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Blade Propelled Bicycle

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Abstract - *The world today heavily relies on fossil fuels for power consumption. It is only a matter of time that fossil fuels will be completely used up and no longer available. In such scenario, riding a bicycle is the best suitable option to go from one place to another. An alternative to this is the electric bicycles which have greater speed and require less effort to ride the bicycle. Also there are some research papers on motion of bicycle with the help of compressed air. Contrary, to already existing technology, the purpose of this research is to get boosted power (thrust). The research mainly involves designing the bicycle frame and giving it electrical power support for motion of the structure with the help of batteries, motors, propeller fans, etc. Design and modification of bicycle carrier is also one of the salient features of the research. The ultimate goal is to have a green environment by reducing emission gases and reducing the reliance of fossil fuels.*

Key Words: **Alternative1, Batteries2, Bicycle3, Bicycle Carrier4, Designing5, Motors6, Power7, Propeller Fans8.**

1. INTRODUCTION

The first verifiable used bicycle belongs to German Baron Karl von Drais, a civil servant to the Grand Duke of Baden in Germany. Drais invented his Laufmaschine (German name for "running machine") in 1817, that is referred to as Draisine (English) or draisienne (French) by using the press. Karl von Drais patented his design in 1818, which changed into the first commercially successful two-wheeled, steerable, human-propelled machine, commonly known as a velocipede, and nicknamed hobby-horse or dandy horse. It started with manufacturing in Germany and France.

The 21st century has seen an endured utility of era to bicycles (which commenced within the 20th century): in designing them, constructing them, and using them. Bicycle frames and additives hold to get lighter and greater aerodynamic shape without sacrificing the strength in large part with the use of pc aided layout, finite structure analysis, and computational fluid dynamics. Recent discoveries such as bicycle stability had been facilitated via pc stimulations. Once designed, new technology is carried out to manufacturing along with hydroforming and automated carbon fibre layout. Finally, digital gadgetry has increased from just cyclocomputers to cycling power meters and electronic gear-transferring systems.

In recent years, bicycle designs have trended toward multiplied specialization, as the range of casual, recreational and commuter cyclists has grown. For those groups, the industry responded with the hybrid bicycle, occasionally advertised as a town bike, cross bike, or commuter bike. Hybrid bicycles combine factors of avenue racing and mountain bikes, even though the term is applied to a wide variety of bicycle types.

By 2007, e-motorcycles were notion to make up ten to twenty percent of all two-wheeled vehicles at the street of many primary Chinese localities. A standard unit requires 8 hours to rate the battery, which offers the variety of 25 to 30 miles, at a speed of 20km/h.

2. LITERATURE REVIEW

Several research papers are available related to the topic Blade Propelled Bicycle. Following are some of the studies which have helped in this research.

• Nguyen Ba Hung et al [1] have studied the running traits of electric bicycle. Electric bicycle is attracting more human beings as attention around the sector because it's far certainly one of environmentally-friendly motors in addition to a zero-emissions vehicle. In order to broaden a high overall performance electric powered bicycle, a stimulation observe of its opening characteristics is conducted primarily based on consequences of key parameters which includes rider's mass, wind speed and slope. Operation of this bicycle is simulated based totally on dynamic equations with sure operating conditions. Based on required electricity obtained from this simulation, a suitable power is selected for motor of the electric bicycle.

• Jaewon Sung et al [2] have studied the electricity required by means of an electric powered bicycle. The objective of this examine is to analyze dynamic characteristics and to optimize required energy of an electric bicycle ready with a semi-automatic transmission. In this simulation, we examine the dynamic characteristics and operation traits of an electric powered bicycle an optimized evaluation is conducted to maximize the electricity era of electrical bicycle. We also conduct an experiment on a real street and analyse the dynamics and the required energy of the electric bicycle.

• Octacek Lim et al [3] have studied dynamic overall performance and electric intake of electrical bicycles on the consequences of numerous operating situations. This establishes the stimulation models which include dynamic models of the electric bicycle and battery fashions. The consequences of operating conditions consisting of air density and slope on the dynamics and electric consumption of the electric bicycle are investigated. The simulation results

show that the reduction of air density and slope results in a development of the dynamic overall performance and electric intake. Apart from the simulation look at, an experimental have a look at changed into additionally performed to observe the dynamic and electric intake traits of the electric bicycle.

