International Journal of Recent Advances in Multidisciplinary Topics
Volume 3, Issue 7, July 2022
https://www.ijramt.com | ISSN (Online): 2582-7839

IoT Based Vehicle Battery Monitoring and Security System

Toufique Kasam Patel[1], Prathamesh Prakash Mane[2*], Aditya Sudhakar Kuchekar[3], Onkar Ashok Patil[4], Akash Sanjay Ghodake[5]

[1,2,3,4]*UG Student, Department of Electrical Engineering, Annasaheb Dange College of Engineering and Technology, Ashta, India*
[5]*Assistant Professor, Department of Electrical Engineering, Annasaheb Dange College of Engineering and Technology, Ashta, India*

***Abstract*: Day by day, the EV (Electrical Vehicles) use is widely in all over world. The most of peoples prefers the electrical vehicle for daily use in their routine. But there have so much hazardous problems facing with electric vehicle. The primary battery risks are generally a result of external or internal short circuits, high or low temperatures, overcharge or over-discharge. An external short circuit is another form of electric abuse that may destabilize the battery. Severe electrical deformation and impact, corrosion and electric shock during maintenance. Also, batteries, when exposed to high temperatures, may lead to problems.**

***Keywords*: Electrical vehicle, over-discharge, destabilize the battery.**

1. Introduction

Recently, there are so many incidences regarding fire hazards in EVs. Chronologically,

1. In Pune, Ola S1 Pro scooter got fire. It was parked outdoor in the Sun.
2. In Vizag, Okinava Scooter got fire when it was being charged in the nighttime and the temperature went too much, the scooter started fumes and fire started. There were 2 deaths happened.
3. In Trichy, an Okinava schooter suddenly blasted in the middle of the road.
4. In Chennai, a Pure EV scooter got fire.
5. Recently in Oct. 2021, 3 scooters catched fire suddenly, one of them was okinava and another was Pure EV. but this is all about consumer vehicles. In Dec2021, Hero Electrics dealership, Vizag catches fire and the entire in Thanjavur and Balaghat.

This topic is so sensitive now-a-days, because people want to buy EVs because of the increasing fuel prices. And so many incidents are happening. There might be many accidents occurred. Ultimately, there is some connection in between summer heat and the EVs, because no such incidents occurred in cities where average temperature is cold. The situation may get increased in the middle of summer. Because there is risk of money and life also. After all these cases, Government has stated their investigation and this all points towards only one thing- "batteries".

In India, Ola holds a big market share in EVs. In general, companies adapt their technologies specific to a region. Surprisingly Athar EVs have not been found in such incidents. While there has been a spike in the production and importation of EVs to India the battery packs are mainly from China. Recently CEO of Athar said in an interview that, the batteries that Indian EV brands are importing are not designed considering Indian environment. Local manufacturers don't have any inputs into the battery packs that are used in these EVs. Most of these batteries are not suitable for Indian hot weather. Average temperature on Indian roads can hover above 45 degrees Celsius and this can create overheating of the battery pack.

Brands nowadays are focusing on sales and marketing but not on the quality. Most of the brands launched their vehicles in the winter season last year, so at that time heating was not a major issue but nowadays.

So special battery packs should be designed considering the Indian weather. Root cause of batteries catching fire,

Most of batteries are lithium ion. So, one of the reasons is manufacturing defects or the software that handles the pack was not designed for the batteries.

Although main weakness of these batteries is organic liquid electrolytes so due to high temperatures there is huge chance of getting catching fire.

2. System Modelling

A. The Arduino Nano

Based on the ATmega328P launched in 2008, the Arduino Nano is a compact, comprehensive, and breadboard-friendly board. It has the same connections and specifications as the Arduino Uno board, but in a smaller package.

The Arduino Nano has 30 male I/O headers in a DIP30-style arrangement that can be programmed using the Arduino Software integrated programming environment (IDE), which is common to all Arduino boards and can be used both online and offline. The board may be powered by a 9 V battery or a type-B micro-USB connection.

