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HIRASUGAR INSTITUTE OF TECHNOLOGY, NIDASOSHI-591236

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

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A PROJECT SYNOPSIS ON

"Design and Implementation of Hybrid Powered Multifunction Bicycle"

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Introduction

Increase in the number of travelling vehicles has increased the problems such as air pollution and to the use of petroleum. The human sensibility for the energetic and environmental problem is encouraging the research in alternative solutions for the automotive field, as multiple-fuelling, hybridization and electrification. At the same time the systems are modified considering the current problems. For this the solution is the electrically assisted bicycles. The electrically assisted bikes are normally powered by rechargeable battery, and their driving performance is influenced by battery capacity, motor power, road types, operation weight, control, and, particularly, by the management of the assisted power.

Proposed system is combination electric hybrid vehicle using solar energy, pedalling action and the battery (electric charge). The system is designed specifically for multiple applications and the battery outlet can also be used for agricultural applications as well as household lighting applications. The proposed system is designed with the objective of providing a hybrid self-charging low-cost mode of transport for the rural community.

OBJECTIVES

1. To develop a Hybrid Electric Vehicle which can be powered using hybrid sources

   i.e., Human efforts, electric and solar energy.

2. To develop a regenerative charging system.

3. To implement solar energy-based charging system.

4. To build a multipurpose e-bicycle.

The System will be demonstrated by building a low-cost hybrid electric bicycle which can be used as low-cost daily mode of transportation mostly focused for rural community.

METHODOLOGY

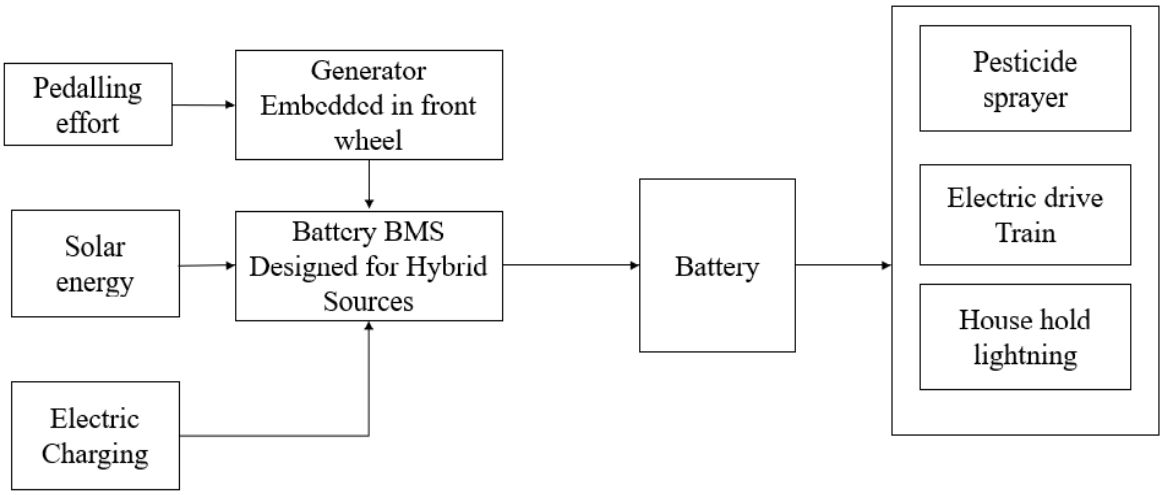


Fig:4.1 Block Diagram

As shown in the block diagram the project consists of the concept solar powered multifunction bicycle. As shown the project can be consists of development of a low-cost electric bicycle which can be powered by three sources, human energy, electric energy and the solar energy. The Innovation is done in the way the bike manages to help boost the battery backup collecting the surplus energy from the generator embedded in the front wheel of the vehicle to charge the battery. When the person rides this bicycle from battery source or by pedalling action, the rear wheel is used to drive the bicycle and the front wheel is used to regenerate the part of energy which will be used for charging the battery recovering some amount of the energy. The project also consists of detachable solar power source which can be used to charge the battery using solar energy. The solar power source can also be used to power other applications such as agricultural pumps as well of household lighting if desired. Further regenerative charging system will continuously charge the battery which the bicycle is in motion.

