Design of Battery Monitoring System for Electric Vehicle

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Abstract: Lithium-ion batteries are expected to be the primary source of energy for the future generation of transportation systems. Following the standard industrial communication protocol, this study describes a methodical approach to designing an effective hardware test bed for Battery Monitoring System (BMS) applications in the Electric Vehicle (EV) industry. The hardware test bed collects both battery voltage and current data acquisition.The architecture of abattery hardware test bed is then described, as well as the reasoning for picking key componentssuch as the microcontroller and voltage/current sensors. The batteries are initially charged totheir maximum capacity. The initial battery powers the vehicle. The source is switched to thesecond battery when the first battery goes belowa particular level (low battery).

Keywords: Battery Monitoring System (BMS), Electric Vehicle (EV), Lithium-ion batteries

1.INTRODUCTION

By switching dual batteries, an e- runtime vehicle's can be extended. This project intends to extend the range of existing battery- powered electric vehicles by adding a second batteryand switching between them intelligently based on battery level. Because of their high energy densityand efficiency, the proposed batteries are lithium ionbatteries (Li-ion).

1.1About the project:
This piece of paper is used to keep track ofthe voltage level. There are two batteries in this device. One is the primary battery, while the other is the backup battery. The Arduino UNO controller is used to calculate battery voltage levels. The voltage level is calculated using the voltage sensor and sent to the controller. The main battery will provide power to the system. Ifthe primary battery is depleted, the controller will automatically change the power source.

2.LITERATURE SURVEY

Project Title: Battery Management System In Electric Vehicle,Year of Publishing:2020
Abstract: In portable devices, low power dissipation andlong battery life are critical. Circuit designers canforecast and optimise battery runtime and circuitperformance using accurate and efficient circuit and battery models. This study proposes andimplements an accurate, intuitive, and comprehensive electrical battery model in a Cadence environment. In portable devices, low power dissipation and long battery life are critical. Circuit designers can forecast andoptimise battery runtime and circuit performance using accurate and efficient circuit and battery models. This study proposes and implements an accurate, intuitive, and comprehensive electricalbattery model in a Cadence environment.

Project Title: Iot-Based Battery Parameter Monitoring System For Electric Vehicle,
Year of publishing:2020
Abstract: In this suggested system, the voltage, current, and remaining charge capacity of the battery are estimated in a real-time situation. We built a PIC-based system to monitor these battery parameters and designed a data collecting system to monitor them. Furthermore, data is shown on an Android mobile device and kept in a database on a server. To construct the final product for our proposed system, we created a realistic model.

Project Title: Electric Vehicle Battery SwappingStation
Year of publishing: 2017
Abstract: The availability of appropriate charging infrastructure is essential for the rapid adoption of electric vehicles (EVs).Access to such infrastructure would remove a number of roadblocks to EV mobility range expansion. A Battery Swapping Station (BSS) is an efficient way to deliver powerto electric vehicles while avoiding long wait periods at a charging station (BCS). Unlike the BCS, the BSS charges the batteries in advance and prepares them for changing in a fraction of the time it takes the BCS. These stations have the potential to provide unique benefits by acting as a conduit

between electric vehicle owners and the power grid to the electrical grid This paper examines the benefits of constructing the BSS from a variety of angles. As a result, a model for battery charging scheduling from the station owner's perspective is provided. An example is given to demonstrate how the suggested model could aid BSS owners in asset management by arranging battery charging time.

SYSTEM ANALYSIS
Existing system:
Local battery monitor system is built in the existing system for monitoring battery leveland plotting the graph for user view using Matlab, therefore the programme requires a high-end processor, which raises the cost.

3.PROPOSED SYSTEM:

The batteries are initially charged to theirmaximum capacity. The initial battery powers the vehicle. The source is switched to the second battery when the first battery goes below a particular level (low battery). An embedded system (Arduino/microcontroller) is used to monitor the battery level and then switch the system on. The car is now powered by the second battery. An IoT-based battery monitoring system is used to track electricalvalues as well as locate nearby chargingstations. The technology is readily connected tothe internet for updating information and sending the vehicle's location to the server.

