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IOT Based Battery Monitoring System For Electric Vehicle.

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Abstract— *This project describes the application of Internet-of-things (IoT) in monitoring the performance of electric vehicle battery. It is clear that an electric vehicle totally depends on the source of energy from a battery. However, the amount of energy supplied to the vehicle is decreasing gradually that leads to the performance degradation. This is a major concern for battery manufacture. In this work, the idea of monitoring the performance of the vehicle using IoT techniques is proposed, so that the monitoring can be done directly. The proposed IoT-based battery monitoring system is consisting of two major parts i) monitoring device and ii) user interface. Based on experimental results, the system is capable to detect degraded battery performance and sends notification messages to the user for further action. Battery performance is influenced by factors such as depth of discharge (DOD), temperature and charging algorithm. In the existing system of this project, the health monitoring of the batteries is done by using temperature sensor and voltage sensors. So, the voltage level and temperature level only calculated in this system. Then the state of charge is obtained in the existing system. In the existing system only the temperature and voltage level only identified. In this project, we are going to monitor the battery level using current sensor and voltage sensor. When the battery level is getting low, the lead will blink, as well as it will be also displayed in lcd and also send message to the particular person using internet of things.*

I. Introduction

In two state charging system, initially the battery is charged in constant current mode until the battery reaches 80% of completely charged voltage and then Constant voltage mode is applied until the battery is fully charged. A common tendency of rechargeable batteries is getting discharged during idle period. This phenomenon is called self-discharge. The Idle state self-discharge rate is approximately 2- 4% per month. Some machines have built in battery monitoring system. Black start generators of a power plant have such monitoring system which monitors and charges up the battery regardless of the idle or running state of the generator. The monitoring system is an external solution for those machines that can measure battery parameters, charge the battery if need and warn user if there is any abnormalities. It also charges the battery in two stage constant current (CC) mode and constant voltage (CV) mode. The system alerts user if the battery temperature is high or electrolyte level is low. It also offers data logging and viewing data over internet if the monitoring system is connected to user's Wi-Fi network. The monitoring system is designed to monitor the parameters of the battery continuously and send that information to the user. Using different sensors different battery parameters such as voltage, charging current, temperature and electrolyte level are obtained. Voltage sensor, current sensor, temperature sensor and electrolyte level sensor are connected to Arduino. An LCD display is attached to the system which shows all the data collected from the battery. IOT module is connected to Arduino via serial communication port. Sensor data is sent to IOT module.

II. Objectives

- Protect the cells or the battery from damage
- Prolong the life of the battery
- Maintain the battery in a state in which it can fulfil the functional requirements of the application for which it was specified.

III. Literature Review

3.1 RECHARGEABLE BATTERIES AND THEIR MANAGEMENT- A. A. A. Elgammal and A. M. Sharaf, IEEE Instrumentation & Measurement Magazine (Volume: 14, Issue: 2, April 2011) vol. 2, no. 2, pp. 77–89, 2012.

With the consumer electronics, electric vehicles (EVs) and portable product markets growing, design of battery packs can challenge the designer because they are no longer a simple configuration of cells. They could contain many safety features, intelligence, energy aware models and selective batteries feeding the host product, serial data communication, and even recycling suggestions. In all these situations, a simple concept which should be kept in mind by designers is that batteries are like human beings, and they need care and intelligence.

We report here that a newly invented pulse activator makes it possible to reduce sulphation on the electrode of lead-acid battery resulting the prolongation of the battery life. A high-pulsed current is discharged and then a high pulsed current charging is made. The high current used is 5 to 10 C. Through the battery evaluation test of charging and discharging, the effectiveness of the performance of this high current pulse activator is proved

3.2 STOCHASTIC MODELING OF LEAD-ACID BATTERY PARAMETERS- J. C. Rojas-Zerpa and J. M. Yusta, "Application of multicriteria decision methods for electric supply planning in rural and remote areas", Renew. Sust. Energ. Rev., vol. 52, pp. 557-571, Dec. 2015.

