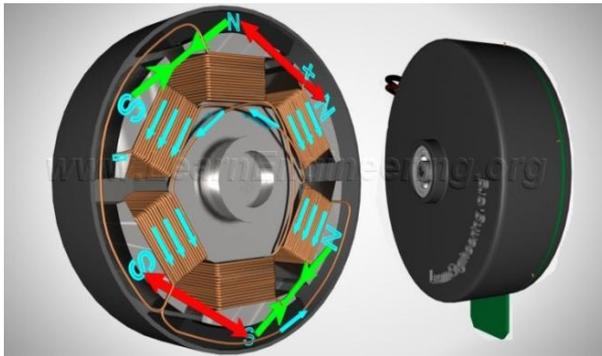


Fig8, Brushless DC motor.

It was settled that the best solution in driving the bike is with an electric DC motor; thus, creating an electric bike. In the DC motor, a static field flux is induced using permanent magnets or a stator field winding. Located on the rotor of the DC motor is the armature winding. The armature winding is the series of conducting coils, each connected in segments of a commutator that are wound around the iron core in which voltage is induced. This causes it to rotate within a magnetic field; if the wires are broken or damaged, the armature will not rotate properly. For the DC motor to generate any torque, the coils of the armature must be connected to an external DC circuit with an even number of brush heads. Figure shows a circuit model of a DC motor. The application of DC motors has increased dramatically. As technology advances, new and improved designs of the DC motor will be implemented.

Brushless DC (BLDC) motors are the primary choice for a wide variety of applications. The BLDC motor system is emerging as one of the most useful drive options for a wide range of applications ranging from small, low power fans and disc drives, through medium size domestic appliance motors and up to larger industrial and aviation robotic and servo drives.

When comparing a typical DC motor to an AC motor, the fundamental advantage is the ease with which the motor can be controlled to give varying speeds, direction, and even regenerative braking. The main drawback to the DC motor is that the carbon brushes of a conventional DC motor wear down and create a great amount of dust. This in-turn requires a great amount of maintenance and lead to the overall replacement of the motor itself. Another major problem that conventional DC motors have is their high

level of radio frequency interference (RFI). The RFI generated by the brush gears can be of major concern to communications between certain aspects of a DC motor application and may cause failure. Thus, the brushless DC motor was developed to have the same advantages of a conventional DC motor, without the problems and disadvantages caused by the brushes. The main advantages and characteristics of a BLDC motor compared to a conventional DC motor include:

- Longer life and higher reliability
- Higher efficiency
- Ability to operate at various speeds, including high speed applications
- Construction of motor rigid
- Rotor has permanent magnet
- Low Cost to manufacture
- Simple, low-cost design for fixed-speed applications
- Clean, Fast and Efficient
- Complex control for variable speed and torque

Feature scope and modification

The available feature scope are as:

1. If increase the speed of bicycle required high torque DC motor used.
2. To provide the charging system.
3. To use lighting system for night use.

10. ADVANTAGES & LIMITATION

ADVANTAGE:-

- 1) Easy to assemble and disassemble
- 2) Easy to handle
- 3) Separately use of bicycle
- 4) Low cost
- 5) Environmental Eco-friendly
- 6) Less effort

LIMITATION:-

- 1) Required high torque DC motor.
- 2) Less speed
- 3) Proper alignments are required

APPLICATION OF PROJECT

- 1) To travel purpose of roadway
- 2) It is use industrial area under pollution control.
- 3) For driving purpose in pollution control area in some country like USA, Japan, china etc.

11. CONCLUSION

At the conclusion of the project, we had accomplished full system integration physically. The major challenge remaining is creating a set of software that the microcontroller can use to control the system given all the feedback systems that communicate with it. Some additional features we may implement include creating a display and circuitry for monitoring the battery state. In conclusion, we have designed an electromechanical



bicycle with a minimal amount of additional weight, an integrated control system, based on the decision-making of the rider and microcontroller, and that is capable of greater efficiency than typical bicycle through its use of regenerative motor control and various other feedback control mechanisms.

ACKNOWLEDGEMENT

The satisfactions that accomplishes the successful completion of any task would be important without the mention of the people who make it whose constant guidance and encouragement crown all the efforts with success. It is our privilege and pleasure to express our profound sense of respect, gratitude and indebtedness constant guidance inspiration.

I am thankful to all the Teaching & Non-teaching faculty of Mech Department and Librarians of J.D.I.E.T. engineering all our for their good wishes, their helping hand and constructive criticism, which led the successful completion of this project.

REFERENCES

- 1) www.google.com
- 2) www.wikipedia.org
- 3) www.freepatentsonline.com
- 4) Engineering mechanics
- 5) Strength of machine
- 6) Theory of machine
- 7) Electrical engineering