Electric Chainless Bicycle

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Abstract: The traditional sprocket wheel mechanism is substituted by the circular rack and pinion gear mechanism in the transmission system of the bicycle. The results indicate that new mechanism can provide different output torque at wheels by changing the point at which force is applied in the pedal. It was found that manual load given by the rider results in increased in the displacement of the bicycle and increased in efficiency of the bicycle. Due to the to and fro motion of the paddle arm it is easy to drive the bicycle in standing position especially while driving on slopes. The bicycle will also be electrically driven so it will be having 3 modes Manual mode, Pedal assist mode in which bicycle could be driven for more than 50 km and electric mode in which bicycle can be driven up to 30 km.

Keywords*: *chainless, efficiency, displacement.

I. Introduction:

This new drive mechanism is integral with the driving wheel and does not require a separate crank mechanism and crank support members between the steering wheel and the driving wheel. The traditional bicycle mainly consists of sprocket and chain mechanism and the chainless bicycle which are already designed mainly consist of straight or spiral bevel gear with the shaft for power transmission.
The new bicycle will also be electrically driven along with the circular rack and pinion gear mechanism in the transmission system of the bicycle. The new bicycle will be having three modes while driving which are as follows:
(i) Electric mode (30 Km. range) (ii) Pedal assist mode (50 Km. range) (iii) Manual mode

II. Objectives:

1) To obtain different output torque at wheels without gear shifting derailleurs system by changing the point at which force is applied on the pedal.
2) Due to the to and fro motion of the pedal arm of the bicycle it would be easy to drive the bicycle in the standing position.
3) To achieve increased in the displacement of the bicycle for the manual load given by the rider.
4) To increase the efficiency of the bicycle.
5) As the entire mechanism is on the rear part there are no chances of grease ending up on the clothes.
6) To make the bicycle safe by eliminating the chain as there are chances of clothes getting entrapped in the chain and sprocket.

III. Literature Survey:

Design And Analysis Of Shaft Driven Bicycle [10], paper mainly dealt with obtaining an increase in displacement of bicycle by increasing the maximum amount of torque that can be transmitted to the rear wheel for a minimum applied human effort. The actual components of the shaft driven bicycle were designed by them based on the design calculations and the analysis was performed theoretically. The simulation was performed on the designed model of the shaft and bevel gear assembly using the simulation tool ANSYS by them. It was found by them that manual load given by the rider results in increased displacement of the bicycle, the human effort was reduced.

Design, Analysis & Fabrication Of Shaft Driven Bicycle [4], in this paper, straight bevel gears were used at the rear wheel side and spiral bevel gears were used at the pedal side. The shaft used for power transmission had two gears mounted on each side of the gear. According to this paper in chainless bicycle there is increase in efficiency and smooth power transmission but there is little increase in initial torque. It was observed by them that there is reduction in noise and vibration.

Shaft Driven Bicycle [9], project was similar to the previous project instead of using one spiral bevel gear and one straight bevel gear as used in the previous project two straight bevel gears were used in the bicycle at both the end. Power was transmitted by using straight bevel gear at the rear end along with the shaft for transmitting the power. The use of bevel gears by them allowed the axis of the drive torque from the pedal arm to be turned through 90 degrees. The drive shaft then had another bevel gear near the rear wheel hub which meshed with a bevel gear on the hub of rear wheel, where the rear sprocket would be on conventional bicycles. Thus, the back wheel was rotated in direction perpendicular to the drive shaft resulting into forward motion of the bicycle.

Design Of An Efficient Gear Driven Bicycle [1], this project mainly dealt with the use of series of spur gear which lead to increase in the speed of the bicycle, reduction in human effort and increase in efficiency as compared to traditional bicycle. Spur gears were used to transmit the power from the pedal arm to the rear wheel hub. The distance covered by their bicycle was 3 to 4 times more than the conventional bicycle. But the main disadvantage of the project was due to use of spur gears in series there was rise in the weight of the bicycle.

