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Design of Hybrid Electric Cycle with Automatic Speed Breaker Alert System

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Abstract: It is very well known that fossils fuels are depleting and renewable energy sources are gaining importance day by day. Among various renewable energy sources, solar energy seems to be a reliable and viable one. Hence, in this work solar energy is used as the main source of supply. The present work comprises of two modules, the first module focuses on design of hybrid electric vehicle which runs by solar powered PV panel, and the second module involves automatic detection of speed breakers. The hybrid vehicle also has an option of pedalling based on driver's choice. It is also ensured in design that motoring operation is not interrupted by the pedalling. Nowadays, vehicles are prone to accidents frequently, because of misheeding of speed breakers on the road either by over speeding or driver becoming unconscious. The second module of our project tries to overcome the above issue. This is implemented by detecting and exact location of speed breakers using vibration sensor and GPS and thereby giving an automatic alert to the driver.

Keywords: Solar PV panel, Arduino micro controller, vibration sensor, GPS.

I. INTRODUCTION

A lot of studies revealed the supply of fossil fuels are limited. Researchers have also identified the impacts of using fossil fuel energy on global climate change.

The demand for energy is increasing as the world population grows and the economic growth in many developing countries as well as the developed countries. The energy crises can be anticipated in the near futures.

Alternative energy opposed to fossil fuels ought to be explored earlier rather than late.

Renewable energy such as solar energy can provide a long term solution and it can minimize global climate change. The main objective of this work is to convert an ordinary cycle into a hybrid electric vehicle and to implement an automatic speed breaker alert to the drivers to prevent the occurrence of accidents due to misheeding of speed breaker.

II. SYSTEM DESIGN

A. Objectives

The main objective of this work is to transform the ordinary bicycle into an electric vehicle and automatic speed breaker detection. The design of a hybrid electric cycle is an energy management strategy problem between two sources of power.

The value of crude keeps on increasing every day and it becomes tough to cope with the ever growing price.

The electric bicycle module will promote each cleaner technology also as a lesser dependence on oil. It will run on clean power with the flexibility to recharge a battery.

Nowadays vehicles are prone to accidents frequently, because of misheeding of speed breakers on the road either by over speeding or driver becoming unconscious.

The second module of the proposed work tries to overcome the above issue.

This is implemented by detecting and exact location of speed breakers using vibration sensor and GPS and thereby giving an automatic alert to the driver.

The block diagram of Module 1 and Module 2 of the proposed work is shown in Figure 1 and Figure 2 respectively.

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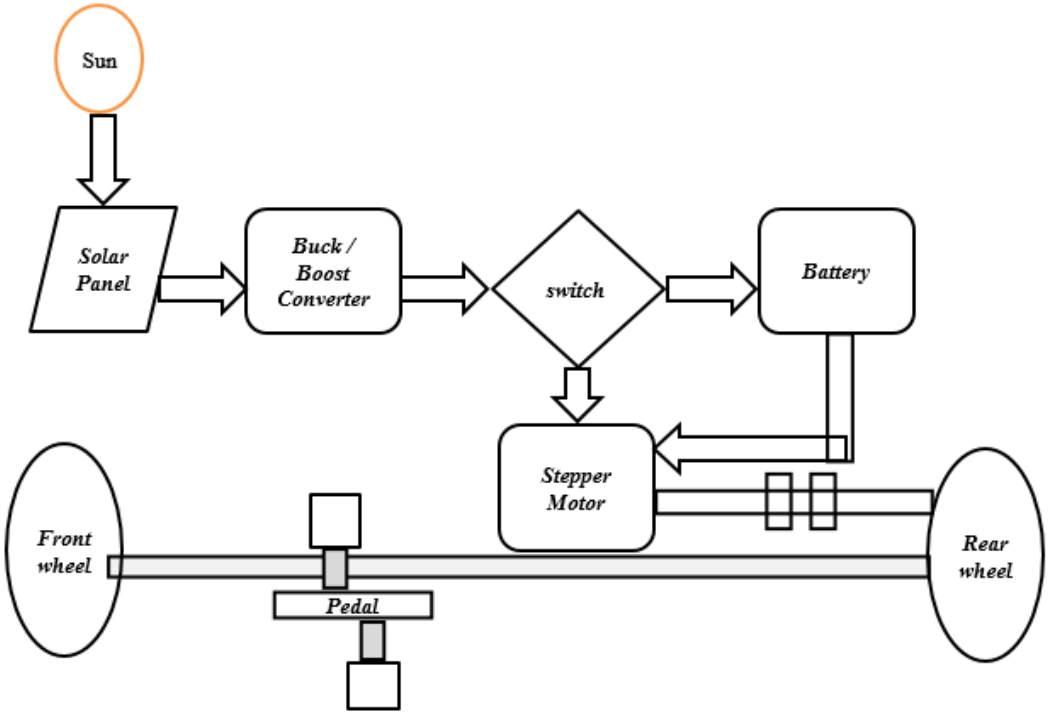

