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Smart Share E-Cycle for Eliminating Docking Station using BLDC Motor

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ABSTRACT:The growing population and pollution in the smart city urge an efficient transportation sharing system. As we know E-cycle sharing is an affordable, easily accessible and reliable. An efficient cycle sharing system provides information about the availability of share cycles near to the user, route condition, daily cycle schedule. The sensors provided within the cycle can communicate via wireless communication, providing real-time data about hired time, speed of the vehicle, nearest charging station, etc. This cycle is provided with a conversion kit that has a hub motor which can convert the operation of the cycle from mechanical to electrical and vice-versa. Other than the conversion kit it has a battery, hub motor, controller, GPS module, and sensors& actuators for locking and unlocking. Another important feature is that the user can lock and leave the cycle at his convenience. Thus, elimination of docking stations

KEYWORDS:E-Cycle, Zero Docking Station, Share Cycle, BLDC motor.

I.INTRODUCTION

Smart city demand for energy-efficient transport system also emphasizes on sharing system for utilization of the vehicle. Sharing an e-cycle system has various benefits like appropriate resource management, reducing pollution, leading to improved health. To motivate the e-cycle use, a modular conversion kit is designed. This kit can be assembled into a conventional cycle by a layman. For this conversion kit to be more efficient a BLDC motor is used and gears are eliminated by adopting direct drive in the wheel design. Apart from the motor the kit owns a throttler, dual battery, RFID-based battery locking, and unlocking system, OTP-based rental system, LCD screen display, controlling units, and backups. The motivation of our work is to enhance the efficiency of an e-cycle sharing system by making cycles smart by deploying sensors on the cycle that will help in collecting real- time data. In, recent years the popularity of an e-cycle sharing program has shown vital growth. Another reason is easily accessible and economical in promoting short term e-cycle rental system. There would be less congestion for commuters in traffic of the car parking. Tourists can also enjoy hassle-free travel without changing multiple busses and taxis. The environment also gets the benefit of less smog after a weekday commute. Cities are managing the development and urban living culture is facing major challenges in our daily lives. Based on statistical data of 2007, half of the population of the world was living their lives in cities. UN population fund forecasts that by the end of 2030 nearly 60 percent of the world population would live their lives in cities. Out of all major issues, we can outline, air quality, environ- mental crisis, and transportation issues. The use of a bicycle is an important mode of transportation that could be helpful to many urban transportation issues. As the use of motor vehicles is increasing problems like cost, congestion, accidents, loss of amenity and space, noise, air pollution, energy consumption and harm the natural environment. In the future, the use of the e-cycle as transport should be the transportation solution for cities as it has no adverse effects.

II.SYSTEM MODEL AND ASSUMPTIONS

The proposed model negotiates the idea of sharing a conventional cycle in a smart way. The sharing is done via OTP which makes the system more convenient to use. The location detail of the cycle is obtained with the help of GPS module. As soon as the renter hires the cycle, he/she can locate the cycle and unlock it with the OTP. Soon after the cycle is unlocked the motor is engaged so that user can ride cycle with motor power, meanwhile a timer is displayed on the cycle screen to notify the user about the time left. This system provides a bonus 3 minutes after the hired time which the user can pedal without motor assist. This time should be utilized for parking at a convenient location. This basic model is shown in figure 1.

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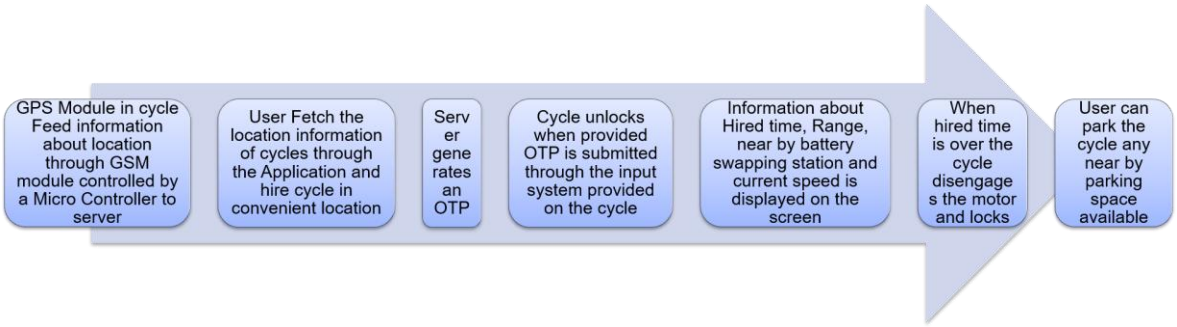

