Design and Analysis of Hub-Less Cycle with Fusion 360 Software

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Abstract **- The construction of Hub less wheel bicycle with gear train drive Mechanism is designed to convert the human muscle power through pedaling work into the mechanical work. The system is assembled with the combination of pedals, shafts, one small size alloy wheel and one large size Hub less wheel which is function as driving wheel. The pedal and shaft are receiving the human effort and convert into rotational mechanical motion. This rotational motion is transmitting up to the driving wheel via the spur gear drive train. The gear drive train is the combination of four stages of gear pair. These gear pairs not only transmit the power but also improve the gear ratio step by step. The gears and pinions of drive train are fixing with the bicycle body by using deep groove ball bearings. The last spur gear in the gear train is coupled with the driving wheel through the Hub less mechanism which also performs the holding function of driving wheel. The front wheel is small in size as compared to drive wheel and it only perform the system balancing function without actually participate in driving and driven mechanism. This system has ability to reduce the fatigue on bicycle rider by improving the power transmission efficiency and by extending the maximum limit of bicycle speed.**

Index Terms **- Hub less wheel, Sprocket spur gear, Engineering and Technology.**

I.INTRODUCTION

Today India is the second largest country in the world according to the population. India is the large market for all types of vehicles but up to till large numbers of peoples are deprived from good transportation system. There are large number of citizens are located in rural area where modern transportation facilities are not useful due to the poor condition of roads and their networks. Today the cost of the fuels is also increasing Very rapidly. There are several pollutants are emitted into atmosphere by these fossil fuel operated vehicles and day to day this problem becomes very critical. So, we have a need of the transportation vehicle which is able to provide service without the consumption of fossil fuels to prevent the emissions of pollutants. It should also able to conduct the goods where proper provision of road network is unavailable. Bicycle is essential to save the natural resources and it also help to keep the environment clean. There are different types of the bicycle available to provide service to customers. But there is the need to give an alternative to conventional bicycle to overcome different drawbacks. To overcome these drawbacks and to improve the quality of service we develop new mechanism which fulfils the need of customer. The cycle with conventional look (i.e.) cycle with spoked wheel (hub wheels) is always being used everywhere and an alternate for the look is not considered in design. Only the frames and chassis of the cycle has been altered throughout the ages. The wheel has stayed the same. So, considering it as the main objective of our project, the hub less cycle is designed. To overcome these drawbacks and to improve the quality of service we develop new mechanism which fulfils the need of customer.

II.RESEARCH METHODOLOGY

Design consists of applications of scientific principles and technical information for invention of new mechanism to perform specific function with more efficiency and less cost. The plan philosophy relies upon two kinds;

- System Design
- Mechanical Design

The course of our work starts with arranging stage including introductory research, writing review and foundation examine. The fundamental thought is to

transmit control by interfacing the hawk rigging to the pinion which networks with the back wheel having outside or inside apparatuses. It is trailed by idea age stage that incorporates assessing existing hub less wheel, client prerequisite and idea plan. Prototyping the hub less wheel into the moped or cycle using the apparatus drive mechanism and we progress toward testing efficiency. Collection of all equipment and material required for overall fabrication of hub less wheel setup for more efficient and light weight First and foremost is the ideology of the project. Improved aesthetics of the cycle was kept as the vision of the project. As per that, the design conception was framed. The design conception involved the process of welding to be done in areas of joints which kept the wheel assembly firm. Wheel was the main aspect to be considered in the project. The reduction in chain length enhanced the fact of less loss of energy. It will also reduce the fatigue encountered by the driver. The cycle was a conventional cycle. It was amended as per the needs. Then the wheel was separately welded with the rollers placed in he required areas. Next was to weld the wheel with the frame. After welding process of wheel and frame, the cycle was fabricated successfully.

III.CONSTRUCTION

CONSTRUCTION:

Basic idea of construction is that a driver can drive the vehicle with maximum efficiency.