DESIGN:

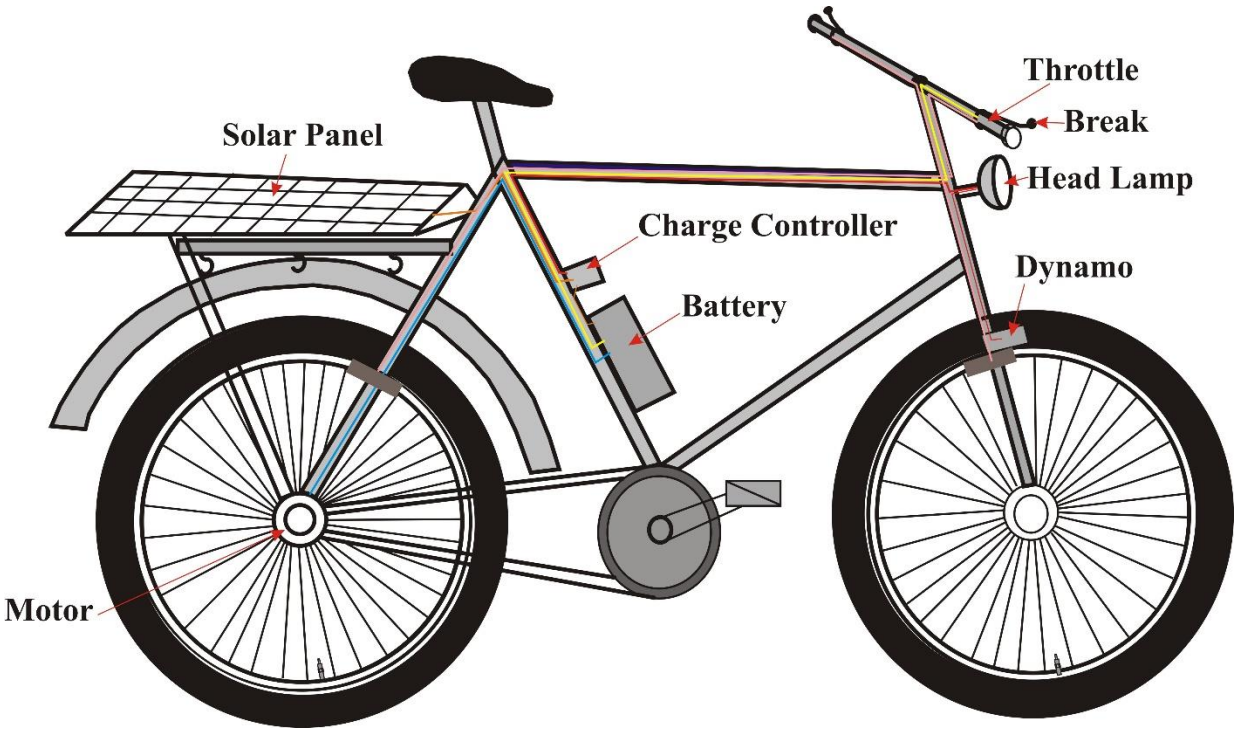


Fig:7.1. Bicycle Design

Diameter of the bicycle wheel D = 0.8m Radius r = 0.4m

Speed required s = 20km/hr

Bicycle weight Wb= 25kg

Weight of the rider (Approximately) Wr = 75 kg

Total weight Wt = 100 kg

Power calculation:

Normal reaction on each tyre Wn = Wt/2 = 50 kg

Force F = Wn * g = 50* 9.81 =490.5 N

1. Considering static friction:

   friction coefficient u = 0.03

   Fs = u * F = 0.03 * 490.5 = 14.71 N

   Torque Ts = Fs * r = 14.71 * 0.4 = 5.88 Nm

2. Considering dynamic friction:

friction coefficient u = 0.004

Fd = u * F = 0.004 * 490.5 = 1.962N

Torque Td= Fd* r = 1.962 * 0.4 = 0.7848 Nm

3. Angular Speed: w = velocity/radius

= 20,000/ (0.4*3600) = 13.88 rad/sec

Power Requirements:

1. On plane Ground

for initial condition Ps = Ts*w = 5.88 * 13. = 81.66 W

for dynamic condition Pd = Td * w = 10.89 W

Overall power requirement = 92.55 * 2 = 185.1W

2. On inclined surface

let angle of inclination a = 2^0

total force required is

a] considering static friction

F = u * m*g * cos (a) + m*g sin (a) =63.64 N

therefore, power required = F*V = 353.55 W

Extra power required = 353.55 – 185.1 = 168.45 W

b] considering dynamic friction

F = u * m*g * cos (a) + m*g sin (a)= 38.15 N

Power P = F*V = 211.94 W

By considering the above calculations we require 250W motor.

Calculation of charging time of battery:

Charging time of battery = Battery Ah / charging current.

Charging time for 14Ah battery = 14 Ah/ 3 A = 4.66 Hrs.

It is for ideal cases…

Practically, it has been noted that 40% losses occur in case of battery charging.

Then 14*(40/100) =5.66Ah.

Therefore, 14+5.66 = 19.6Ah (14Ah + losses)

Now, charging time of battery = 19.6Ah /3A = 6.53 Hrs.

Selection of solar panel:

If we use a panel of 40 W ,24V

Charging time of battery = Battery Ah / charging current

Charging time = 14 Ah / 1.66 A= 8.66 Hrs

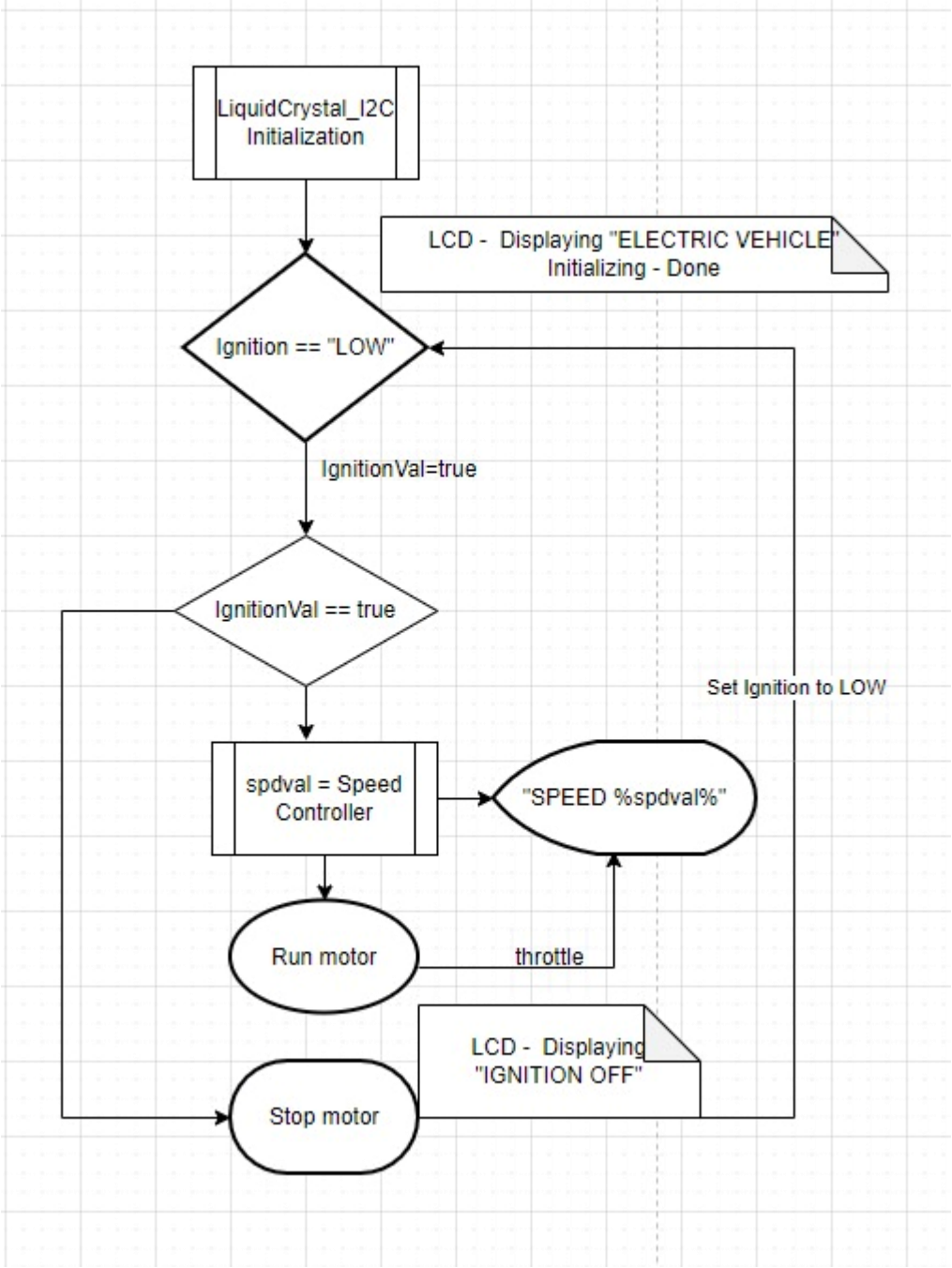
Size=350x540x35 mm

Selection of battery

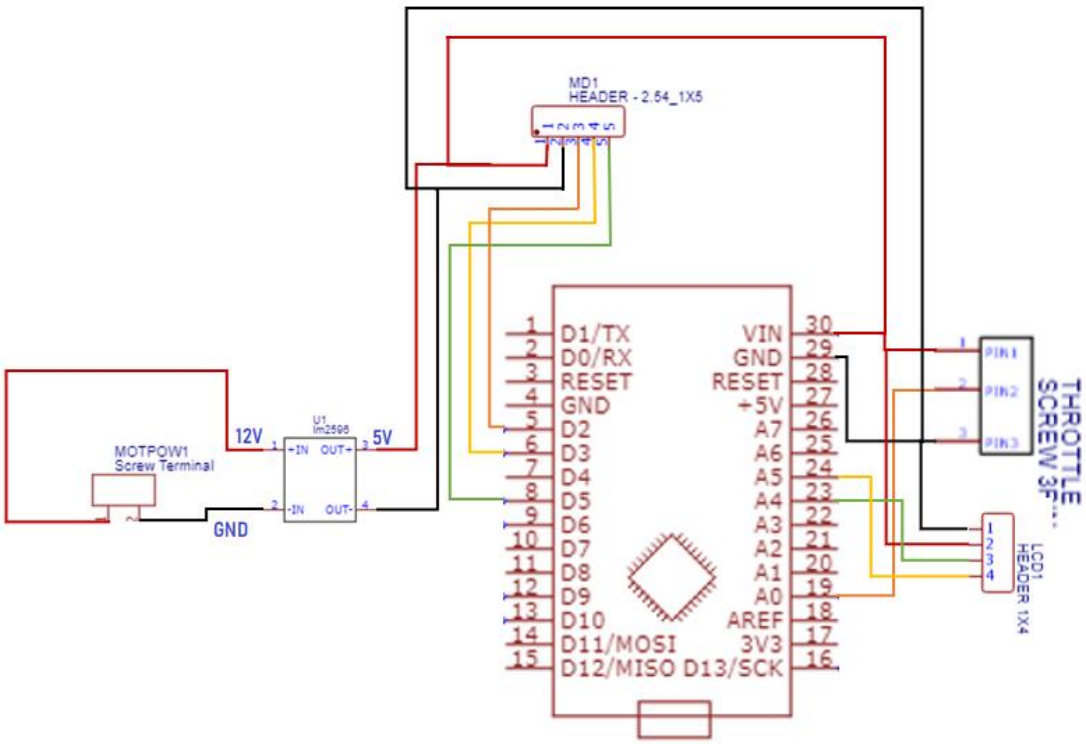
Two of 12V, 14Ah battery can be used

24*14=336 W

Flow Chart


LiquidCrystal_I2C Initialization
LCD - Displaying "ELECTRIC VEHICLE"
Initializing - Done
Ignition == "LOW"
IgnitionVal=true
IgnitionVal == true
Set Ignition to LOW
spdval = Speed Controller
"SPEED %spdval%"
Run motor
throttle
LCD - Displaying "IGNITION OFF"
Stop motor

Circuit Diagram of Speed Controller of Motor



In the above circuit diagram, we have used various components like Arduino Nano, Throttle, Motor, Battery, And Converter. Arduino Nano require 5V to Operate but from battery we get 12V DC but to supply 5V to operate Arduino Nano we convert 12V to 5V by converter. There is a code to control the speed of the motor and to display the battery status and speed of the bicycle in Arduino Nano. From the throttle sensor position of the throttle will sense and sensed input is given to the Arduino Nano. From Arduino Nano signal is given to the motor and even control the battery input to the motor. As we change the position of the throttle the input to the motor through battery gets changed So that we can control over the speed of the motor.

RESULTS

Fig.11.1. Hardware Model of Bicycle

After the completion of the project the following results are obtained.

Following table gives the reading of vehicle

Load	**Km/hr**
Without load	15 km/hr
With load (one person of 67kg)	12-15 km/hr

Following table gives the reading of Solar Panel

Time	**Voltage**
Early Morning	16.34V
Morning	28.3V
Afternoon	31V
Evening	12.6V

Following table gives the reading of Dynamo

Speed in rpm	**Voltage**
2800	12.6V
1400	6.015V
700	2.89V
1800	7.89V

