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Design and Fabrication of Foldable Smart E-Cycle

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Abstract: ***Transportation becomes the most priority for the people move to one place to another to improve their economic status and to satisfy their needs. Increasing population has improved the transportation needs and increased gradually pollution and consumption of fossil fuels. This tends to change the automobile manufacturer to produce electric vehicles. Cycling is one of the mode to travel small distance and also used for some health benefits. Due to much man effort cycling is not possible for longer distance now a day. But, it is possible to make cycling for more distance by enhancing the cycle features. By adding electric motor, foldable and self balancing mechanisms to the current design of the cycle this makes cycles to smart and efficient to operate. This paper describes the process of design, development and fabrication of a foldable smart e-cycle. This work is more useful in confined areas like college campus and schools, which expect zero pollution, zero noise effect and no fuel consumption. The construction process includes the designing and fabricating the model, assembling the model and testing it.***
Keyword: Smart Bicycle, design and fabrication

I. INTRODUCTION

Transportation is most important for people now a day. People travel now a day for improving their economic status and for their primary needs. The existing cycle is man operated so the people look for vehicles like bikes, scoters, cars etc for easy and quick movement. Now a day's pollution become high and fuel price high made the automotive manufactures and people view towards non polluting vehicles such as electric vehicles. Cycling is preferred for short distance travels. But the main problem here is to made much effort to move. By keeping this on one hand hence incorporating an electric motor with battery makes cycling quite easier. Even though a design of foldable mechanism and a smart balancing mechanism to ensure rider safety and comfort. By combining these technology on the current design of the cycle will surely turn eyes of people towards to the smart cycle. The cycle uses electric energy. So it's is less in cost to operate and also its none polluting. It will be use full in the cities where traffic and pollution is high and also encourage cycling.

II. PROBLEM IDENTIFICATION

Now a day we have Gear cycle, Electric cycle, Ordinary Cycle, which are not compact in size. All people learn cycle only first though we have Car, Bike while learning cycle balancing is important factor and many will find difficult to starting. So to ones comes the above problem we are about to design a cycle is electric, foldable which is combine in single and self balancing.

III. LITERATURE REVIEW

[1]Pallav Gogoi, et.al, In this journal paper stabilization of a two wheeled vehicle is the major part of the transportation system. Gyroscopic plays the major role in the stabilization of two wheeler vehicle Gyroscopically stabilized vehicles higher safety when compared with normal two wheelers.[2]Omer Saleem Bhatti, et.al, This journal paper demonstrates development of control and stabilization technique of self-balancing robot. It verifies the vertical stability, and even with the external bounded impulsive force applied to it. By programming a vertical reference position, the proposed robotic system can be balanced.[3]S.V. Pavan Kumar Maddukuri, et.al, The paper proposes the concept in the electric vehicle with consumes renewable energy. Although a regular unicycle is a pedal-powered by an electric motor and uses a control system to balance in the roll direction.[4]Prashant Govardhan, et.al, In this journal paper desicribes that the transportation vehicles that are made now a day that needs a rider to balance it. Balancing two wheeler vehicles is a hard task as compare to the four wheel vehicle. There are lots of innovations ongoing in the area of automotive manufacturing are cars became electric, smart and safe, but at same time they are very expensive too and not everyone can afford it.[5]Sergio Tamayo-Leon, et.al, In this paper describes the problem of self-stabilization at zero speed of a rider less bicycle with a Control Moment .Gyroscope (CMG) is addressed. It says the cycles are non linear under external disturbances, and then controllers are used to provide necessary self-balancing and disturbance rejection.[6]Sachin Johny, et.al, This journal paper describes the process of designing and fabrication folding and locking mechanism.

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And also integrating an electric motor that helps cycling more easier in rugged environment.[7]R.S. Jadoun, et.al, With the increase in fuel prices, pollution content in atmosphere and due to gradual end of the non-renewable sources of energy we have to alter the source of our energy in our vehicles. With these consideration .we have to switch over to other sources of energy without using conventional sources such as petrol, diesel.[8]Shlok Desai, et.al, E-bike comprises the features like high mobility efficiency, compact, electrically powered, comfortable riding experience, and light weight vehicle. E-bike is the most versatile future vehicle considering its advantages. The purpose of the research is to find an alternative to improvise human comfort, solve global problems and promote sustainable development. An electric Bike is a battery-operated vehicle which is economical with low maintenance cost.[9]Pramod R. Sonwane, et.al, This journal paper describes that the two wheeled self-balancing robot which is basically operated on an inverted pendulum system. This system is dynamically stable but statically unstable. This robot involves physics and control theories.[10] Mukeshkumar Prasad, et.al, The paper reports to design and build a bicycle prototype that is able to drive and balance itself without a rider. The automatic balancing bicycle will have a control system to keep itself balanced and prevent it from falling. It is driven by an electric motor.

