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Online Estimation of SoC and Range in Electric Vehicle with IoT Integration

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Abstract

This project describes the IoT based SOC estimation of battery at the electric vehicle and Range estimation of the vehicle based on the voltage and current calculation. To improve the convenience of the Electric vehicle. State of charge is the level of charge of electric charge battery Relative to its capacity. The units of soc are percentage points 0%=empty; 100%=full. An alternative from of the same measure is the depth of discharge DoD, the inverse of SoC 100%=empty; 0%=full. In this research, the state of charge of the battery is determined and the battery is allowed to charge or discharge by standard reference current, since the overcharging and undercharging would affect the battery performance. So a battery should not be fully charged or discharged, because overcharging of a battery will affect the life time of the battery and undercharging of a battery will increase the initial charging time. Online estimation to determine SOC of battery is attempted in the proposed work with the electrical parameters which is developed using an intelligent controller.

Keywords: Electric Vehicle, IoT, SoC, Intelligent Controller.

1. Introduction

Rising crude oil prices and worldwide awareness of environmental issues have resulted in increased development of energy storage systems. The battery is one of the most attractive energy storage systems because of its high efficiency and low pollution. There are several kinds of batteries currently being used in industry: lead-acid battery, Ni-MH battery, Ni-Cd battery, and Li-ion battery. The battery has the advantages of high working cell voltage, low pollution, low self-discharge rate, and high power density.

SoC estimation is a fundamental challenge for battery use. The SOC of a battery, which is used to describe its remaining capacity, is a very important parameter for a control strategy .As the SoC is an important parameter, which reflects the battery performance, so accurate estimation of the SoC can not only protect battery, prevent over discharge, and improve the battery life but also allow the application to make rational control strategies to save energy. This project presents a detailed review on existing mathematical methods used in SoC estimation and further identifies possible developments in the future SoC is normally used when discussing the current state of a battery in use, while DoD is most often seen when discussion the lifetime of the battery after repeated use. In a battery electric vehicle, hybrid vehicle (HV), or plug-in hybrid electric vehicle (PHEV), SoC for the battery pack is the equivalent of a fuel gauge. It is important to mention that state of charge, presented as a gauge or perceptual value at any vehicle Dash board, especially in plug-in hybrid vehicles, may not be representative for a real level of charge.

1.1. Electric Bike

An electric bicycle also known as an e-bike or ebike is a bicycle with an integrated electric motor which can be used to assist propulsion. Many kinds of e-bikes are available worldwide, but generally fall into two broad categories. Bikes that assist the rider's pedal-power and bikes that add a throttle, integrating moped-style functionality. Both retain the ability to be pedalled by the rider and are therefore not electric motorcycles.

E-bikes use rechargeable batteries and typically travel up to 25 to 32 km/h (16 to 20 mph). High-powered varieties can often travel more than 45 km/h (28 mph). In some markets, such as Germany as of 2013, they are gaining in popularity and taking some market share away from conventional bicycles, while in others, such as China as of 2010, they are replacing fossil fuel-powered mopeds and small motorcycles.

An electric bicycle also known as an e-bike or ebike is a bicycle with an integrated electric motor which can be used to assist propulsion. Many kinds of e-bikes are available worldwide, but generally fall into two broad categories. Bikes that assist the rider's pedal-power and bikes that add a throttle, integrating moped-style functionality. Both retain the ability to be pedalled by the rider and are therefore not electric motorcycles.

E-bikes function like hybrid electric vehicles since the electric motor combines battery propulsion with another source of electricity but this time by pedal power instead of internal combustion engine power so in some cases the terms used would be hybrid electric bicycle or hybrid pedal-electric bicycle. Depending on local laws, many e-bikes (e.g., pedicels) are legally classified as bicycles rather than mopeds or motorcycles.