Renewable energies are in constant growth and evolution, being a clean way to provide the energy required for the sustainable development of human society. In this context, energy storage systems are a key factor in the integration of renewable generation, because through them, the flexibility of the power system can be increased. Lead-acid batteries have been extensively used to provide electricity in isolated and rural locations, and could be integrated to the smart grid in order to improve its performance.

3.3 SEMI-MARKOV MODEL FOR CONTROL OF ENERGY STORAGE IN UTILITY GRIDS AND MICROGRIDS WITH PV GENERATION- C. A. Hill, M. C. Such, D. Chen, J. Gonzalez and W. M. Grady, "Battery energy storage for enabling integration of distributed solar power generation", IEEE Trans. Smart Grid, vol. 3, no. 2, pp. 850-857, Jun. 2012.

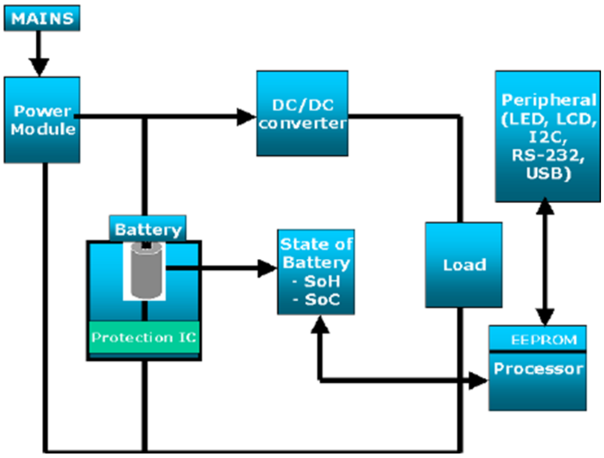
Photovoltaic (PV) penetration levels in the power grid have significantly increased during the last years. However, issues such as cloud-induced intermittency in PV generation forces equipment on the electrical grid to cycle excessively, preventing PV generation from being considered as a reliable or dispatch able source of power, particularly by utilities.

A semi-Markov process model is proposed to model PV power. Unlike existing models of PV power, the proposed model has a wide range of applicability across both small and large timescales. These applications include simulating PV power, short-term forecasting of PV power, design of rule-based controllers for energy storage units (ESU), and stochastic scheduling of ESU in conjunction with other resources. The model is applied to study two cases of coordinating ESU with PV generation. In the first case, the model serves to design a coordination scheme for a hybrid battery-ultra capacitor (UC) ESU where the UC serves to extend the lifetime of a lead-acid battery.

IV. Conventional Method

An overview of new and current developments in state of charge (SOC) estimating methods for battery is given where the focus lies upon mathematical principles and practical implementations. As the battery SOC is an important parameter, which reflects the battery performance, so accurate estimation of SOC cannot only protect battery, prevent overcharge or discharge, and improve the battery life, but also let the application make rationally control strategies to achieve the purpose of saving energy. This paper gives a literature survey on the categories and mathematical methods of SOC estimation. Based on the assessment of SOC estimation methods, the future development direction of SOC estimation is proposed.

Using real-time measurement road data to estimate the SOC of battery would normally be difficult or expensive to measure. In application of the Kalman filter method is shown to provide verifiable estimations of SOC for the battery via the real-time state estimation.



A. EXPLANATION

Battery Monitoring System (BMS) is a smart system whose function is to monitor the vigour of a battery pack. BMS computes the battery's capacity, depreciation of battery while the charging/discharging and correct productivity of the battery and provides this information in real time to users. This mitigates the sense of incorrect safety of periodic battery assessment as it is vigilant to emerging issues before hand typical BMS framework incorporating the measurement of key battery parameters e.g., current, voltage, temperature etc., and performing necessary calculations/estimations to extract useful information about energy storage system i.e., State of Health (SoH), State of Charge (SoC), operating temperature range. Based on these calculated parameters, controlling actions are taken to maintain the battery's lifecycle and safety against potential hazards. Therefore, the prime objective of monitoring is to gauge various variables, log events, generate warnings, record usage profile and represent this information locally and remotely to the user. BMS is unable to sense movable connections present in the battery, leakage of cell material, corrosion of connections leading to the development of high resistance and subsequently fire danger. It is also unable to visually monitor developing swelling, potential leakage, cracks in the outer geometry of battery pack etc.