IV. Scope:

To overcome the disadvantages faced in traditional sprocket wheel mechanism using sprocket and chain mechanism.

1) In chain drive there is velocity fluctuation when unduly stretched.
2) The chain drive requires slack adjustment, lubrication, careful maintenance and accurate mounting.
3) The cost of production of chain is comparatively high.

V. Design and Calculation Report:

A. Input Design Condition:

1. Design Input Parameter:
(i) Types of Gearing: Internal Gearings
Desired Gear Ratio: 5
Pressure Angle: 20.00°
Module: 2.00 mm
Root Fillet: 0.20 mm

(ii) Pinion:
No. of Teeth: 36
Mounting Hole Diameter: 45.00 mm
Face Width: 20.00 mm

(iii) Gear:
No. of Teeth: 180
Face Width: 20.00 mm

2. Material properties used for calculations:
Pinion Density: C 45 [En 8D] - Normalized
Contact Stress [MPa]: 384
Bending Stress [MPa]: 448
Gear Density: C 40
Contact Stress [MPa]: 381
Bending Stress [MPa]: 445

B. Strength Validation

(i) Pinion:
Allowable Bending Stress: 590.830 MPa
Allowable Pitting Stress: 489.950 MPa

(ii) Gear:
Allowable Bending Stress: 481.900 MPa
Allowable Pitting Stress: 486.120 MPa

C. Basic Dimensions

(i) Pinion:
Base Diameter: 67.66 mm
Outside Diameter: 76.00 mm
Pitch Diameter: 72.00 mm
Root Diameter: 67.00 mm
Chordal Thickness: 2.77 mm
Chordal Thickness Height: 1.49 mm
Chordal Dimension: 14.76 mm
Tooth Thickness: 7.99 mm

(ii) Gear:
Base Diameter: 338.29 mm
Outside Diameter: 356.00 mm
Pitch Diameter: 360.00 mm
Diameter: 365.00 mm
Chordal Thickness: 2.77 mm
Chordal Thickness Height: 2.50 mm
Dimension: 14.76 mm
Tooth Thickness: 7.99 mm