2. Literature Review

2.1 Two Wheel-Drive Electric Motorcycle Having a Braking Controller

In the past few decades, the extent of damage to the Earth's environment as technology advances becomes more and more serious. To reduce the destruction and make the best use of renewable energy, electric vehicles (EVs) have been considering as the environmental friendly solution in transportation. Among these, electric bikes and motorbikes are considering as the most convenient and helpful vehicle for short range transportation. The electric bike considered here adopts a customized brushless DC hub motor (BLDCHM) in the rear wheel which is designed with sinusoidal back-EMF like a permanent magnet synchronous motor. For this motor, at each time step, only two phases are excited through the conduction of operating modes. The motor possesses the advantages of high torque at low rational speed, which especially is appropriate for electric bikes or scooters.

2.2 Accelerated Computation of Multiphase Hortcircuiummary for Unbalanced Distribution Systems Using The Concept Of Selected Inversion

With ever-increasing rise in inflation, fuel costs and taxation, we endeavour to design and fabricate a fuel-efficient bike, which is of low cost and high efficiency. It is proposed to overcome the drawbacks of existing electric bikes, which are currently available in the market. Our proposal ‘The Hybrid Bike with 3 speed transmission system’ is an electromechanical system which consists of two phases. In the first phase, it works as an electric bike which is eco friendly and in the second phase it works on an IC engine.

The second phase is used only when the battery is discharged completely and during high speed application. A hybrid bike is a vehicle that has two power sources: an electric motor to propel its wheels, and a gasoline engine to recharge the vehicle's electrical storage system. The main feature which makes this hybrid bike an outstanding one from the existing electric bikes is the presence of three speed transmission system (gear) which is used for effective speed control of the motor as well as the IC engine. The working of this bike has two phases.

In the first phase, it runs on an electric motor. In the second phase, it runs on an internal combustion engine.

2.3 A CONTROLLER OF BRUSHLESS DC MOTOR FOR ELECTRIC VEHICLE

The motor used in the first phase is used as a generator to recharge the battery when the bike is operating on the IC engine. Electric three-wheeler auto rickshaws known as easy bikes are becoming quite common in Bangladesh. Due to obvious advantages offered by these vehicles such as zero carbon emission and no requirement of gas encourages people to transition from traditional fuel-operated vehicle to electric vehicles. The battery charging stations for these vehicles employ bulky chargers containing iron core transformers with maximum efficiency around 80%. As a country which suffers from power shortages, it is highly desirable to have a charger that is more efficient. In this paper, a new type of charger is proposed which uses a ferrite core transformer. A prototype of this charger is built and compared with a conventional charger. It is found from the experiments that the proposed charger exhibits efficiency more than 90%. In addition, the proposed charger weighs only about 2 kilograms, whereas the conventional charger weighs about 10 kilograms. Global population increase has led to an exponential rise in the amount of transportation vehicles.

2.4 CONTROL STRATEGY FOR POWER FLOW MANAGEMENT

As a green solution, electric vehicles are gradually becoming more and more popular. Electric vehicles have several advantages over regular vehicle; they do not require any gas, they emit no harmful substances into the atmosphere, they are subsidized by the government, and they require less maintenance. However, there are a few disadvantages of these vehicles as well. For instance, electric vehicles are not suitable for countries facing major shortage of power. Electric vehicles contain a battery bank which needs to be charged at regular intervals. The chargers used to charge these vehicles contain iron core transformers, which gives rise to power losses, and hence, inefficient charging operation.

2.5 Efficient Energy Management For Electrical Scooters

As a green solution, electric vehicles are gradually becoming more and more popular. Electric vehicles have several advantages over regular vehicle; they do not require any gas, they emit no harmful substances into the atmosphere, they are subsidized by the government, and they require less maintenance. However, there are a few disadvantages of these vehicles as well. For instance, electric vehicles are not suitable for countries facing major shortage of power. Electric vehicles contain a battery bank which needs to be charged at regular intervals. The

chargers used to charge these vehicles contain iron core transformers, which gives rise to power losses, and hence, inefficient charging operation.