B. ADVANTAGES

1. Longer service life than Calcium batteries.
2. Easier to recharge when completely discharged.
3. Lower cost.

C. DISADVANTAGES

1. Larger electrolyte reserve area above the plates.
2. Higher Cold Cranking Amp ratings.
3.The existing system having only one battery, so not reliable. There is no automatic charge controlling circuit, it will affect the battery life.
4. Maintenance is poor compared to proposed system

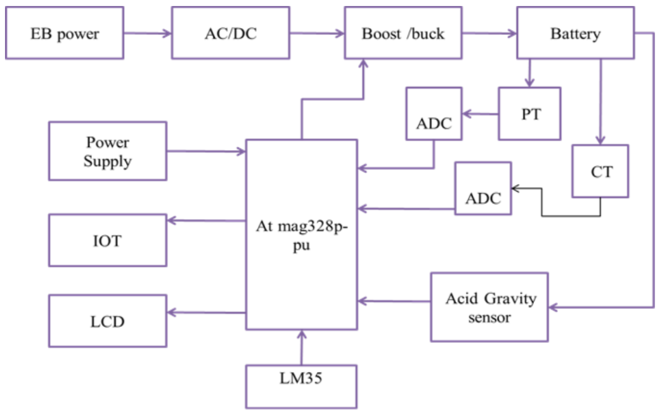
V. Proposed System

A. INTRODUCTION

With the blast in the EV business, there is an uncommon interest for a productive battery the board framework yet for that at first checking of the battery is required. In India we can see an exponential increment in the number of electric Rickshaws which use Lead Acid battery rather than the utilizing a progressively effective lithium-particle battery. The principle reason being the expense of the lead corrosive battery what direction lesser than the lithium-particle battery, henceforth it is critical to construct a battery observing and the board framework for lead corrosive battery.

These lead corrosive battery functions admirably in the surrounding temperature yet gives lacklustre showing at lower temperature. The present framework right now utilized are not versatile to various air conditions and in a nation like India temperature puts a significant job in deciding the presentation of the battery on the grounds that the temperature here can go as high as 51.0 °C (123.8 °F) Phalodi, Rajasthan and as low as −45 °C (−49 °F) in Kashmir. Henceforth it is essential to think about the conduct of the battery at various temperatures which could assist us with structuring a framework that increasingly versatile to the encompassing conditions.

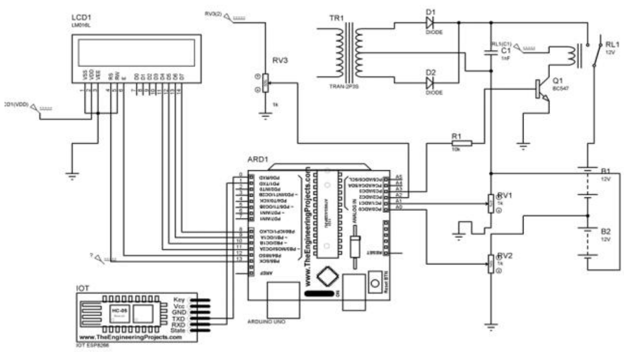
For improving an and increasingly proficient battery pack we need to remember a great deal of elements like Cell and Battery Voltages, Charge (or Amp hour) Capacity, Energy Stored, Specific Energy, Energy Density, Specific Power, Amp hour (or Charge) Efficiency, Energy Efficiency, Self-release Rates, Battery Geometry, Battery Temperature, Heating and Cooling Needs, Battery Life and Number of Deep Cycles. Taking a shot at these parameters and getting increasingly exact qualities will assist us with structuring progressively powerful BMS which will empower the client to take the best choices as per the prerequisites.