Technical Specification:

- Microcontroller: Microchip ATmega328P [4]
- Operating voltage: 5 volts

*Corresponding author: prathammane8518@gmail.com

- Input voltage: 6 to 20 volts
- Digital I/O pins: 14 (6 optional PWM outputs)
- Analog input pins: 8
- DC per I/O pin: 40 mA
- DC for 3.3 V pin: 50 mA
- Flash memory: 32 KB, of which 0.5 KB is used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock speed: 16 MHz
- Length: 45 mm
- Width: 18 mm
- Mass: 7 g

B. Vibration Sensor

The impact of mechanical strain induced by high-frequency motion of the equipment is utilised by a piezoelectric vibration sensor (also known as piezo sensors) to detect acceleration and, hence, vibration. These sensors are adaptable gadgets that may be used to monitor a variety of operations. By shifting to an electrical charge, this sensor employs piezoelectric phenomena to measure changes in acceleration, pressure, temperature, force, and strain. They emit a 4-20 mA signal proportionate to the total intensity of vibration. For cost-effective continuous vibration monitoring, the 4-20 mA output is widely accepted by process control systems such as a PLC, DCS, or SCADA system.

C. The SMS Facility

Unauthorized access and the location of the car will be sent to the user through SMS. This information is transferred to a server, where it is received by a user-friendly Android application, which displays everything, including the location.

D. Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices having a linearly proportional output voltage to the temperature in degrees Celsius. In comparison to linear temperature sensors calibrated in Kelvin, the LM35 device has the benefit of not requiring the user to remove a large constant voltage from the output to get easy Centigrade scaling.

E. RFID Ignition Control Module

Radio Frequency Identification is abbreviated as RFID. RFID refers to small electrical devices that include a chip and an antenna. This little chip has the capacity to store around 2000 bytes of data or information. RFID devices are used to replace bar codes or magnetic strips used on the back of ATM cards and credit cards, and they provide each object with a unique identifying code. RFID devices, like magnetic strips or bar codes, must be scanned to obtain information.

Working of RFID:

Radio Frequency Identification is abbreviated as RFID. RFID refers to small electrical devices that include a chip and an antenna. This little chip has the capacity to store around 2000 bytes of data or information. RFID devices are used to replace bar codes or magnetic strips used on the back of ATM cards and credit cards, and they provide each object with a unique identifying code. RFID devices, like magnetic strips or bar codes, must be scanned to obtain information.

F. Current Sensor

Current sensors, also known as current transformers or CTs, are devices that use the magnetic field to detect and provide a proportional output to measure the current flowing through a wire. They work with both AC and DC power. The ACS712 Current Sensor Module has an accurate, low-offset linear Hall circuit with a copper conduction route positioned near the die's surface. The Hall IC turns the applied current flowing via this copper conduction line into a proportionate voltage by creating a magnetic field.

3. Block Diagram

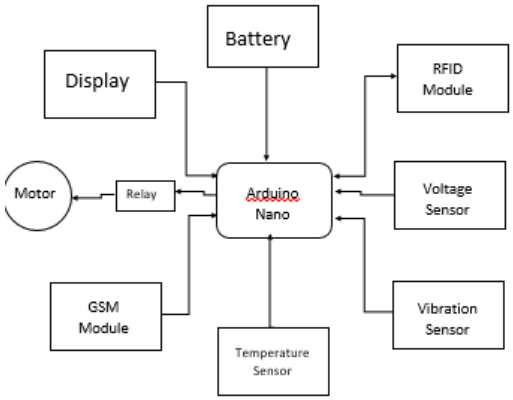

Fig. 1. Block Diagram of IoT based vehicle battery monitoring and security system

1) LCD Display

This is a simple Alphanumeric display with 16 characters and two lines. Green background with black writing. Uses the HD44780 parallel interface chipset, which is quite popular. The interface code is open source. To connect to this LCD screen, you'll need at least 6 standard I/O pins. LED backlight is included. Both 4bit and 8bit modes are supported.