3. System Design and Components

3.1 Proposed System

The following diagram show the details about the proposed system design of our project.

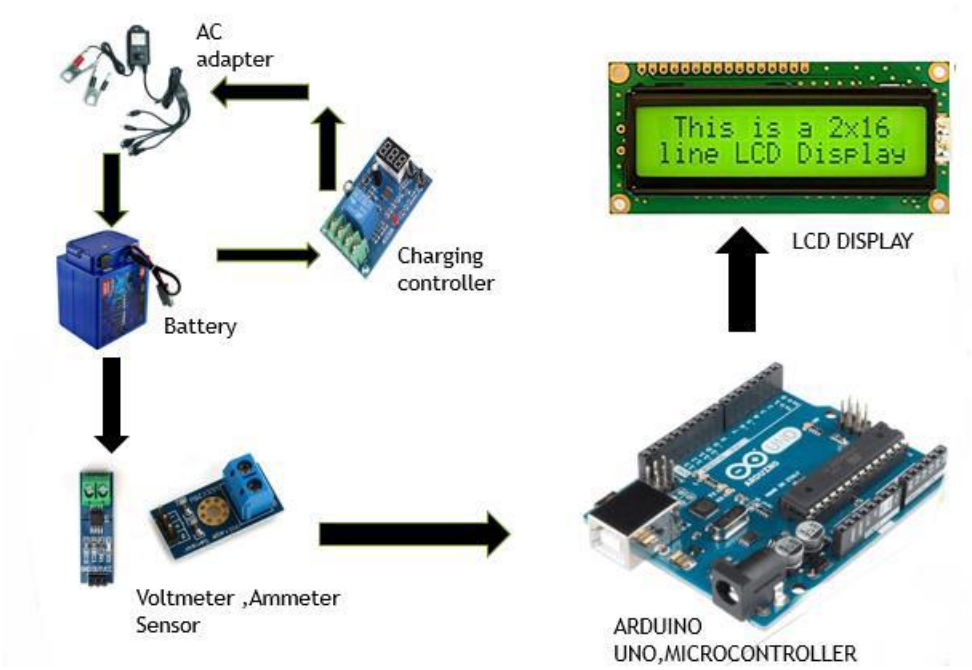

Figure.1. Block Diagram of the Proposed System

4. Result and Output

In this project, a detailed description of the design and construction of a more efficient, lightweight and cost-effective charger for electric easy bikes has been presented. A direct comparison of the proposed charger has been made with a typical conventional charger by creating the same charging conditions in the lab. The use of the ferrite core transformer in the proposed charger not only makes it much lighter, but also more efficient. Furthermore, the cost of such a charger is expected to fall with time, whereas iron core chargers are likely to become more expensive.

The experimental findings suggest that if the proposed charger is produced in a large scale, it has the potential to completely replace the conventional iron core chargers. Considering the fact that there are about one million easy bikes in Bangladesh at present, implementing the

proposed charging scheme can boost energy savings by a huge amount. From this project it is concluded that the hybrid bike is highly reliable and economical compared to the other electric bikes in the market as it has better speed, high load handling capacity and can travel about 116km on a full charge. It is eco friendly when it is in electric mode. The transmission system enables the bike to efficiently handle the load and travel according to the terrain. The engine is used as a backup in case when the battery is fully discharged. Thus the vehicle can be used to travel for long distance.

4.2 Experimental Output

The braking control unit was set to activate after the bike accelerated to 35 km/h. for the details of the results. For all cases, the bike stopped within 0.5 sec. Further experiments under the steep descent road sections are currently under arrangement. The results will come in the near future.