IV. EXPERIMENTAL SETUP

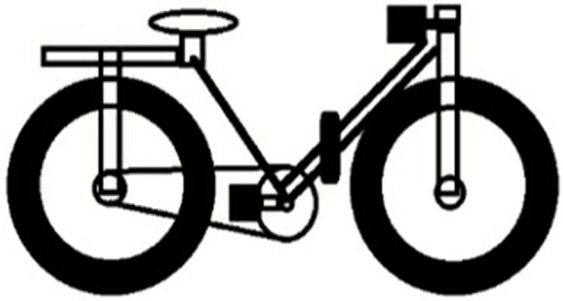

Figure 1. Experimental setup of foldable smart E-cycle

V. DESIGN MODEL AND CALCULATION

A. Design Calculation

(a)Battery:

12 volt, 7 amps

Battery watts = volt*amps

= 12*7

= 84 watts

(b)Motor:

Speed = 30 RPM

Voltage = 12 Volt

Power = 18 Watt

Torque of the Motor:

Torque = (P X 60) / (2 X 3.14 X N)

Torque = (18X 60) / (2 X 3.14 X 30)

Torque = 5.72 N-m

Torque = 5.72 X 10^3 N-mm

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B. Design Model of foldable self balancing E-cycle

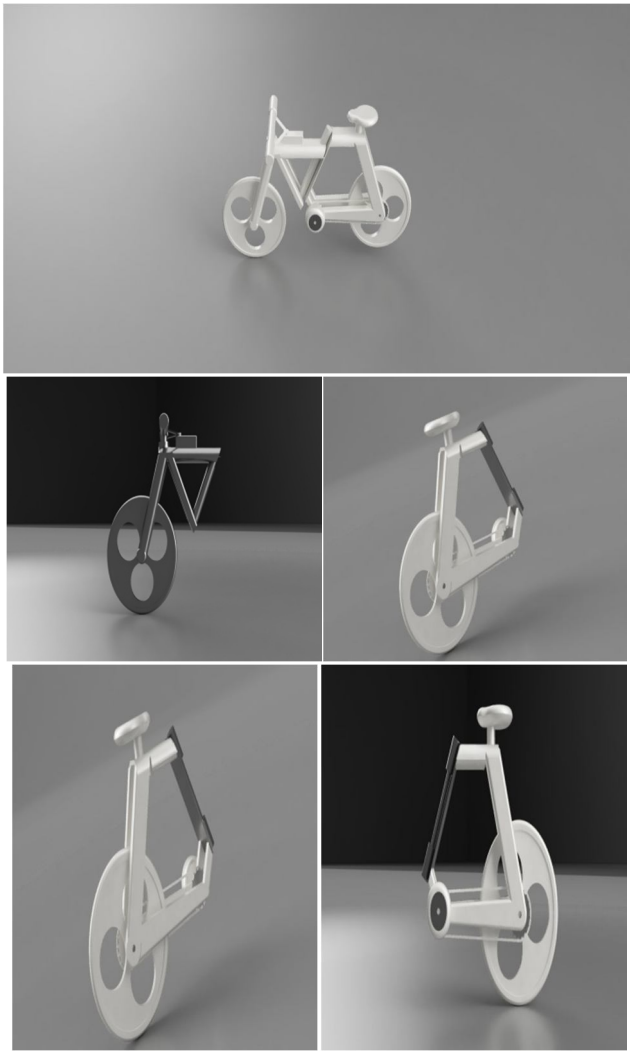

Figure 2. 3D model of foldable smart E-cycle

VI. COMPONENTS USED

A. DC Motor

Direct current motor is machine that a convert electric power resulting in mechanical power output. Normally the motor output is a rotational motion to the shaft. The input is to be direct current supply. But in case of DC motor direct current is used. The mechanism of direct current motor is like a bar wound with wire is placed in between two magnets having North and South Pole. When it is provided with electric supply the wire becomes energized resulting in rotational motion which leads to rotational output. The universal motor can operate on direct current but it is a lightweight motor used for portable power tools and appliances.