A. EXPLANATION

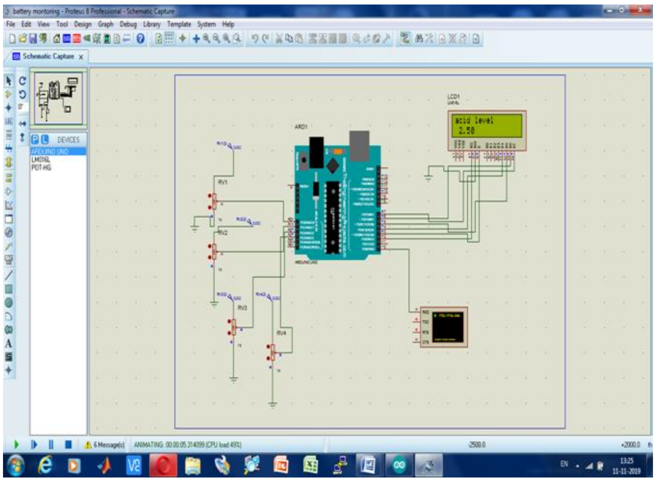
The block diagram of our proposed system is used temperature and Voltage sensor, current sensor module, a liquid level sensor module. The temperature and humidity data are estimated around the battery with the use of a acid gravity level. The battery's acid level, one of the most important parameters to be determined, is evaluated through an electrolyte level sensor module explained in detail in the next subsection. The battery's important parameters, namely, the full charge capacity, the remaining charge capacity, the state of charge, voltage, and average current are assessed through the IOT module. For data transmission between the device and the Atmag328p-pu, the UART protocol is used. The ADC is also used for communication between the device and the microcontroller. The battery data from the sensors are received and the calculation and the analysis part are implemented in the microcontroller. Further, for our proposed system, the data is transferred to a IOT using a UART protocol. For a clear representation and working procedure, the pin map detailed diagram of our proposed system, with the corresponding inputs and ports. It should be observed that in our proposed system the communication between the various parts of the system is done using IOT technology, considering the mobility of the vehicles and the batteries in an industrial environment. The vehicles are self-governing and can connect to any of the gateways installed in the premises of the industry.

