IOT Based Smart Battery Monitoring

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***Abstract*- A system identification-based model for the online monitoring of batteries for electric vehicles (EVs) is presented. This algorithm uses a combination of battery voltage and current measurements plus battery data sheet information to implement model-based estimation of the stored energy, also referred to as state-of-charge (SOC), and power capability, also referred to as state-of-function (SOF), for deep-cycle batteries. This online monitoring scheme has been implemented for a bank of deep-cycle lead-acid batteries and experimental laboratory tests using simulated driving cycles have yielded promising results. In addition, actual road data from an EV powered by these same batteries has been analyzed with the proposed model to demonstrate the system's usefulness in determining the battery state-of-health (SOH). Finally, the limitation of the use of a linear model for battery terminal voltage behavior is discussed.**

Index Terms- ArduinoNano, transformer, nRF24L01, voltage regulator, etc.

I. INTRODUCTION

An important reason why effective use of existing battery technology in EVs remains a challenge is the difficulty in obtaining relevant battery internal state information that is not readily measurable. For example, a battery's stored energy, referred to as its state-of-charge (SOC), cannot be directly inferred from measurements of the battery voltage and current. A common scheme known as Coulomb counting uses the integrated current value to estimate SOC. However, the Coulomb counting method is prone to errors caused by a variety of sources such as noise on the current measurement that is integrated over time. Other approaches to estimate the SOC for lead-acid batteries have been proposed and reviewed in. It has been asserted in the literature that the lead-acid battery open-circuit voltage (OCV) has a nearly linear proportional relationship with the SOC. While a true SOC estimation based on OCV requires the interruption of the load, some studies have proposed methods that attempt to estimate the battery OCV with a Kalman filter. Filter structures can be based on either electrochemical laws, or a battery equivalent circuit. Other studies have utilized impedance information to infer the SOC in lead-acid batteries. The evolution of the structure of the PbSO4 electrode during discharge has been cited as the reason for the observed increase in impedance at lower SOC for lead-acid batteries. In the laboratory environment, the impedance spectroscopy technique is commonly used to extract battery impedance information. One study found the resonant frequency of the lead-acid battery and its terminal connection has a nonlinear, monotonic relationship with the SOC. Despite the promising lab results, impedance spectroscopy remains cumbersome to implementing actual vehicle applications. The OCV-based SOC estimation methods often ignore the degraded battery power capability during discharge that is attributable to the increased impedance. For example, the Kalman filter in uses a covariance matrix to accommodate the change in impedance instead of changing the impedance in the model. In a similar manner, impedance-based SOC estimation algorithms generally use impedance estimates only as an indicator for SOC without considering the impact on power capability. The battery power capability estimation sometimes referred to as state-of-function (SOF), is intended to determine whether the battery can provide the necessary power for an application. For example, if the battery voltage is predicted to drop below a specified minimal value during a stressful EV acceleration transient, the SOF is considered inadequate. It should be noted that a battery having a nominal SOC reading does not automatically imply a positive SOF, depending on the application power requirement. For hybrid-electric vehicle (HEV) applications, Van Bree et al proposed a methodology that assumes zero change in SOC (and OCV), and uses a batch of data to fit the electrochemical-based equivalent circuit. The equivalent circuit is then used to predict terminal behavior, deriving SOF indication. In addition to SOC and SOF estimation, important information on the battery state-of-health (SOH) can be obtained from battery impedance measurements. When discharging, higher battery impedance lowers the terminal voltage, reducing the output power and forcing an early end to the discharge when the cut-off voltage is reached. The SOH indicator is essential for determining whether a battery replacement is required. For HEV applications, Wiegman proposed an equivalent circuit-based method that utilizes the naturally broadband excitation in the driving cycle to continuously estimate the parameters of a linear, fixed-order model by means of system Identification. Wiegman presents detailed work on the characterization of battery behavior over hundreds of seconds of HEV operating conditions, with a focus on power capability for both sourcing and sinking energy. This system has the advantage of reflecting SOC in the estimated OCV and power capability in the estimated impedance. However, important issues remain in order to apply system identification-based battery models in EVs because of some significant differences between EVs and HEVs. Unlike HEVs, the monitoring algorithm for an EV application should have a consistent method of initializing the battery model parameters at the beginning of a discharge cycle.