Fig.1. Basic model of smart share e-cycle

This system has a hub motor (BLDC) which also acts as generator during regenerative braking and mechanical pedalling. The electronic commutation for the motor is provided by a motor controller which is basically a 3-phase inverter system. This motor is powered by 2 Li- ion battery packs that isconstructed by 26nos of 18650 individual batteries connected in 13S2P configuration to provide a nominal voltage of 48.1 V and electrical charge of 5 Ah. Even though there are 2 batteries to power the motor, only one battery is used at a time. The second battery is switched after the first battery is completely exhausted.

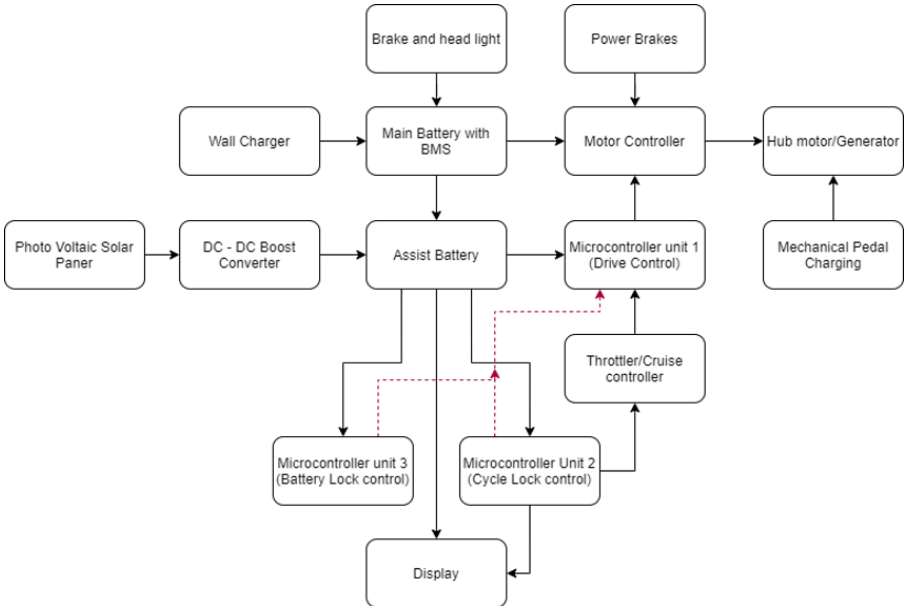

Fig.2.Block diagram of smart sharing e-cycle

The system has 3 microcontroller units which will enhance the performance of the system as a whole. The microcontroller unit 1 is equipped with a 3-axis gyroscope to identify the slope of the terrain and assist during hill climb and descent. This will also improve the efficiency of the system by limiting the power to motor during hill descent. Second microcontroller unit has the GPS and GSM modules to communicate with the user and also to govern the locking and unlocking of the cycle using a stepper motor. Third microcontroller is in charge of locking and unlocking the battery cabinet, which can be unlocked using a RFID tag which will also helps in monitoring the count of batteries in different battery swapping stations.

The microcontroller units in this system are powered by an assist battery of 12 volts, which is charged by a photovoltaic panel so that it will never get exhausted.

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III.MATLAB SIMULATION

The simulation model of sensored BLDC motor is shown in figure 3.