Features:

- 16 Characters x 2 Lines
- Green Backlight
- 5x7 Dot Matrix Character + Cursor
- HD44780 Equivalent LCD Controller/driver Built-In
- 4-bit or 8-bit MPU Interface
- Standard Type

2) Relay

Relays are employed when an independent low-power signal is required to control a circuit, or when several circuits must be controlled by a single signal. Relays were initially utilized as signal repeaters in long-distance telegraph circuits, refreshing the signal coming in from one circuit by broadcasting it on another. Relays were widely employed to conduct logical operations in telephone exchanges and early computers.

3) GSM Module

The SIM900A GSM module is frequently used in GSM, IoT, and Embedded Application development. The SIM900A is a dual-band GSM/GPRS engine that operates on the EGSM 900MHz and DCS 1800MHz frequencies. The essential interface is provided via a GSM (idea/Airtel) SIM card. If the alcohol sensor detects an alcohol percentage more than a predetermined level, the GSM module in the system is configured to send an SMS.

4) Current Sensor

Current sensors, also known as current transformers or CTs, are devices that use the magnetic field to detect and provide a proportional output to measure the current flowing through a wire. They work with both AC and DC power. The ACS712 Current Sensor Module has an accurate, low-offset linear Hall circuit with a copper conduction route positioned near the die's surface.

5) Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices having a linearly proportional output voltage to the temperature in degrees Celsius. In comparison to linear temperature sensors calibrated in Kelvin, the LM35 device has the benefit of not requiring the user to remove a large constant voltage from the output to get easy Centigrade scaling.

6) Battery

HEVs, PHEVs, and EVs employ the Li-ion energy storage technology.

Lithium-Ion Batteries:

Because of its high energy per unit mass compared to other electrical energy storage methods, lithium-ion batteries are presently employed in most portable consumer gadgets such as mobile phones and laptops. They also feature a high power-to-weight ratio, excellent high-temperature performance, and minimal self-discharge. Although most lithium-ion battery components may be recycled, the expense of material recovery continues to be a problem for the business. The Lithium-Ion Battery Recycling Prize, sponsored by the US Department of Energy, aims to find methods for collecting, classifying, storing, and transporting used and discarded lithium-ion batteries for eventual recycling and materials recovery.

7) Motor

Three-phase motors are the most common and commonly utilized of all configurations in E-bikes. A BLDC motor's stator is made up of stacked steel laminations with windings positioned in slots cut axially along the inner perimeter.

8) RFID Module

When the RFID EM18 module detects the RFID tag, a signal is delivered to the Arduino Nano board, which validates the user. After verification, the controller permits the ignition to be turned on. If an unregistered tag is used to gain unwanted access, a notice alert will be issued to the mobile application, as well as an SMS to the user. When the approved RFID tag is shown again, the controller checks it and turns off the ignition system.

SoC:

The essential quality indicators are the condition of health and state of charge, since they give useful data for optimising the battery management system (BMS).

The difference between a fully charged battery and the same battery in use is described by the state of charge of a battery. It has something to do with the amount of power left in the cell.

It is calculated by dividing the remaining charge in the battery by the maximum charge that the battery can give. As seen below, it is represented as a percentage.

$$SoC\ \% = 100\ \frac{(Q_0 + Q)}{Q_{max}}$$

Q_0 = Initial charge of the battery (mAh)

Q = The quantity of electricity delivered by or supplied to, the battery. It is negative during the discharge and positive during the charge. (mAh)

Q_{max} = The maximum charge that can be stored in the battery (mAh)

SoH:

The state-of-health (SoH) of a battery explains the difference between a tested battery and a new battery while also considering cell ageing.