• Ramis Zaripov and Pavels Gavrilovs [4] studied the dynamic performance of the electrical bicycle. Experimental studies of the dynamics and electricity of an electric motorbike are presented. The acceleration traits were measured through a traction electric pressure and the dynamics of the acceleration have been expected at exceptional battery charges. It is hooked up that once a battery is used as an energy source, the acceleration time to a speed of five m/s decreases with the discharge of the battery. This is due to a decrease within the output strength of the battery as it discharges due to a decrease in voltage and a growth in internal resistance (a growth in the voltage jump below load); Acceleration with pedaling leads to an enormous reduction inside the power expended for acceleration to a given pace. At the identical time, the course traversed by using the electrical motorcycle during the acceleration time additionally increases. This means that the reduced strength consumption inside the acceleration mode with pedaling decreases even more.

• Derek Covill et al [5] studied the Bicycle Frame behaviour under various loading conditions using Finite Element Analysis. The load cases analysed include static representations of dynamic bump situations which occur sporadically and also those which occur constantly or regularly such as those generated at the drive and handlebars during climbing or cruising. The resulting stresses within the bicycle are analysed in the context of frame performance relating to static and fatigue strengths and are also compared to similar load cases presented in the literature. Further research is required to understand the influence of tube profiles on frame strength, and to analyse the modes of failure for various bicycle designs and materials used under typical and extreme usage in order to understand the implications of design on safety.

• Adrian Shaw et al [6] have studied the material and design optimization of bicycle frame. Fatigue is a prominent failure mechanism for bike frames, and can lead to serious accidents, costly recalls, and poor product image for bicycle frame manufacturers. The team collaborated with a local bike company, in the process of developing a new 6061-T6 aluminium bike, to investigate the fatigue behaviour of the new frame and optimize the material/heat treatment and frame design. The fatigue testing was done in-house using a test rig specifically built for this project according to the ASTM standard F2711-08 for horizontal loading.

3. DESIGN

3.1. Problem Statement

To design a pocket friendly bicycle powered by motor, propeller fans, batteries, etc. in order to reduce human effort and to give more efficiency by use of batteries as a power source and also to evaluate bicycle frame for its load carrying capacity and durability.

3.2. Stages of design

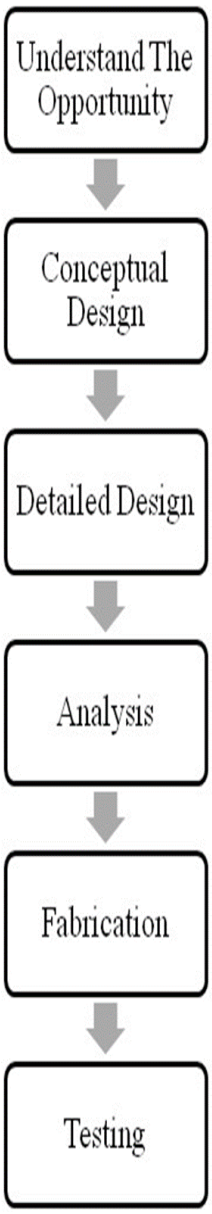

Fig -1: Stages of design

3.3. Calculations

Let us consider the average speed of Blade Propelled Bicycle as 35 km/hr.

Also, consider a 100m distance which will be travelled by the Blade Propelled Bicycle at 35 km/hr = 9.72 m/s.

Total mass of the Blade Propelled Bicycle including average human weight = 100 kg

Let the speed of Motor shaft be 20000 rpm.

According to Newton's 3rd equation of motion,

v2 = u2 + 2as [7], we get

a1 = 0.47 m/s2 and a2 = 0.00405 m/s2

We know that,

Force F = m (a1 – a2)

F = 46.595 N

Also,

Power P = F x v

= 452.9034 W

This is the total power required to propel the Blade Propelled Bicycle.