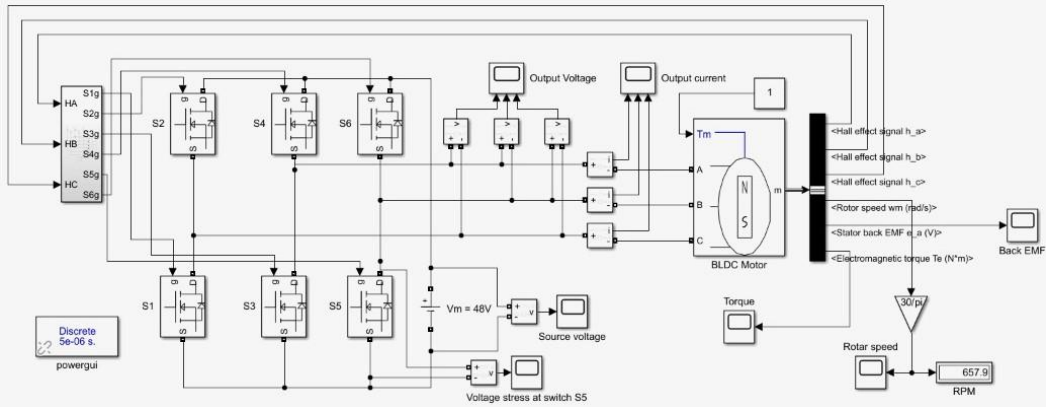

Fig.3. Simulink model

Source voltage of 48 V is fed as input and the torque constant of the motor also is defined. As a result, we obtained the output RPM as 650 and a trapezoidal back emf.

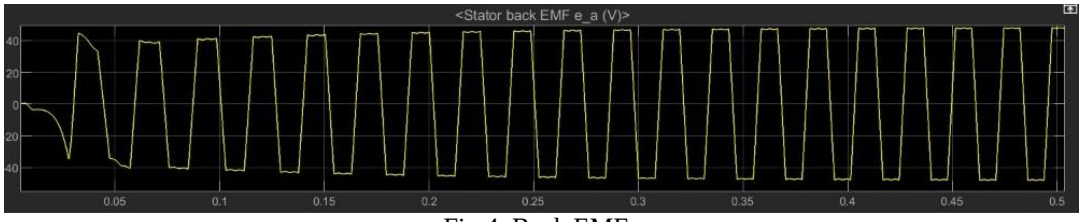

Fig.4. Back EMF

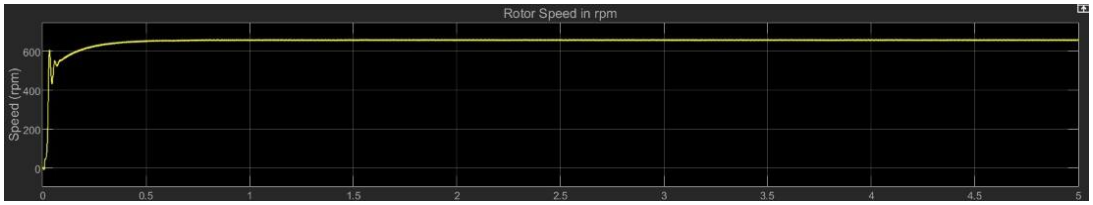

Fig.5. Rotor Speed

IV.CONCLUSION

We have represented a detailed design, implementation plan and evaluation of smartsharing E-Cycle system along with sensor networking techniques. Collected data couldbe presented both locally to the cyclist and others as well through back-end services.The E-Cycle sharing portal concept promotes a social and friendly network amongcyclists. Our smart sharing E-Cycle system allows the users to easily book a cycleusing the website at any time without human intervention. A user can take the cyclefrom the nearest available location via OTP. Thus, no docking station is required.This OTP expires after the time of rental. The user can lock and leave the cycle atany location at his convenience. The GPS module used in the system will trace thee-cycle and update the information of the cycle position each time. No chargingstation is required for this design since it uses a battery swapping mechanism. ALonger range can be covered using battery swapping. Other features are regenerativebraking, hill ascent, and descent assist, RFID-based battery swapping, rider accidentnotifier, and a parallel hybrid powertrain. In the future when conventional sources ofenergy would be scarce, the e-cycle share system will provide an effective means of transport and within the city, it can be made compulsory to travel through cycles.