Here, the average battery charging time is 7hrs 35 min. The bicycle will run on road Top speed of 15 kmph. It has the average economical riding speed for max range of 12-15 kmph. It can travel up to 30km at one full charge. we have the battery peak voltage of 24V, our motor excitation voltage of 24V and Current rating of battery is 8.3Ah and voltage rating of battery is 24V.

CONCLUSION

The proposed project deals with the concept of solar powered multifunction bicycle. From the proposed project it can be concluded that the project provides solution to low-cost eco-friendly transport system for specifically developed keeping the rural community in mind. The bicycle has the provision to be driven using hybrid sources including solar energy, human efforts aka pedal energy as well as the battery source. To increase the battery backup the proposed project uses energy regeneration and recovery using the generator embedded in the front wheel of the bicycle. This generates the electricity and charges the battery when the cycle is in motion. The proposed system is also expected to provide a solar mode of charging for electric bicycle which uses solar panel on the cycle to charge the battery. In addition, the solar panel can also be used to power other applications such as agricultural pumps and household lighting in villages.

Innovations in the Project

1. This is Hybrid Electric Bicycle which can be powered using hybrid sources i.e., Human efforts, electricity and solar energy.
2. A regenerative charging system.
3. Implement solar energy-based charging system.
4. Build a multipurpose e-bicycle.

Scope of Future Work

1. Sprocket design can be modified
2. Can improve the Battery management system by using modern accessories.
3. Gearbox can be used to achieve required torque and speed.
4. Different methods can be implemented to display the distance travelled and can predict the remaining battery capacity status,
5. We can use solar tracking system to extract more energy from the sun.
6. Battery box we used van be altered.