The following components are used to construct the System:

Frame:

Conventional cycle was picked up for the project. Hercules turbo drive is the cycle selected. The carrier is taken so that the cycle gets a good look. The cycle frame is made up of steel. The cycle consists of a single speed chain drive mechanism. The cycle frame is not modified, only the rear wheel is converted into hub less and certain modifications are done for mounting the gear for providing drive input.

Wheel Assembly:

The wheel assembly consist of inner rim and the outer rim. The outer rim has the rack which is bent and welded to it. This rack engages with the gear attached to the chain drive. A wheel assembly, which is particularly applicable to bicycles, includes a hub, a pair of laterally spaced bearings, and is constructed to cooperate with a frame of a bicycle. The bearings include an outer race that is directly engaged with the hub. An inner race of each `

Bearing is constructed to directly receive a portion of the bicycle frame such that the wheel is supported by direct interaction of the bicycle frame and the bearing members. Optionally, a hollow axle may extend between adjacent bearings to further enhance the lateral stiffness of the wheel assembly

Outer rim:

The outer rim is fitted with a tubeless tyre. The tyre is radially tyre. Tyre offers long life as compared to tube tyres because the tubeless tyre gets easily damaged. The rim is the "outer edge of a wheel, holding the tire. It makes up the outer circular design of the wheel on which the inside edge of the tire is mounted on vehicles such as automobiles. For example, on a bicycle wheel the rim is a large hoop attached to the outer ends of the spokes of the wheel that holds the tire and tube. In cross-section, the rim is deep in the center and shallow at the outer edges, thus forming a "U" shape that supports the bead of the tire casing.

Pedal Shaft:

It comprises of at least one sprocket, attested to the crank to which the pedal attached. The rider power will be transmitted into rotational mechanism through pedal shaft.

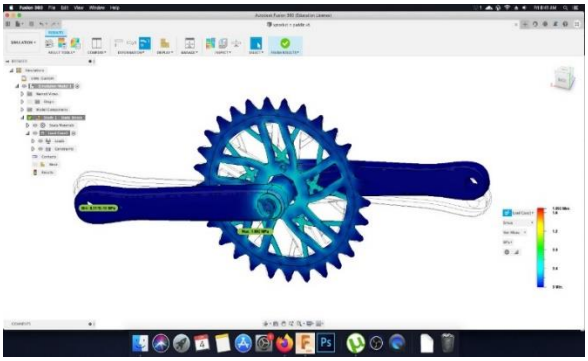
It consists of one or more sprockets, also called chainrings or chainwheels attached to the cranks, arms, or crankarms to which the pedals attach. It is connected to the rider by the pedals, to the bicycle frame by the bottom bracket, and to the rear sprocket, cassette or freewheel via the chain.

Ball Bearing:

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation between the bearing races.

The purpose of a ball bearing is to reduce rotational friction and support radial and axial loads. It achieves

this by using at Least two races to contain the balls and transmit the loads through the balls. In most applications, one race is stationary and the other is attached to the rotating assembly. As one of the bearing races rotates it causes the balls to rotate as well. Because the balls are rolling, they have a much lower coefficient of friction than if two flat surfaces were sliding against each other.



Idler Sprocket:

Idler sprockets are a flat hub less sprocket, with a sealed bearing that allows the sprocket to rotate freely. The bearings used in our idler sprockets use a wide inner race to create spacing between components on a shaft. Idlers are normally mounted in a fixed position on a fixed shaft or attached to a tensioner arm. Idler sprockets should be used on drives when long lengths of chain are used to take up any chain sag that may occur. Another situation when an idler sprocket is needed is when a drive is designed where the chain is routed in multiple directions throughout a machine.