A. Figures and Tables

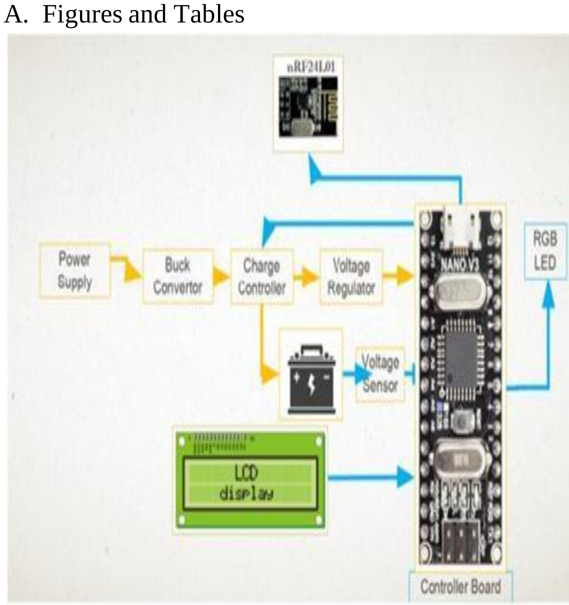

Fig. 1 Transmitter Section

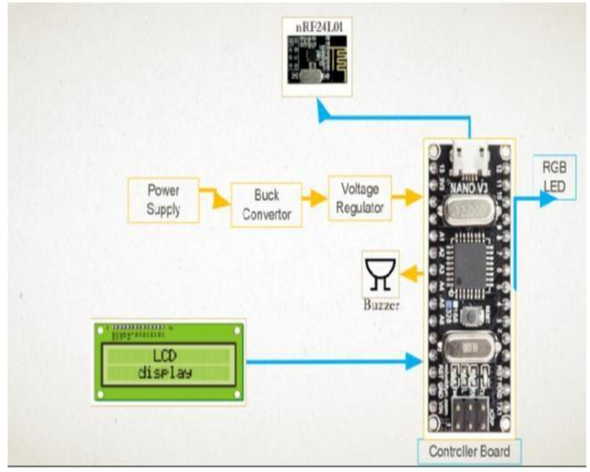

Fig.2 Receiver section

CIRCUIT DIAGRAM

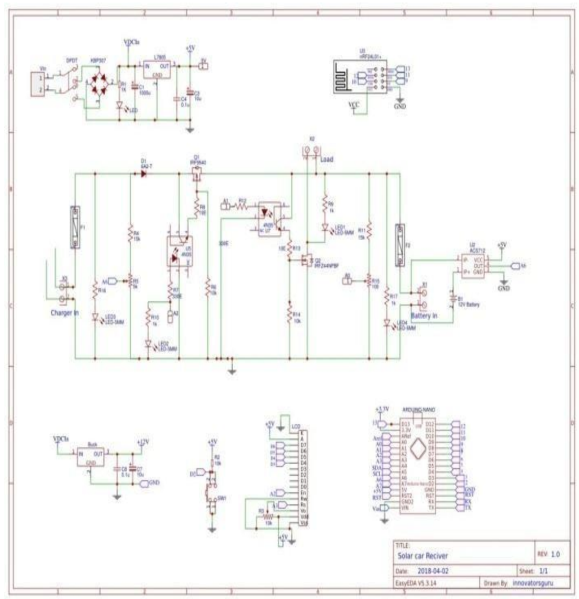

Fig.3 Circuit Diagram Of Transmitter

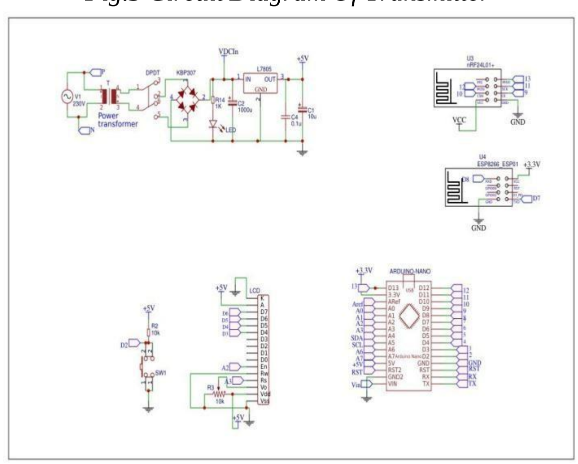

Fig. 4 Circuit Diagram Of Receiver.