Therefore, 1 motor develops Power = (452.9034/4) = 113.225 W

Now, Torque developed by 1 motor

P = (2 x pi x N x T)/60 [8]

T = 0.054 N-m

Therefore we select RS-775 motor with Torque = 0.09 N-m

Thrust calculations

The amount of thrust force required to overcome all the other forces:-

$Fr = Mt * g * Cr + \{(1/2) * Cd * \varrho * (Vb + Va)^2 * Af\}$ [9]

Where, Mt = total mass of Blade Propelled Bicycle

Cr = coefficient of resistance in surface

Cd = coefficient of drag

Vb = velocity of bike

Therefore,

$Fr = (100 * 9.81 * 0.0022) + \{(1/2) * 0.9 * 1.2 * 0.85 * (9.72 + 0.9)^2\}$

= 53.92 N

(Fr1) = force by 1 motor

= 13.481 N

Blade Calculation:-

$A = \{(Fr1)^3 / (4 * \varrho * P^2)\}$

$(pi / 4) * d^2 = \{(13.481)^3 / (4 * 1.2 * (113.225)^2\}$

Therefore,

d = 0.2251 m

Hence we select 10 * 4.5pro Propeller blades having standard diameter of 25.4cm

Table -1: Calculation Results

Sr.no	Parameter	Calculated Value	Selected Parameter
1.	Total Power Required	452.9034 W	-
2.	Torque Produced	0.054 N-m	RS-775 Motor with Torque = 0.09 N-m
3.	Total Thrust	53.92 N	-
4.	Diameter of blade	0.2251 m	10 * 4.5pro Propeller blades with std. diameter of 0.254 m

3.4. Working

3.4.1. Pedal Assist Mode

Pedal help, also referred to as pedelec, is a style that affords power simplest while rider is pedaling. If a person is used to riding a conventional bike, the pedal assist mode has a greater intuitive sense compared to the throttle mode. The pedal assist modes is also fine due to the fact one can be aware of only pedaling and not preserve the throttle in a certain position. The pedal mode will generally give more variety while compared to the throttle mode. A lot of pedal help motorcycles have different stages of assistance, for example: low, medium, or excessive assist. Please be aware that some e-motorcycles have 4 or 5 pedal help settings.

Low pedal mode - rider feels pretty suitable at the bike. It help presents a touch electric assist even as the rider offer more pedal power and get extra of a workout.

Medium pedal mode - rider have a nice tailwind everywhere he/she goes. Medium pedal mode can be a pleasing balance of your pedal strength and the motor power.

High pedal mode - rider experiences like superman! High pedal mode is while the rider wants to cross somewhere speedy and with minimal effort. It may get beneficial if he/she wants to get to work without sweating too much. On the way home rider may want to use the low pedal assist to exercise session the stress of the day.

3.4.2. Battery Mode

In this era full of trends and fads, the world demands speed and efficiency with less human efforts, but not at the cost of degrading the environment. And transportation is one such field where there is more fascination about. People want efficient and comfortable mode of transport. So our group thought of developing a system which is fast, efficient and eco-friendly. Here our group developed an electric bicycle which works on battery power. First a frame structure was designed and then a frame was chosen and then analyzed by applying given loading condition. After choosing a suitable frame structure, various mountings were mounted on the T.

In this type of mode, the bicycle motion is assisted by 6 batteries which power the 4 DC Motor. The motors are placed on the carrier with the help of clamps. These motors are equipped with Propeller Fan Blades, which rotates in clockwise or anticlockwise direction as per requirement. These batteries are connected in combination of series and parallel with the help of wires. When the fan blades rotate, it produces thrust which forces the bicycle to move. The speed of this bike can be controlled with the help of 2 switches. When the switches are put ON, the motors get the power from the batteries and the blades start rotating. This rotation helps the bicycle to move.

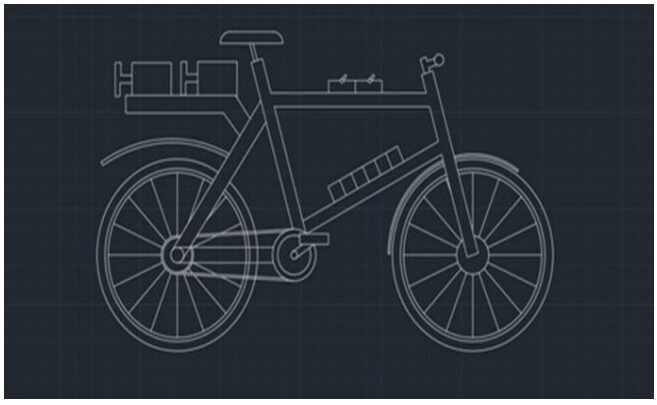

Figure -2: Battery assisted mode

3.5. Analysis of Bicycle Frame

A bicycle frame structure was designed to analyze loading condition when multiple forces act on the frame structure. The frame structure selected was stainless steel structure and all the properties related to it were updated. It includes meshed structure and deformed structure. The structure was designed and then was analyzed in ANSYS WORKBENCH 15.0 under given loading condition. Following outputs were obtained:

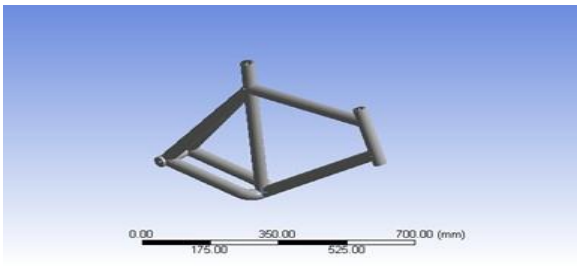

Figure -3: Bicycle Frame Structure

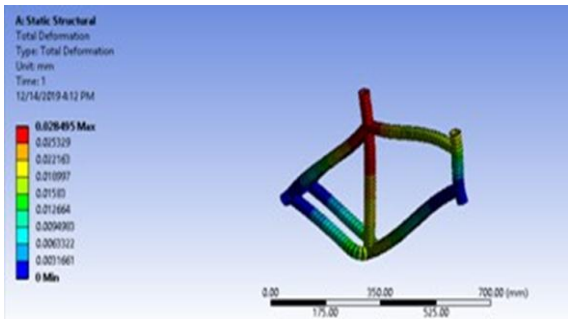

Figure -4: Total Deformation in Frame

Results

Stress = (0.5* Sut)/FOS

σ = (0.5×360)/ (1.5) (Consider FOS =1.5)

σ = 120MPa

Hence design is Safe.

3.6. Parts Manufactured

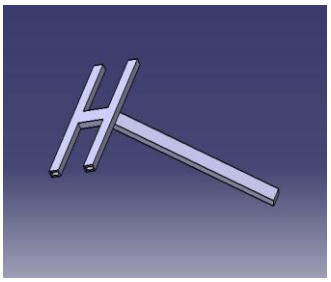

Figure -5: Design Model of Motor stand.

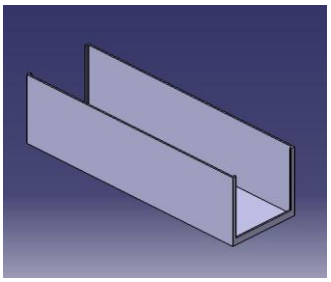

Figure -6: Design Model of Battery support

3.7. Circuit Connections

For the battery operated mode circuit connections is given. Which includes six rechargeable batteries, four motors, two switches, and the whole is connected by wires as shown in fig 4.6.

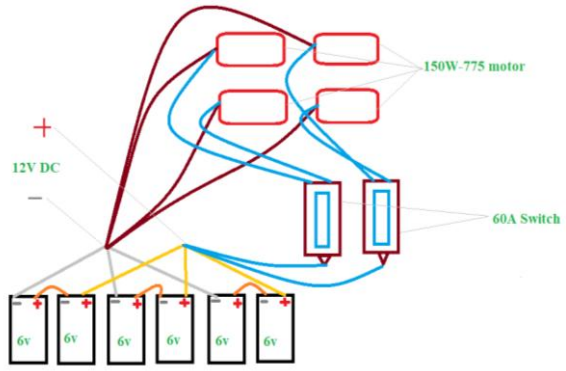

Figure -7: Circuit Connection for the motors

4. CONCLUSION

Today, the level of fuels is depleting at an alarming rate. With this rate of consumption it is quite evident that the fuel will not last in the long run. Also consumption of this fuel causes pollution thereby increasing the average temperature of the Earth's surface. So as to overcome with these challenges, Blade Propelled Bicycle can be an alternative for the 2-wheelers. This Blade Propelled Bicycle uses basic components like batteries, motors, etc. to generate the power and use that power for its motion. Here, the normal bicycle is converted into a power propelled bicycle. The rider can just sit back on his seat and enjoy the ride. It will eventually save the efforts of the rider as compared to an individual riding a normal bicycle. Also, complete justice is being done to the ergonomics of the bicycle. It is cheap and any one can afford it at a much lower cost than the one consuming fuel. Thus the idea of making a power propelled Blade Propelled Bicycle has been met.

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