Spur Gear:

Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. Though the teeth are not straight-sided (but usually of special form to achieve a constant drive ratio, mainly involute but less commonly cycloidal), the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts. Spur gears are more efficient compared to helical gears with the same size. They are quite reliable and offer constant velocity. Spur gears are also considered a member of positive transmission because they don't have any slippage.

Front Wheel:

The front wheel is made of alloy type. In this system conventional method of use of same size wheel is replaced by the use of small size of front wheel. As only the rear wheel is participated in driving function and not the front wheel. Front wheel is used for balancing the structure so reduction in size of front wheel is made good in order to reduce the system weight without any effect on bicycle performance.

Sheet metal:

Sheet metal is metal formed by an industrial process into thin, flat pieces. It is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are constructed with sheet metal. Thicknesses can vary significantly; extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate. Sheet metal is available in flat pieces or coiled strips. The coils are formed by running a continuous sheet of metal through a roll slitter. The thickness of sheet metal is commonly specified by a traditional, non-linear measure known as its gauge. The larger the gauge number, the thinner the metal. Commonly used steel sheet metal ranges from 30 gauge to about 7 gauge.

IV.WORKING PRINCIPAL

It is operated on human muscle power. To develop the torque at shaft, the rider applies force on pedals. Shaft has function to pick the torque and convert it in to rotational motion. As to perform the main function this input rotational power must be supplied up to driving wheel. In this system spur gears and spur pinions drive train is used to replace this chain drive. There are four stages of gear pair are assembled in a train to form the drive mechanism. In stage -1gear pair 44 teeth's spur gear transmit power to the 24 teeth's spur pinion. If we consider that the rider able to the pedal at 60 rpm then by using the gear ratio of stage -1 pinion is rotate at 110 rpm. The second stage gear pair receives power from stage-1 pinion which is fixed on the same shaft of stage-2 gear. Again, in stage -2 the no. of teethes on gear are 44 & no. of teeth on pinion are 24. So, the input revolution of 110 rpm in stage -2 is converted in to 202 rpm. The 202-rpm received by idler pinion having 18 no. of teethes from stage-3 gear having 24 numbers of teethes. So, the 202-rpm converted in to 270 rpm. This 270 rpm from 18 no. of teeth's idler gear

is supplied to 18 teethes wheel pinion. So, at the end of gear train 270 rpm output speed is achieved by taking 60 rpm input speed from pedal shaft via gear train. This rotational power is provided to the alloy Hub less wheel. Through the ball bearing. This ball bearing able to sustain high load with very less maintenance compared to conventional hub. This Hub less wheel also made the design unique and compact. Over gear ratio produced by drive mechanism is about 4.5. Thus, system is able to convert the 60-rpm input speed in to 270 rpm at drive wheel as output speed. The fundamental reason for this framework is to convert human efforts into rotational motion. The hub less system is working on human muscle power, to produce a torque on shaft. The rider connected power on pedals; shaft has capacity to pick the torque and changed over into rotational movement. This rotational power provided up to driving wheel. In this framework goad apparatus and pinion is utilized to supplant the chain drive framework. As indicated by the span of wheel the quantity of teeth on rigging is chosen. The quantity of teeth on goad gear is more than pinion to transmit the power. The general rigging proportion delivered by this instrument is about 4:5. Along these lines' framework can change over the better effectiveness. Because of this sort of framework, the capacities to diminish the weariness on bike rider by improving force transmission proficiency.

