

ROLE OF HYBRID ELECTRIC BICYCLES IN SMART CITIES

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ABSTRACT

This paper presents how hybrid electric bicycles are useful in smart cities and their role in improving the health issues of today's generation and also the environmental issues like green house effect. As the pollution is the main cause for green house effect. This paper deals with different Electric bicycle for different conditions and its classifications and reducing the cost and improving the range of the vehicle.

Keywords: *Electric bicycle, Health, Pollution, transportation,*

I INTRODUCTION

With concern of the environmental issues and health issues of today's life we need to change our life styles for better health and better tomorrow. Pollution is the main cause for environmental issues, hence we need to be very careful about the pollution. Transportation is the second biggest sector contributes to the air pollution primarily through the consumption of fossil fuel and accounts for more than one third of the total crude oil consumption.

From the several tests it is identified that challenges are involved in improving the performance of the system.

II BASIC CONFIGURATION OF ELECTRIC BICYCLE SYSTEM

The Configuration of the Electric bicycle system consists of a controller that controls the power flow from the battery to the electric motor. This power acts in parallel with the power delivered by the rider via the pedal of the bike (figure 1)

The rider of Electric bicycle can choose to

- Relay on the motor completely
- Pedal and use the motor at the same time
- Pedal only (as a conventional bicycle)

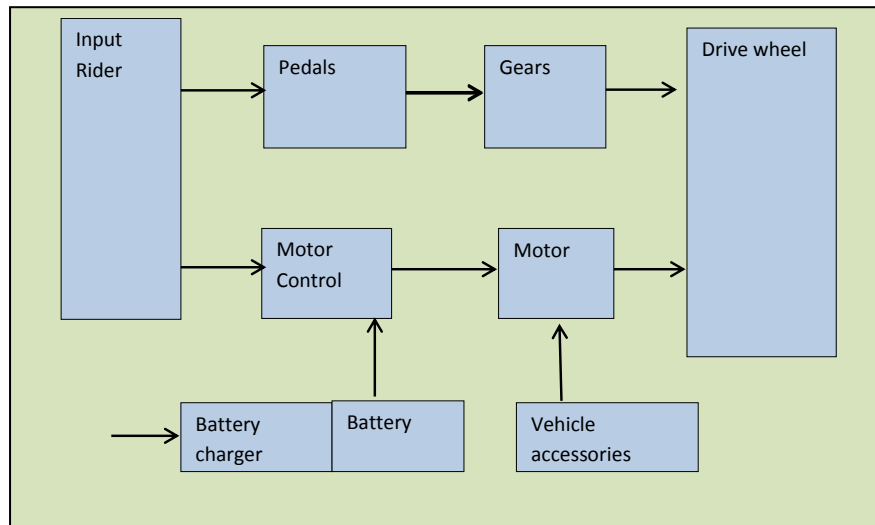


Figure.1

For the experimental investigation an electric bicycle with brushed DC motor installed in the front hub, a controller, thumb throttle and a battery pack are used(Figure 2) The Electric hub motor in the front wheel is not used during the measurements, yet using this bicycle, the actual setup of an electric bicycle is represented. The torque and speed are directly measured in the hub of the rear wheel using a power tap hub[2].



III ADVANTAGES OF USING ELECTRIC BICYCLE

Electric bicycles are gaining popularity worldwide specially in china, japan, Europe, Taiwan and United states because of its several beneficial features.. Today China is the largest manufacturer of the Electric bicycles exporting the majority of Electric bicycles also meeting the local demand. According to china's Electric Bike General Technical Qualification GB17761-1999[1]chinese electric bicycles may not exceed 20km/h and may not be heavier than 40kg .Number of aspects favour the use of electric bicycles in different situations. These

include lower energy cost per distance travelled(1-2% of the cost travelled by car) for a single rider, environmental friendliness and health benefit for the rider.(Table 1)

TABLE 1: ADVANTAGES OF USING ELECTRIC BICYCLE	
Energy Cost:	
- Rs. 2.82/km for going by car - Rs.0.45/km for going by electric bicycle	
Other costs: Generally no licence ,no registration and no parking fee.	
Environmental friendliness: Zero emission vehicle	
Health Benefit: Incorporation of exercise and longer distance commuting	
Traffic flow: Most countries allow	