It should finally be noted that the braking design proposed here is to provide auxiliary braking torque to the driving wheel like engine brake in the gasoline powered vehicles rather than to replace the mechanical brake. It is not to completely replace the traditional mechanical brake but to enhance the braking effect while reserving space for versatile applications. The project presents the theoretical approaches of ORSynRM suitable for small electric propulsion. The magnetic field analysis of the structure is covered also here.

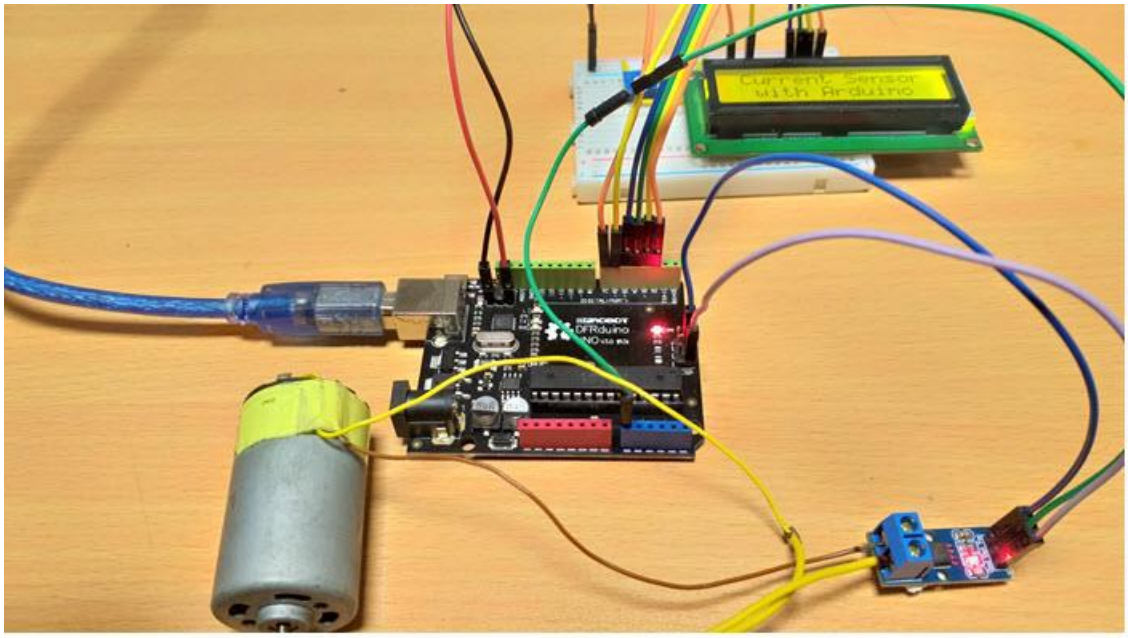

Figure.2. Hardware Kit

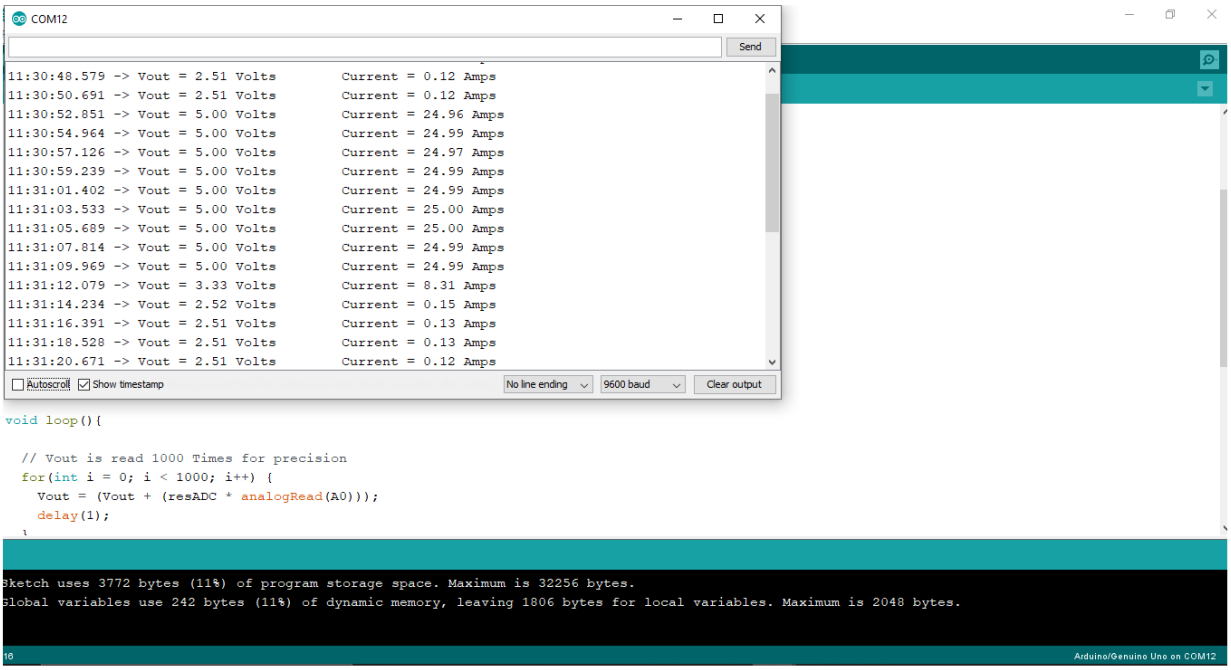