Figure 1. Block Diagram of Module 1 (Hybrid Electric Vehicle Driven in Motor Drive Mode)

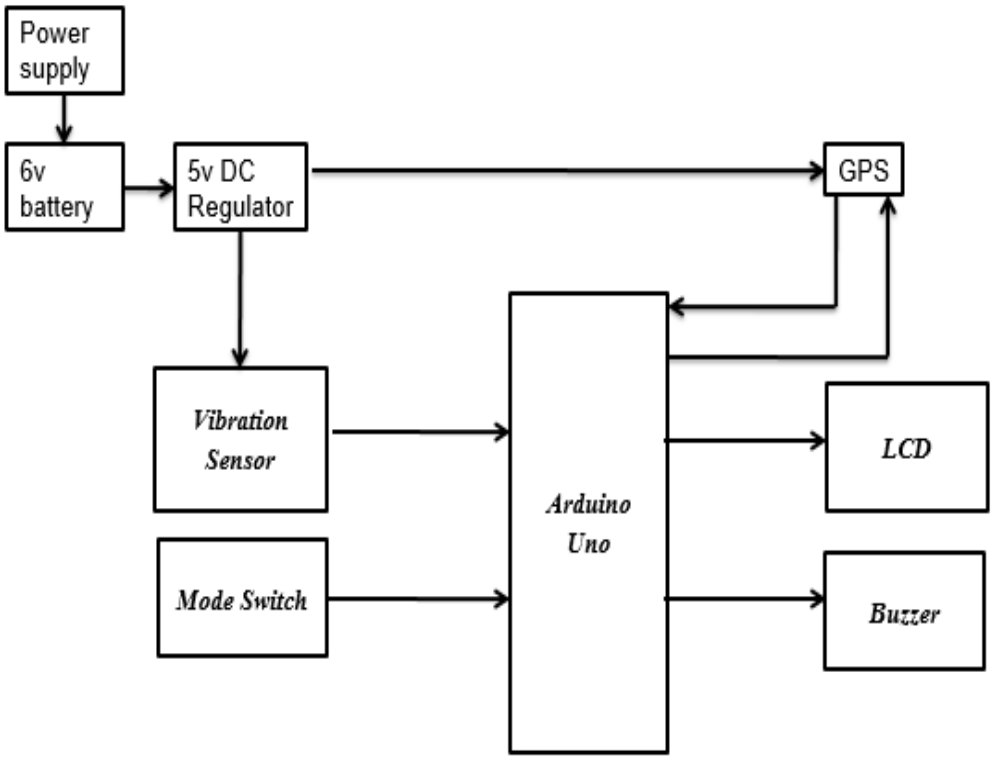

Figure 2. Block Diagram of Module 2 (Speed Breaker Alert System)

III. COMPONENTS DESCRIPTION

A. Components for Module 1

Solar panels convert solar energy into electrical energy by photovoltaic principle. The basic functional unit of a solar PV array is a solar cell which comprises of semiconducting materials. The energy of the photon, overcomes the barrier potential by removing electrons from the N-type material. This creates free motion of electron from the N-type to P-

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type and the conventional direct current flows from P-type to N-type. This project works an 18.5volt, ampere, watts PV panel.

The buck-boost converter is a type of DC to DC converter that has an output voltage that is either greater or lesser than the input voltage. It is equivalent to a flyback converter using a single inductor instead of a transformer. In the present work, the buck-boost converter is used to reduce the output voltage from the panel to 12V. A 12V Battery is used to store the energy obtained from PV panels. The Type of battery used is Lead Acid Rechargeable Battery with a rating of 12V, 3AH connected in series charging mode. A 12V rated wiper motor is used in this work which provides the required starting and pulling torque to drive the cycle.

B. Components for Module 2

Arduino bridges the gap between the physical and real world, it senses and controls objects and other digital devices. Arduino board comprises of a variety of microprocessors and controllers. Expansion boards and circuits can be interfaced with the Arduino board using sets of digital and analog (I/O) pins in it. It also has a provision for loading programs from the personal computer using serial communication interfaces like Universal serial bus. In this work, Arduino UNO R3 board is used for control operation.

The GPS module receives information from the satellite constellation, calculates the latitudinal and longitudinal direction and locates the exact position of the device on earth. It receives signal from the antenna which is converted into digital signal, processed and the exact location is sensed using navigation processor. It also uses a real time clock. The entire information is displayed in the display unit. It uses 5V DC supply.

The 5V dc regulator uses two electrolytic capacitors, a heat sink,7805 IC, 1kΩ resistor and an LED.IC7805 regulates the output voltage to 5V dc. The threshold limit up to which the IC is designed to perform regulation is 35V. If the voltage is near 7.5 then the IC does not require any sink to dissipate heat but above 7.5 it starts producing heat slowly.

The vibration sensor requires a 5V dc supply. If it suffers any kind of abnormal vibration, those physical input is converted into equivalent analog signal and fed to the Arduino board. If it is a small vibration the signal is small, if it is an abnormal vibration then the sensor produces a serious of impulses by which the Arduino identifies the disturbance as speed breaker.