VI. Components required:

A. Components required to be fabricated:

1. Circular rack and Pinion

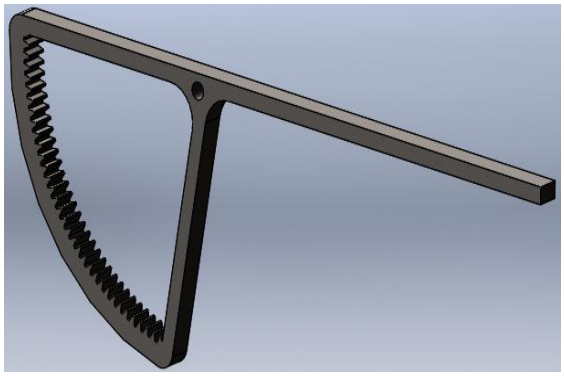

Fig.1. Internal gear

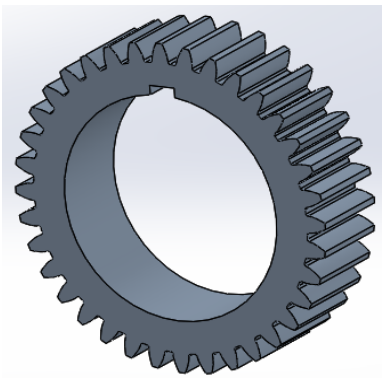

Fig.2. Spur gear

2. Rear hub

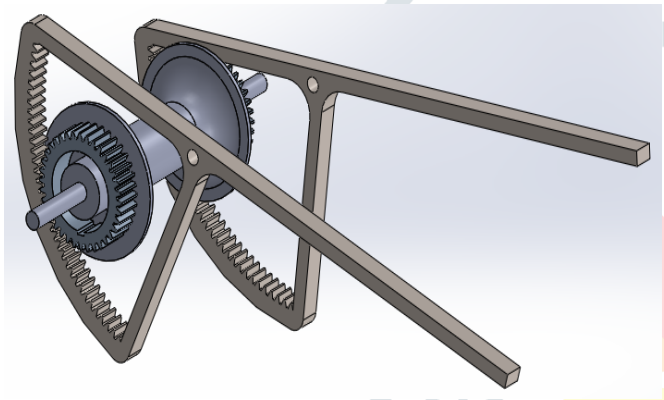

Fig.3. Rear Hub assembly

B. Electrical Components:

1. Brushless gear hub motor for electric bicycle on front wheel 36v 250W and twist throttle with battery indicator

Fig.4. Brushless gear hub motor

Fig.5. Twist throttle

2. 24V/36V 250W 12A Brushless DC square wave controller and Electric bicycle finger throttle

Fig.6.Brushless DC square wave controller

Fig.7. Throttle

VII. CAD Model:

Fig.8. CAD Model

VIII. Methodology:

1) In the new mechanism the circular rack will be attached to the paddle arm which will be pivoted to the main body.
2) When the force is applied on the paddle arm the circular rack will rotate the pinion gear which will provides a drive to the rear wheel axle.
3) Both paddles are attached with free wheel assembly so that when we apply an effort on paddle, cycle moves in forward direction.
4) Free wheel assembly allows the rider to achieve a free run without paddling like on slopes or gradient.

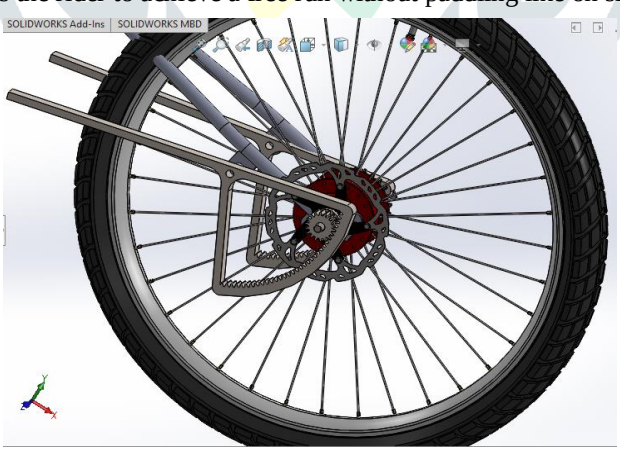

Fig.9. Circular rack and Pinion mechanism

IX. Conclusion:

By using circular rack and pinion gear mechanism variable output torque at the wheel can be obtained. Hence this mechanism can replace complex multi gear and derailleur system in the transmission system of the bicycle. Due to the to and fro motion of the pedal arm of the bicycle it would be easy to drive the bicycle in the standing position comfortably. The effort of leg muscles can be reduced while driving in standing position as the major riding force will be the body weight of the rider. All mechanical elements of this new drive mechanism that require lubrication are on the rear part due to which there are no chances of clothes getting entrapped in the chain and sprocket or grease ending up on the clothes.

X. Acknowledgment:

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XI. References:

[1] K. Rajasuthan, G. Balaji, M. Palpandi, "DESIGN OF AN EFFICIENT GEAR DRIVEN BICYCLE", INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY, December 2016.

[2] Aakash Patel, Hitesh Prajapati, Vivek Patel, Amit Patel, "Design & Modelling of Chainless Bicycle with Gear Mechanism", International Journal for Scientific Research & Development| Vol. 5, Issue 05, 2017.

[3] Khan Hassan Zakariya, Kolkar Abhimanyu Dashrath, Quazi Azhar Husain Farrukhzama, Assistant Prof. Shivraj Kavhale, "Design and Fabrication of Chainless Bicycle" International Research Journal of Engineering and Technology (IRJET) Volume: 05, Issue: 03 Mar-2018.

[4] Dandage R.V., Patil A.A., Kamble P.N., "DESIGN, ANALYSIS & FABRICATION OF SHAFT DRIVEN BICYCLE", 5th International Conference on Recent Development in Engineering Science, Humanities and Management, 16th April 2017.