Figure.3. Current Sensor Output

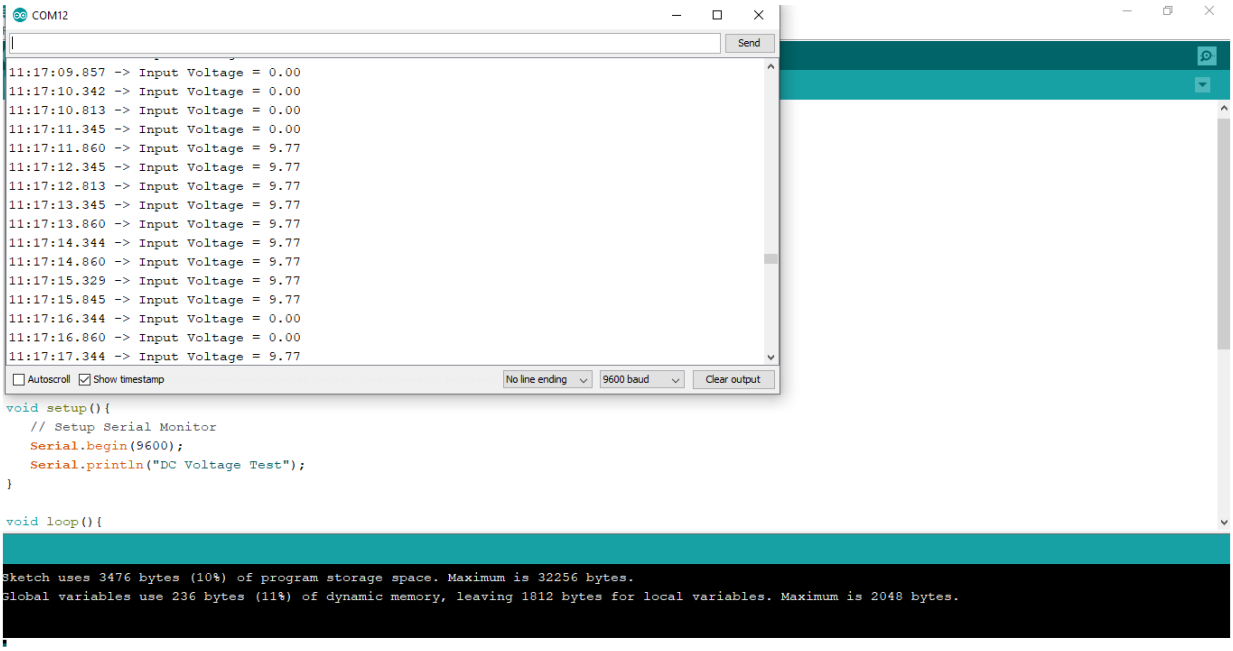

Figure.4. Voltage Sensor Output

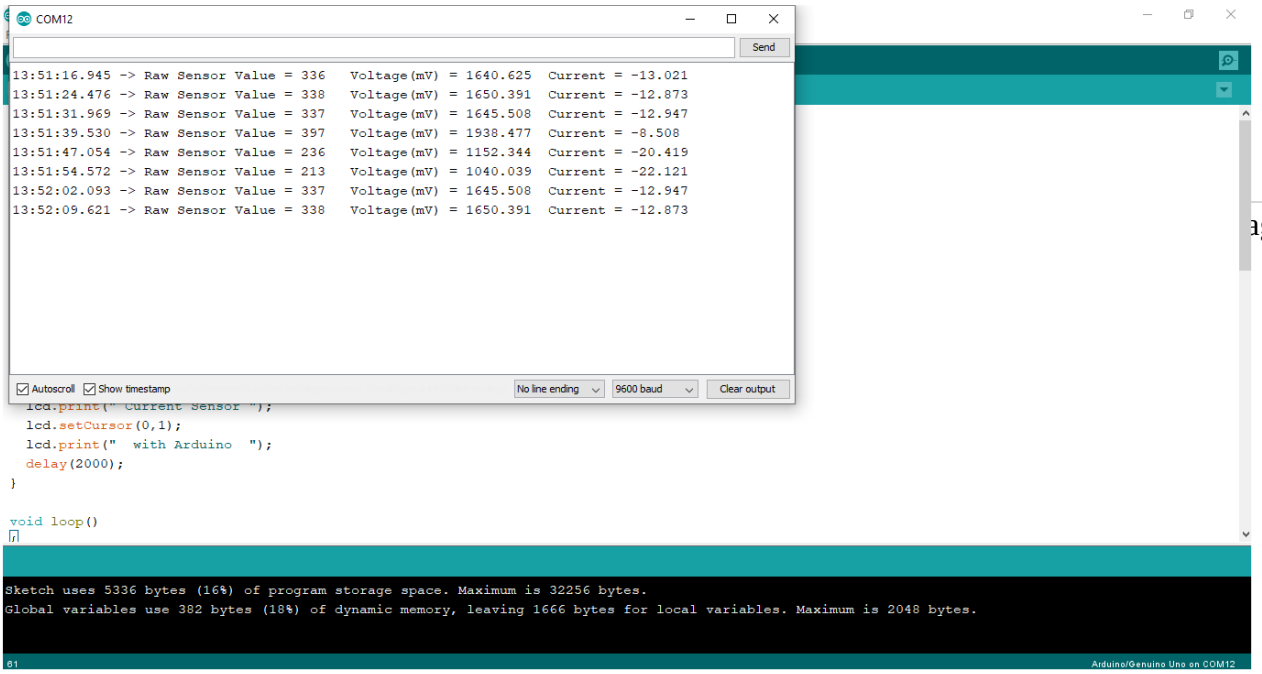

Figure.5. Overall Output

Figure.6. Final Assembled Prototype

Figure.7. **Battery Level Estimation Using SOC (Maximum Level)**

Figure.8. Battery Level Estimation Using SOC (Medium Level)