REQUIREMENTS SOFTWARE AND HARDWARE:

Hardware Requirements Specification:

- Power supply
- Microcontroller atmega 328p
- 16x2 LCD display
- Buzzer
- Buck converter
- Opto-isolator
- MOSFET
- Resistor
- Voltage regulator
- Lamp
- Battery
- nRF 24L01
- WIFI ESP8266 Ex
- Transformer

SOFTWARE SPECIFICATION REQUIREMENT

- ARDUINO
- UBIDOTS
- ESP FIRMWARE FLASHER

HARDWARE REQUIREMENT

Specification-

A. ARDUINO UNO
B. Microcontroller Atmega 328
C. Operating voltage 5v
D. Input voltage (recommended) 7-12v
E. Input voltage (limit) 6-20v
F. Digital I/O pins 14(of which 6 provide PWM output)
G. Analog input pin 8
H. DC current per I/O 40mA
I. flash memory 32kb
J. SRAM 2kb
K. EEPROM 1kb

Fig.5 Arduino Nano

A. LCD DISPLAY

LCD stands for Liquid Crystal Display. LCD is finding widespread use replacing LEDs (seven segment LEDs or other multi segment LEDs) because of the following reasons:

*Character LCD 16x2
*5x8 dots includes cursor
*Built-in controller
*+5V power supply only
*Negative voltage optional for +3V power supply
*1/16 duty cycle
*White LED backlight not available

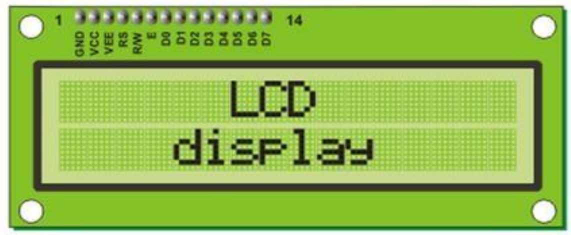

Fig.5 LCD Display

M. Buck converter

It is known as a step-down converter. It generates an output voltage either greater or less than the input voltage.

Advantages

Regulating the output voltage over the full power source voltage range.

Fig.6 Buck Converter

N. Power MOSFET

• It handle the high level of powers.
• High switching speed

NORMAL CHARGING –

P MOSFET = LOW
N MOSFET =HIGH

DEEP DISCHARGE --

P MOSFET =LOW
N MOSFET =LOW

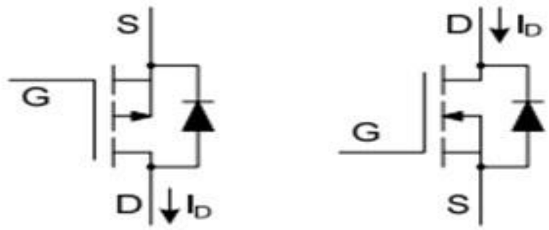

Fig.7 Power MOSFET

APPLICATIONS AND ADVANTAGES

APPLICATION

1. emergency vehicles need to ready and good condition of vehicles. Basically the battery is main equipment to start the vehicles.
2. military based vehicles
3. Ambulances .
4. fire brigade vans

ADVANTAGES

- Low cost
- Reliable circuit
- High performance
- Easy operation
- Safety and security.
- Safety for the humans and vehicles battery
- Real time monitoring.
- Low power consumption.

CONCLUSION

In this project, we can estimate the battery life. The power monitoring of battery. The overcharge and deep discharging of battery can be observed and monitored.

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