Figure 3. DC power motor

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B. Battery

Batteries have gained popularity as they became portable and useful for many purposes. The use of batteries has created many environmental concerns, such as toxic metal pollution. A battery is a device that converts chemical energy directly to electrical energy it consists of one or more voltaic cells. Each voltaic cell consists of two half cells connected in series by a conductive electrolyte. One half-cell is the positive electrode, and the other is the negative electrode. The electrodes do not touch each other but are electrically connected by the electrolyte, which can be either solid or liquid. A battery can be simply modeled as a perfect voltage source which has its own resistance, the resulting voltage across the load depends on the ratio of the battery's internal resistance to the resistance of the load.

Figure 4. Battery

1) *Arduino:* Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices. Arduino board designs use a variety of microprocessors and controllers.

Figure 5. Arduino

2) *Compass Magnetometer Module:* The magnetometer provides a compass by sensing where the strongest magnetic force is. The magnetometer measures the strength and direction of magnetic fields including the earth and so it can be used as a digital compass and indicates the way the micro bit is pointing relative to magnetic north.

Figure 6. Compass magnetometer module

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3) *Rectifier:* A rectifier is an electrical component that converts alternating current (AC) to direct current (DC). A rectifier is analogous to a one-way valve that allows an electrical current to flow in only one direction. The process of converting AC current to DC current is known as rectification. A rectifier can take several physical forms such as solid-state diodes, vacuum tube diodes, mercury-arc valves, silicon-controlled rectifiers, and various other silicon-based semiconductor switches. Having discussed what a rectifier is, let us look at a few of its applications in the next section: The primary application of the rectifier is to derive DC power from AC power. Rectifiers are used inside the power supplies of almost all electronic equipment. In power supplies, the rectifier is normally placed in series following the transformer, a smoothing filter, and possibly a voltage regulator. Below, we have discussed a few rectifier applications. As we are aware that all electrical appliances use a DC power supply to function. Using a rectifier in the power supply helps in converting AC to DC power supply. Bridge rectifiers are widely used for large appliances, where they are capable of converting high AC voltage to low DC voltage.

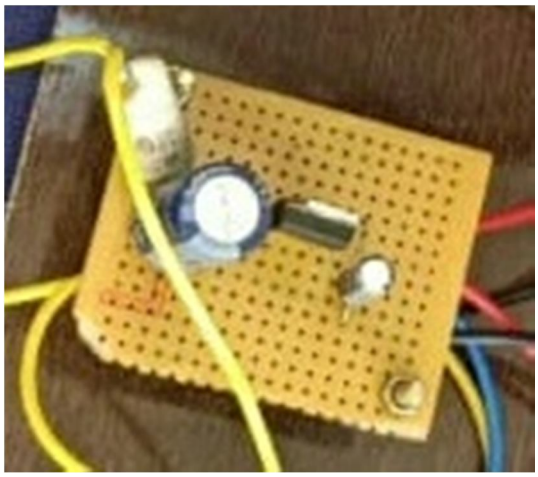

Figure 7. Rectifier

VII. WORKING PRINCIPLE

An accelerometer is a device that measures proper acceleration. It is the type of acceleration associated with the phenomenon of weight experienced by a test mass that resides in the frame of reference of the accelerometer device. For an example of where these types of acceleration differ, an accelerometer will measure a value when sitting on the ground, because masses there have weights, even though they do not change velocity. However, an accelerometer in gravitational free fall toward the center of the Earth will measure a value of zero because, even though its speed is increasing, it is in a frame of reference in which it is weightless. In our project two accelerometers are mounted one to balance the bicycle another one to balance the steering. The bicycle handle bar centre rod is mounted with mechanical links and it is actuated by means of a motor according to the accelerometer and output the motor is actuated and the handle bar is kept in balance. Another DC motor is mounted to drive the bicycle.

VIII. RESULT AND DISCUSSION

A. Velocity and speed of Bicycle (without load)

$$\text{velocity} = \frac{\text{Displacement}}{\text{Time}}$$

Displacement = distance travelled – initial distance
= 7000 m – 0m
= 7000m
Time = time taken to travel 8000 m
= 3600sec
velocity = 7000 / 3600
= 1.94 m/s
speed = 6.98 km/hr

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B. Velocity and speed of Bicycle (with load 15kg)

$$\text{velocity} = \frac{\text{Displacement}}{\text{Time}}$$

Displacement = distance travelled – initial distance
= 7000 m – 0m
= 7000m

Time taken to travel 8000 m
= 4800 sec

velocity = 7000 / 4800
= 1.45 m/s

speed = 5.22 km/hr

IX. FEATURE SCOPE

In today's era, using the bicycle is less due to not balancing itself .The alternative solution is foldable smart E-cycle. In homes foldable smart E-cycle is used and is becoming a very important part of life as it saves time, money and reduces human efforts to a great extent. It is the future of fast moving bicycle