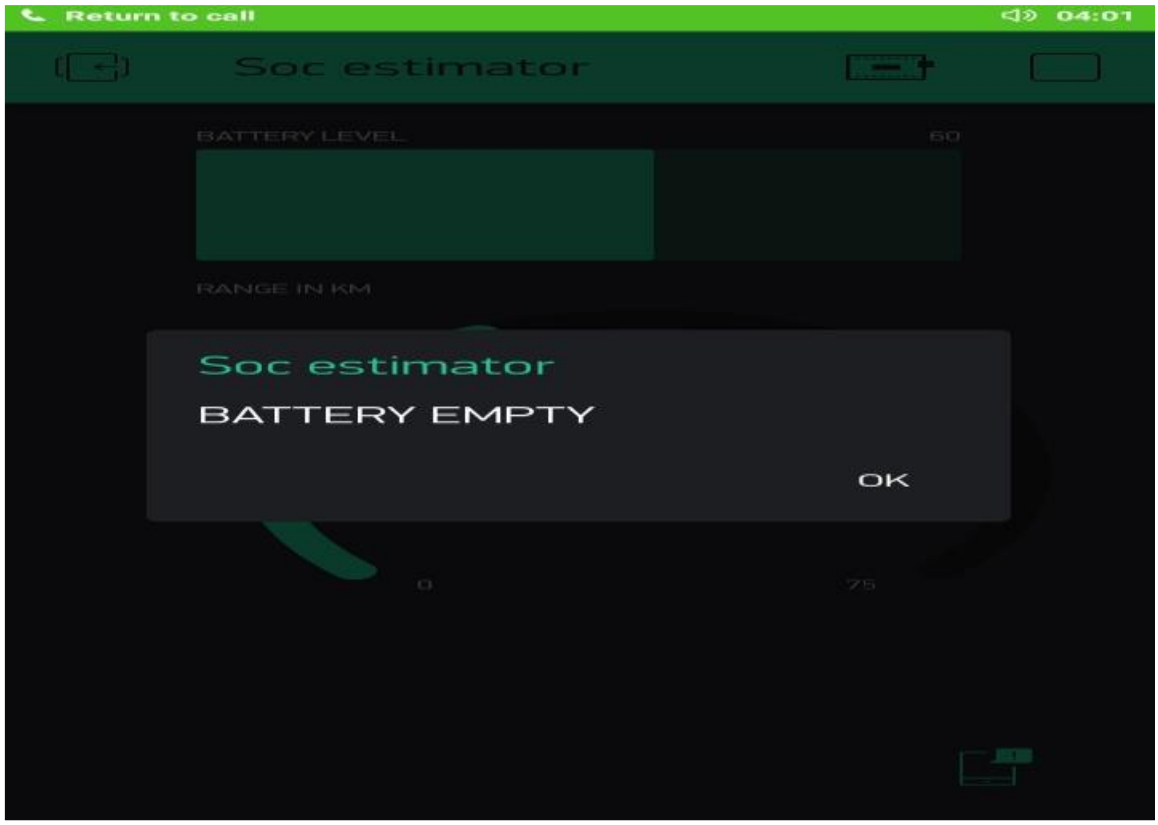

Figure.9. Battery Level Estimation Using SOC (Low Level)

5. Conclusion

With this charging and discharging current the SOC of the battery is predicted and the charger is allowed to charge and for standard charging current. Thus the batteries life can be improved by charging the current with standard reference current. And the influence of temperature will also influence the state of charge of the battery. But the influence of the temperature which will affect the state of charge cannot be accurately determined.

5.1 Future Scope

- As the global warming is increasing day by day and the reservoir of fossil fuel tends to end, the eBikes, solar bikes etc. will be better options.
- As compared to the fuel driven vehicles, the electricity driven vehicles are better when we talk about the pollution. In future, by using suitable arrangements in e-bikes for regeneration like motor, solar panel etc., we will increase the discharging time and therefore increase efficiency.
- As the pollution is increasing a lot and the fossil fuel is decreasing day by day, e-bike battery regeneration is good field for research and development.

- There will be less number of fuel stations in future as there will be increment in number of e-bikes.
- We regenerate the e-bike not only by applying the brakes but also by messing the light friction pulley constantly with the centre hub of the wheel to get continuous voltage which is also a good field for R&D.

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