V.DESIGN

CAD MODELS

Fig: CAD MODEL "A" COMPLETE VIEW

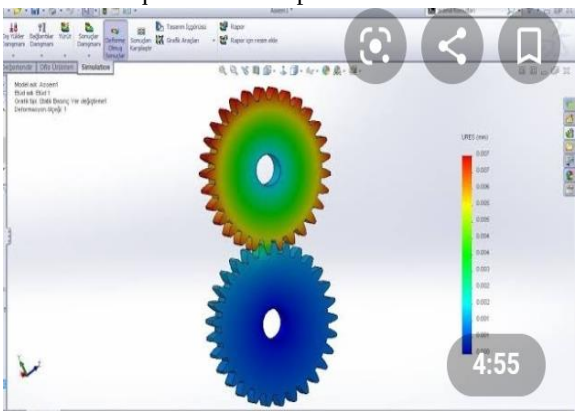
Fig: CAD MODEL "B" GEAR TRAIN MECHNISIM

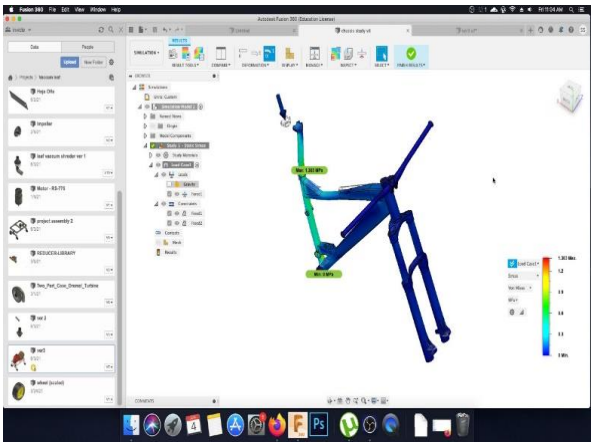
VI.MODEL ANALYSIS

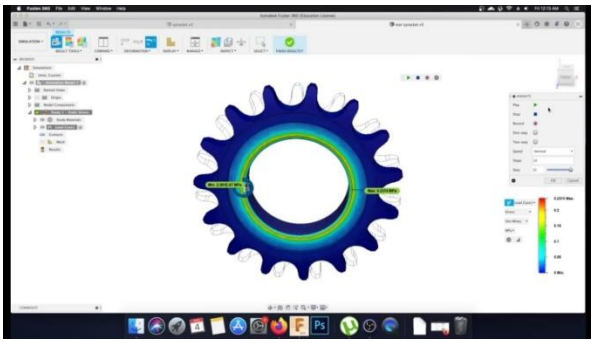
Modal analysis is done to obtain the natural frequency of the object, for a particular geometry and material. For a solid object, modal analysis aims to find various periods wherein the model will attain its natural frequency. Natural frequency is the frequency at which a body freely vibrates without any Driving force. After finding out the natural frequency of the model, one can easily conclude whether resonance is prone to occur, which could lead to catastrophic effects. Resonance is the phenomenon at which the natural frequency of the object is matched by some external agent. This leads to large scale vibration of the body that may even cause failure.

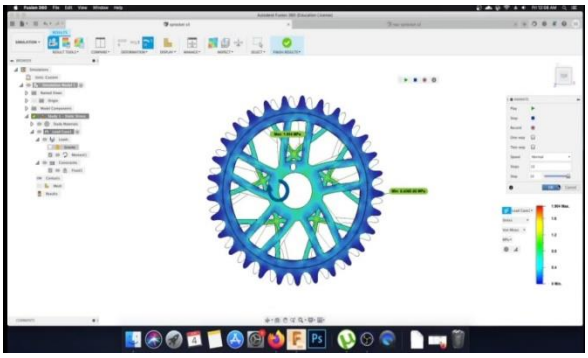
While performing modal analysis, it is important to test it at different modes. The fundaments of wave propagation involve a fundamental mode of vibration followed by modes of overtone. By the theory of standing waves, at different

Modes, the mode shapes change and the frequencies increases in quantitative steps.









VII.CONCLUSION

HUBLESS BICYCLE can be commercialized in order to replace Hub wheel into hub less wheel. Through centerless wheel technology, Hubless bicycle, centerless wheel, spockless wheel can be produced. Hubless bicycle is innovative design, which required less effort and speed will more as per customer satisfaction. The maximum speed limit of drive mechanism is improved.

VIII.ACKNOWLEDGMENT

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