IV PERFORMANCE RANGE OF COMMERCIALLY AVAILABLE ELECTRIC BICYCLES

TABLE 2:PERFORMANCE RANGE OF COMMERCIALLY AVAILABLE ELECTRIC BICYCLES		
Speed		
Average speed	12 mi/h	19km/h
Maximum speed	20mi/h	32km/h
Travel range (full charge)	10-50 miles	16-80 km
Batteries		
Charging time	2-6 hrs	
Cycles of charge/discharge	Upto 400	
Power		
Power consumption (each full charge)	100-500wh	
On board power supply	12-36V	
Torque		
Hill climbing ability	Up to 6% slope	
Weight		
Electric bicycle kit excluding original bicycle weight	4.6-22.8kg	
Price		
Electric bicycle kit only	Rs.16K-52K	
Electric bicycle kit and bicycle	Rs.52K-167k	

Table 2 gives a comparative overview of the performance ranges of today's commercially available electric bicycles. It gives clear picture how widely the specifications of electric bicycles vary according to the bicycle design and the riding conditions for which the electric bicycle is designed.

V CLASSIFICATION OF ELECTRIC BICYCLES

Criteria for classification of electric bicycles have been determined such that they are independent of the country and the purpose of use. These are the bicycle kit type, motor type, motor assembly, assist type, throttle type, motor placement and battery type (Table 3).

TABLE 3: CLASSIFICATION OF ELECTRIC BICYCLES		
Bicycle kit type	• Custom built • Add on	Table 4
Motor type	• Brushed DC motor • Brushless DC motor	Table 5
Motor Assembly	• Gear • Hub • Friction	Table 6
Assist	• Full Assist • Half Assist	Table 7
Throttle type	• Thumb throttle • Twist throttle • Push Button	Table 8
Motor Placement	• Front Wheel • Rear wheel	Table 9
Battery type	• Lead Acid • NiMH • Others	Table 10

TABLE 4: ADVANTAGES AND DISADVANTAGES OF DIFFERENT BICYCLE KIT TYPES

Bicycle Kit Type	
Custom built	Add on
Advantages	Advantages
High end bicycles Good appearance Safety features Little/no installation required	• Comparatively inexpensive • Mounting flexibility • Suitable for different bicycle types • Bicycle can be reconverted to a conventional types
Disadvantages	Disadvantages
Comparatively high cost	Installation needed Connections may not be robust

TABLE 5: ADVANTAGES AND DISADVANTAGES OF DIFFERENT MOTOR TYPE

Motor type	
Brushed DC motor	Brushless DC motor
Advantages Simple controller	Advantages Higher efficiency and brushed motor Comparatively reduced size
Disadvantages Lower efficiency Bigger in size and difficult in mounting into the fork of the bicycle	Disadvantages More complex controller

TABLE 6: ADVANTAGES AND DISADVANTAGES OF DIFFERENT MOTOR ASSEMBLY TYPES

Motor Assembly type		
Gear	Hub	Friction
Advantages - Provides desired gear reduction ratio - Enables easier torque sensing/adjustment	Advantages - Motor integrated in the wheel - Easy mounting - Minimal maintainance	Advantages Light weight
Disadvantages - Chain/belt may be entangled - Chain/belt may need maintenance lubrication/tension	Disadvantages - Can be heavy - Significant shift of the centre of gravity	Disadvantages - Less efficient due to friction loss - Tires wearout easily

Note: Table 7 and Table 8 are excluded from the view of length of paper

TABLE 9: ADVANTAGES AND DISADVANTAGES OF DIFFERENT MOTOR PLACEMENT TYPES

Front	Rear
Advantages - Comparatively easy installation - Good weight distribution - Suitable for low land and hilly regions with good road	Advantages - Best for light weight vehicles - Better traction for hill climbing - Suitable for mountaneous regions and poor ground conditions
Disadvantages Front wheel slides are more dangerous than rear wheel slides	Disadvantages Comparatively complex installation

VI SPECIAL PURPOSE DESIGN OF ELECTRIC BICYCLES

Bicycles are designed according the user requirements for example city bicycles

Hill bicycles requires

Need fast acceleration and frequent stops with an average power of 150w and an average speed of 16km/h

High torque capability and maximum power of 300w @13km/h for short time

Speedy bicycles requires

High speed of 30km/h with average power of 200w in cycling racing

VII CONCLUSIONS

The issues associated with the electric bicycles may be addressed with custom designed drives, that are more efficient over a given operating cycle .These include city bicycles ,distant bicycles, hill climbing bicycles and speedy bicycles.

Overall performance and cost of the system need more attention towards the development the Electric bicycles according the custom needs. Also power source for the electric bicycle is one of the major area where more investigations are required to be done.

REFERENCES

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