3.1 Block diagram description:
In this project, an IoT-based battery monitor system for electric vehicles is created. The Arduinouno is used to control the entire portion in this case. The battery level is monitored via avoltage sensing circuit, with the sensor voltage being fed into the microcontroller's ADC pin. The controller then sends the information to theserver, as well as the vehicle's location for the caretaker's knowledge. If the battery voltage falls below a certain threshold, the system will automatically switch to a different battery.
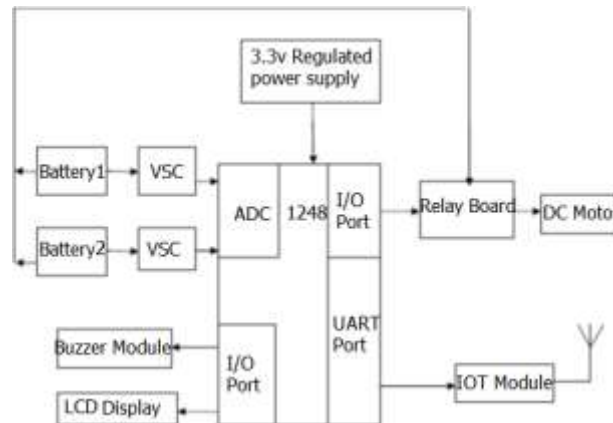

Fig 1.Block diagram

The arduino controller, voltage sensor, solar panel, dc motors, and 12v battery are all shown in the block diagram above. The voltage sensors are attached to the arduinounoanalogpin. The voltage sensor is attached to the battery.The voltage sensor is used to determine thebattery's voltage level. The relay switch is connected to the battery out voltage. The solar panel is connected to the battery through a relayswitch. The controller's GPIO pin is connected to the relay switch.

3.2. Lithium-ion battery:
In 1912, G.N. Lewis started working on the lithium battery for the first time. It wasn't until the early 1970s when non-rechargeable lithium batteries were commercially available. The 1980s were a time when attempts to produce rechargeable lithium batteriesfailed due to instabilities in the metallic lithium employed as anode material. (In a metal-lithium battery, the anode is lithium; in a Li-ion battery, the anode is graphite, with active components in the cathode.)
Lithium is the lightest metal, with the highest electrochemical potential and specific energy per weight of any metal. Rechargeable batteries with lithium metal on the anode have the potential to offer exceptionally high energy densities; unfortunately, cycling causes unwanted dendrites on the anode, which were identified in the mid-1980s. When the expanding particles breach the separator, an electrical short occurs. Thermal runaway, often known as "venting with flame," occurs when the cell temperature increases too rapidly and approaches the melting point of lithium.
Because of lithium metal's intrinsic instability,particularly when charging, research has switchedLithium ions are added

to a non-metallic solution. In 1991, Sony was the first company to commercialize lithium-ion batteries, and it is now the most promising and fastest-growing battery on the market. Even though lithium ion has a lower specific energy than lithium metal, it is safe as long as the voltage and current restrictions are adhered to.

The enhanced specific energy is due to the high cell voltage of 3.60V. Improvements in active materials and electrolytes may allow the energy density to be increased even further. The load characteristics are excellent, and the discharge curve is flat, allowing for more flexibility, efficient use of the stored energy while maintaining 3.70–2.80V/cell is a desired and flat voltage spectrum.

3.3.Requirement Specifications

The requirements specification is a technical description of the software needs. It is the first step in the requirements analysis process, and it enumerates all of the needs for a software system. includes criteria for functionality, performance, and security. The requirements also cover user, operational, and administrative usage situations. A software requirements specification's purpose is to provide a comprehensive overview of the software project, its parameters, and its goals. This section describes the target audience for the project, as well as the user interface, hardware, and software requirements.

Hardware Requirement:

Arduinouno, DC motors, Voltage Sensor, Battery.

Software Requirement:

C, C++ Compiler : Arduino IDE OS:WINDOWS

Firebase:

Firebase is a mobile and web app development platform that offers a variety of tools and services to assist developers create high-quality apps, expand their user base, and increase revenue. To authenticate users to your project, Firebase Authentication delivers backend services, easy-to-use SDKs, and ready-to-use UI frameworks.

Normally, setting up your own authentication system would take months. Even after that, you'll need to maintain the system with a committed staff. However, to utilise Firebase it is necessary to set up the complete system in under 10 lines of code, and it will take care of everything for you, even complicated processes such as account merging

Fig 2:Firebase

You can authenticate your app's users through the following methods:

- Email & Password
- Phone numbers
- Google
- Facebook
- Twitter
- & more!