X. CONCLUSION

The design and fabrication of foldable self-balancing electric bicycle is capable of balancing itself. The bicycle balances itself under various conditions like forced tilt of the bicycle. Thus, the proposed system can be much helped for self-balancing electric cycle reducing accidents and unwanted falls. This paper illustrated the idea of transforming an ordinary bicycle into a foldable self-balancing electric bicycle and the fundamental of its construction. The most important task is the design and development of the folding mechanism that suits the current bicycle design. The main aim of this project is to combine benefits of an electric bicycle and a foldable self-balancing bicycle. The project is to be feasible and the conversion process costs less than the existing foldable electric bicycle.

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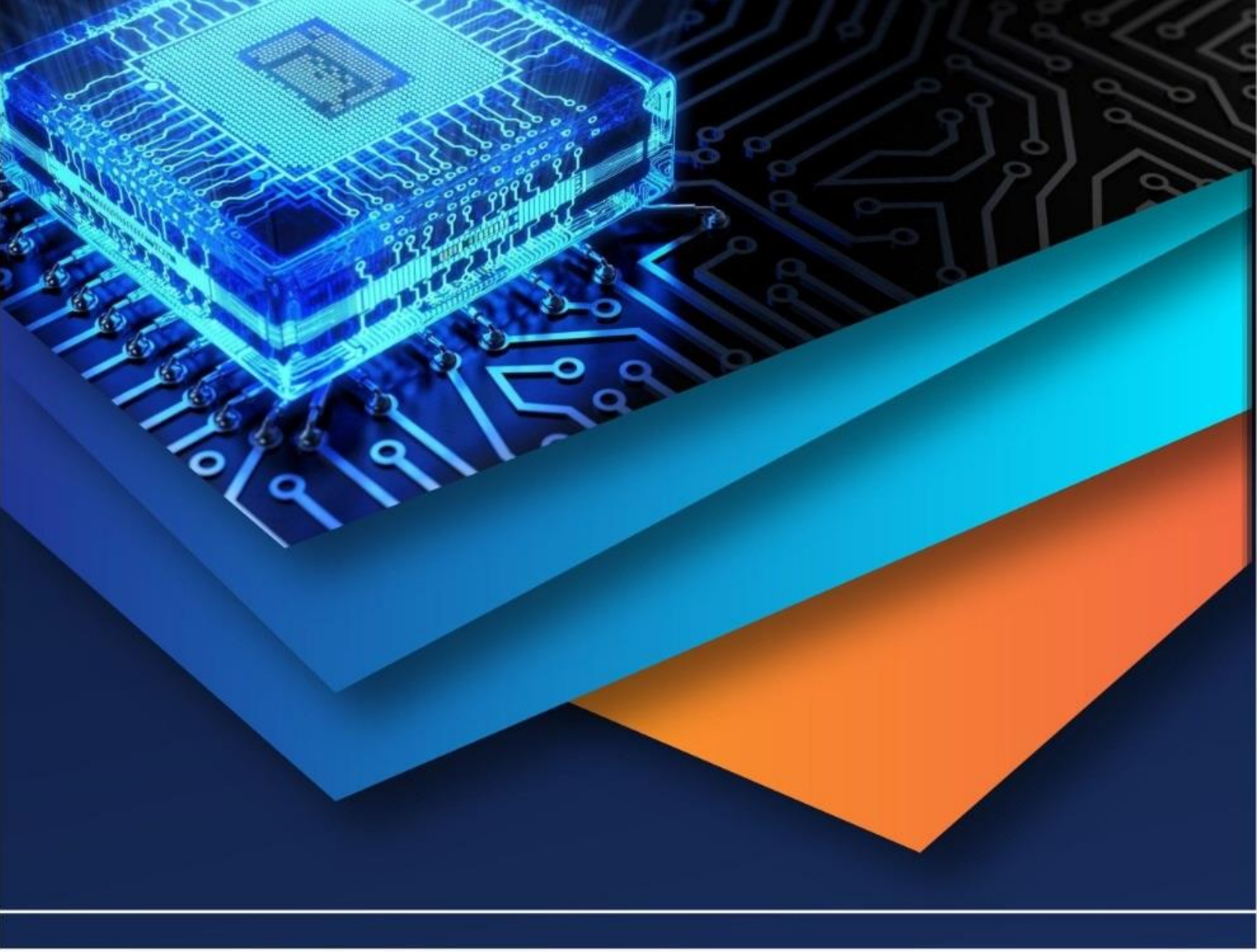

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