B. CIRCUIT DIAGRAM



VI. Results And Discussions

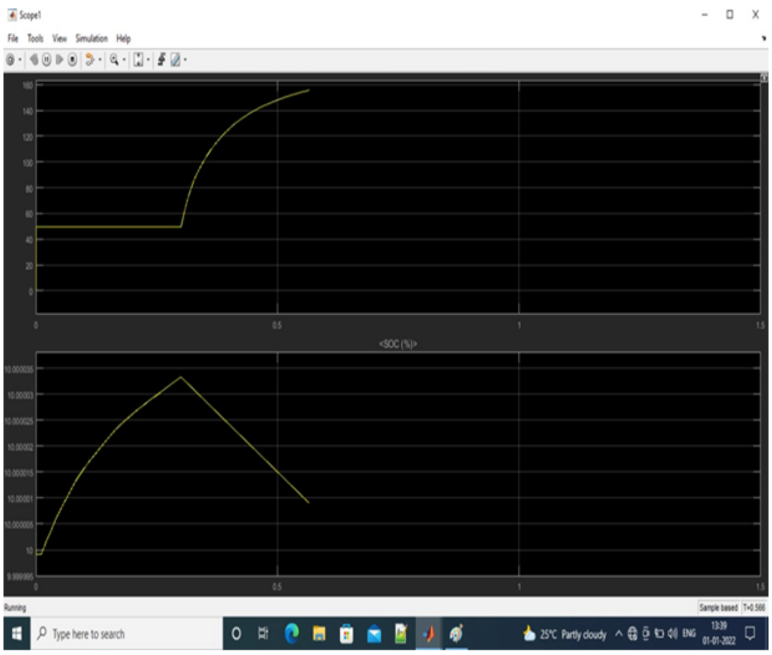
A. FINAL OUTPUT

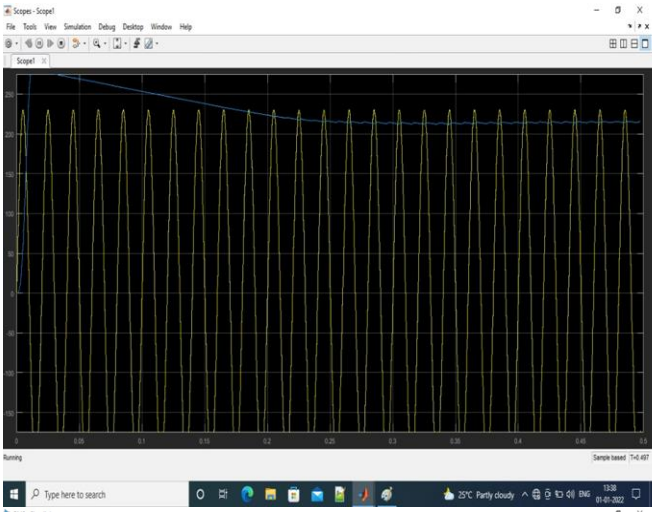


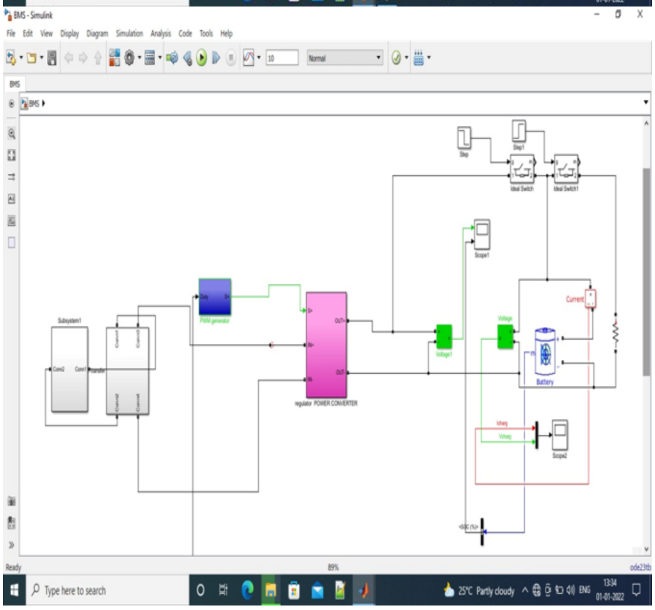
B. ADVANTAGES

1.Our proposed system has a battery protection and management system; it will increase battery life time.
2.Very less battery maintenance.
3. Due to multi batteries high reliable operation
4.Overall efficiency increased and system cost get decreased.
5. Acid gravity sensor used.
6. Mentoring of call voltage

VII. SIMULATION







VII. Conclusions

Battery monitoring and charging system with an ARDUINO microcontroller board as the controller takes the measurement of the voltage, charging current, temperature of the battery. It is capable of sending the acquired data to internet by which the condition of the battery can be monitored remotely. With 2 state charging system it can safely charge the lead acid battery and also capable of providing alarm if the temperature and the electrolyte level changes significantly. With some modification this monitoring and charging device can be used for monitoring and charging multiple batteries at a time. Performance and functionality of this system can be improved by using better charging algorithm and sensing elements. The generic charger made by local vendors are cheaper than proposed system but doesn't have any data logging and monitoring system.

On the other hand, complete monitoring of a generator set and monitoring the voltage level of the battery is one of its features; which makes it very expensive and applicable for industrial applications. The proposed system is dedicated only for charging and monitoring the condition of the lead acid battery of a backup generator. So, it is not a substitute of ARDUINO controller but considering the price, monitoring and remote-control features, it can be a better alternative of local generic external lead acid battery chargers used for charging the battery of the backup generators. All the status of the battery is sent by the IOT module.

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