IV. METHODOLOGY OF PROPOSED WORK

A. Methodology for Module 1

The module 1 has been designed to operate in two modes as shown in Figure 3, normal mode and direct drive mode. In normal mode the motor is fed from the battery. In direct drive mode the motor is fed direct from the PV panel. Initially, the voltage is reduced to 12V using a buck converter and it is stored in a 12V battery. This battery serves as input supply for the wiper motor during normal mode. An ordinary relay switch is used to switchover between the two modes. The operator also has an option for pedaling. Two separate chains are used for pedaling and motoring operation so as to ensure that the motoring operation is never interrupted by pedaling operation.

Figure 3. Hardware Design of Module 1

B. Methodology for Module 2

The second module of the proposed work is supplied by a 6V battery. A 5V dc regulator regulates the power and provides it to the vibration sensor, Arduino board and GPS module. The GPS keeps on receiving the data from the satellite and sends it to the Arduino. When the cycle experiences a high vibration in the speed breaker the vibration

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sensor senses it and sends data to the Arduino, The Arduino records the latitudinal and longitudinal direction of the position where the abnormal vibration, if any, is sensed. If the operator happens to travel in the same road again, the GPS data will definitely match with the recorded data in the Arduino. As a result, when the same speed breaker is encountered in future, the operator is alerted by a buzzer sound and also by an alert message in the LCD.

Figure 4. Hardware Design of Module 2

C. Complete Hardware Setup of the Prototype Model

The full hardware setup of the Hybrid Electric Cycle with motor, solar panel and battery fitted in ready to operate in motor drive mode is shown in Figure 5. The hardware setup of the speed breaker detection in the roads and alert system is shown in Figure 6.

Figure 5. Hardware Setup of Hybrid Electric Cycle

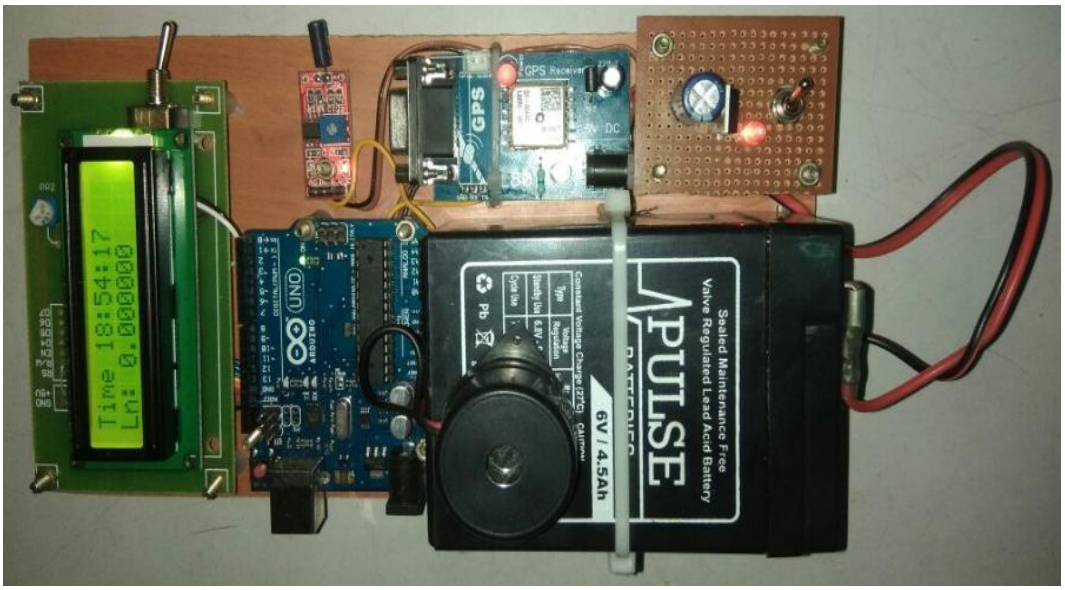

Figure 6. Hardware Setup of Speed Breaker etection System

C. Future Scope of Work

The present work can be further improvised by implementing regenerative braking so that energy during braking can be supplied back to it. A mobile application can be developed, so that alert message can be sent to the mobile itself. Acceleration of the vehicle can be carried out using various speed control techniques.

V. CONCLUSION

An ordinary cycle is successfully converted into a solar fed hybrid electric vehicle without losing any of the user's comfort. The driver can prefer either pedaling or motoring. The driver's safety is also ensured because he is provided with an alert signal whenever he comes across the same speed breaker he traversed before.

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BIOGRAPHIES

Dr. S. Kalyani is working as Professor & Head, Department of EEE in Kamaraj College of Engineering and Technology under Anna University, Chennai, Tamilnadu, India. She has a rich teaching experience of 15 years. She has published many papers in referred Journals and Conference Proceedings. She is a member of ISTE, IE(India), IEEE and IAEng. Her research areas of interest include Machine learning, Renewable energy, Power System dynamics and Soft Computing techniques.

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