[5] Gicky Jose Malppan, Tom Sunny, "Bicycle with Internal Gear Transmission System", International Journal Of Mechanical Engineering and Information Technology, 2015.

[6] M. Rama Narasimha Reddy, G. Hari Prasad, S. Marurthi, R. Ganapathi, M. Janardhan, M.P.Madhu Sudhan, "Design & Febrication of Shaft Drive for Bicycle", International Journal of Emerging Engineering Research and Technology, Volume 2, Issue 2, May 2014.

[7] K. Someswara Rao, P. Abhishek, T. Teressa, G. Santosh Reddy, A. Harieswar, "Simulation and Analysis of Shaft Driven Bicycle Mechanisam", IJISET-International Journal of Innovative Seicence, Engineering and Technology, Volume 3, Issue 7, July 2016.

[8] Ashish S. Gawande, Avinash E. Gedam, Prof. A.A. Khond, Aniket G. Pipre, Nitesh C. Bajait, "Design and Febrication of Shaft Driven Bicycle", IJSRD-International Journal for Scientific Research & Development, Vol.3, Issue 02, 2015.

[9] M. Sunil babu, MD Mushtaq quadri, V. Naga prasad, G. Kedarnath, "Shaft Driven Bicycle", IJARIIE, Vol.3, Issue 02, 2017.

[10] Miss. S. Chandana, Mr. R.Shiva Kumar, Mr. S. Suhas Mr. N.Sai Charan, Mr. Alapati Bhargav, "Design And Analysis Of Shaft Driven Bicycle", IJRI-International Journal Of Resarch And Innovation.

[11] Sagar Pardeshi, Pankaj Desle, "Design and Development of Effective Low Weight Racing Bicycle Frame", IJIRSET-International Journal of Innovative Research in Science, Engineering and Technology, Vol.3, Issue 12, December 2014.

[12] Chien-Cheng Lin, Song-Jeng Huang and Chi-Chia Liu, "Structural analysis and optimization of bicycle frame designs", Advances in Mechanical Engineering, 2017.

[13] Venkat Harish S., Raghavendra K, "Structural Analysis of Bicycle Structure and Improvement Analysis using Analytical and Finite Element Analysis", IJRASET-International Journal for Research in Applied Science & Engineering Technology, Volume 4, Issue VI, June 2016.

[14] Mayur Linagariya, Dignesh Savsani, "Dynamic Chainless Bicycle", IJAREST-International Journal of Advance Research in Engineering, Science & Technology, Vol.2, Issue 5, May-2015.

[15] Anmol Parashar, Seemant Purohit, Shrikant Malviya, Neeraj Pandey, Prof. Amit Kumar Kundu, "Design & Fabrication of Shaft Driven Bicycle", IJSTE-International Journal of Science Technology & Engineering, Volume 2, Issue 11, May 2016.

[16] Amit kumar Singh, Arvind Yadav, Vinay Kumar Chaurasiya, Ankit Yadav, Niteesh Kumar Mishra, "Propose and Manufacture of Chainless Bicycle", IJESC, Vol.7, Issue No.6, 2017.

[17] Sanjay B. Zope, Amol R. Mayur Linagariya, Dignesh Savsani, "Dynamic Chainless Bicycle", IJAREST-International Journal of Advance Research in Engineering, Science & Technoloty, Vol.2, Issue 5, May-2015.

[18] Yashwant Sharma, Praveen Banker, Yogesh Raikwar, Yogita Chauhan, Madhvi Sharma, "R&D ON ELECTRIC BIKE", IRJET- International Research Journal of Engineering and Technology, Volume 05, Issue 02, Feb 2018.

[19] Kunjan Shinde, "Literature Review on Electric Bike", IJRMET, Vol. 7, Issue 1, Nov 2016.

[20] Kartik S Mishra, Shubham V Gadhawe, Dhiraj C Chaudhari, Bhupendra Varma and S. B. Barve, "Design and Development of Solar Hybrid Bicycle", International Journal of Current Engineering and Technology, March 2016.