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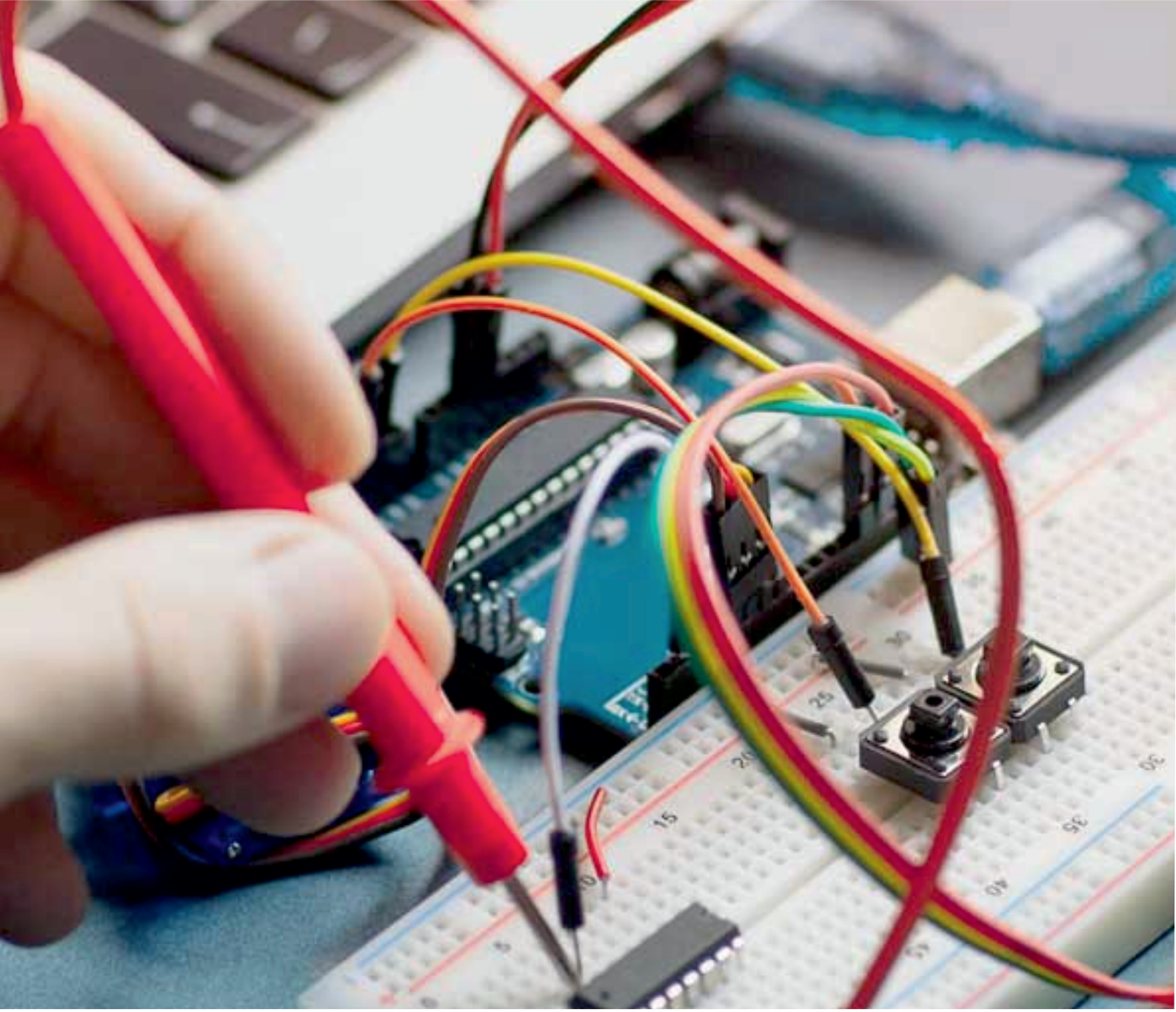

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