It's the proportion of the maximum battery charge to the rated capacity of the battery. As may be seen below, it's stated as a percentage.

$$SoH\ \% = 100\ \frac{Q_{max}}{C_r}$$

Q_{max} = The maximum charge available of the battery

C_r = The rated capacity

4. Simulation

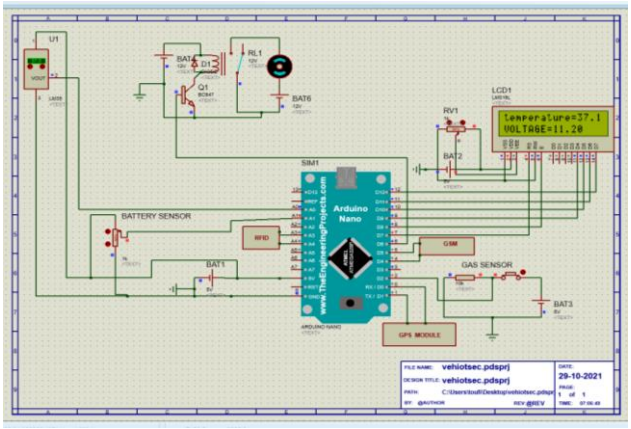

Fig. 2. Output (Temperature, Voltage)

The security is identified by the RFID system. Then the access given to the owner. Battery voltage is measured by the Voltage sensor and values are given to the Arduino system. If value is less than 12V, alert is given to the user “PLEASE CHECK BATTERY”. Temperature is measured by temperature sensor LM35 and these values are given to the Arduino and the value is displayed, if greater than 35°C, an alert is given to the user. Vibration sensor senses the accidents, if an

incident occurs, the signal is given to the Arduino and an alert SMS, and the location of the incident is given to the relative(s) of the owner through GSM and GPS system.

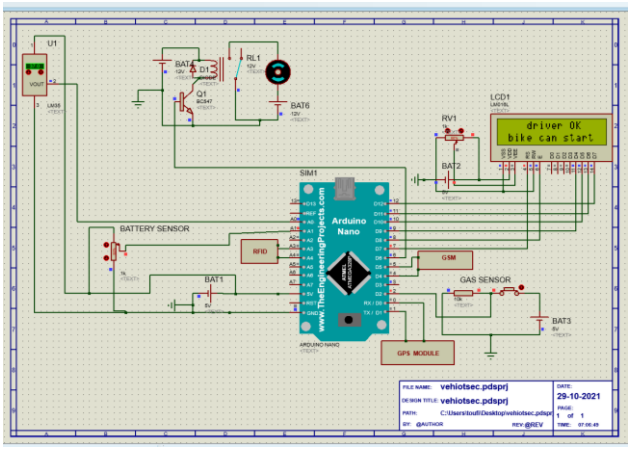

Fig. 3. Output

Fig. 4. Hardware implementation

5. Conclusion

Using this system, we observed that, the security of the vehicle can be increased significantly. Designed battery monitoring system can send alerts and the location of where the accidents happened, life can be saved in case of a major accident.

Also, by using GPS, one can easily find their lost vehicle. From a maintenance point of view, one can get an alert of the capacity of the battery, so that the remaining life of the battery pack can be determined and so one can make a plan to purchase or replace the battery pack. Hence, any internal faults in the battery can be sensed using the voltage characteristics, and chances of battery explosion can be avoided.

References

[1] Sachin S. Aher, Kokate R. D. "Fuel Monitoring and Vehicle Tracking", International Journal of Engineering and Innovative Technology, Volume 1, Issue 3, March 2012.

[2] J. Sherly, D. Somasundareswari, “Internet of Things Based Smart Transportation Systems,” International Research Journal of Engineering and Technology, Volume 2 Issue 7, Oct. 2015

[3] Bharath Kumar Perumalla, M. Sunil Babu, “An Intelligent Traffic and Vehicle Monitoring System using Internet of Things Architecture”, International Journal of Science and Research, 2013.

[4] Shin-Nan-Lu, Hsien Wie Tseng, “Intelligent Safety Warning and Alert System for Car Driving”, in Tamkang journal of science and engineering, vol. 13, no. 4, pp. 395-404, 2010.

[5] Victor Mendez, Kevin J. Hawes, “Method and apparatus for tire pressure monitoring and for shared keyless entry control,” U.S. Patent number: US5463374A.