With Firebase Authentication, creating secure authentication systems is easier, and end users' sign-in and onboarding experiences are enhanced.

3.4.Firebase Cloud Messaging (FCM)

Firebase Cloud Messaging (FCM) is a free service that establishes a secure and energy-efficient connection between your server and your devices, allowing you to send and receive messages and alerts across iOS, Android, and the web. You may simply target messages using FCM by utilising existing segments or creating your own based on demographics and behaviour. You can send messages to a group of devices that are all subscribed to the same subject, or you can send

messages to just one device.

FCM may send messages right away or at a specific time in the user's local time zone. Custom app data, such as priority, sounds, and expiration dates, may be sent, and custom conversion events can be tracked.

The nicest part of FCM is that it requires very little code! FCM and Firebase Analytics are fully linked, allowing you to measure engagement and conversions in great detail.Remote configuration effectively allows us to quickly distribute updates to our users. Using the server side settings, we may alter the colour scheme for a screen, the layout for a specific portion of our app, or display promotional/seasonal options without having to publish a new version.

Remote Config gives us the power to:

Easily update our apps without having to republish them on the app/play store. Easily customise how a section acts or appears in our app dependent on the user/device that is using it.

Firebase Dynamic Links

   Deep links are URLs that lead to a specific piece of material. Deep links make up the majority of web links. Deep links may now be converted to Dynamic Links in Firebase! Dynamic Links allow users to navigate straight to a specific area inside your app. Dynamic Links may be used to convert mobile web users to native app users in three ways.Increase user-to-user sharing conversion. By converting your app's users, when the app is shared with other users you can skip the generic message which is shown when a user downloads it from the store. Instead, you can show them personalised greeting message.

● 	Drive installs from the third party. You can usesocial media networks, email, and SMS can be used to increase your target audience. When users install the app, they can see the exact content of your campaign.
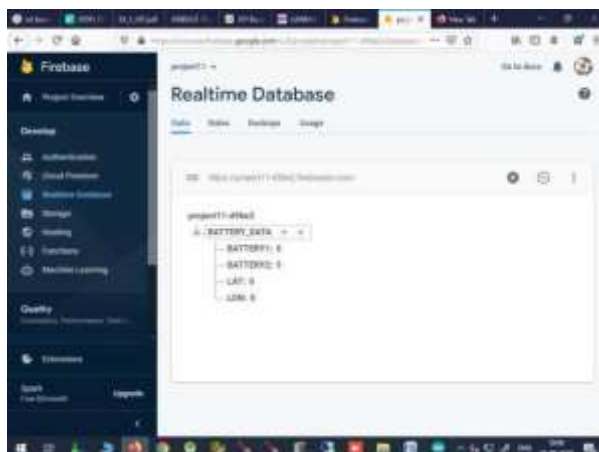
4.OUTPUT

Fig 3.Realtime Database
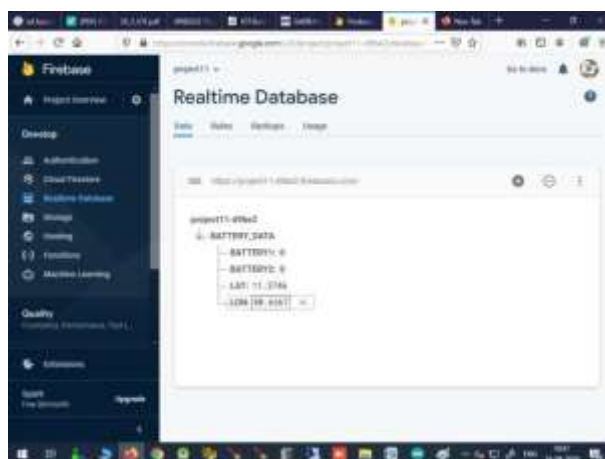

Fig 4.Realtime Database

5.SOFTWARE IMPLEMENTATION

```
#include <SoftwareSerial.h>
SoftwareSerialmySerial(10,11);
#include<LiquidCrystal.h>
int S,S1=0;
String G,LAT,LNG,D;
String json,s,s1,s2,s3,s4;
int swt,b,b1;
int sensor;
String e="Latitude:";
String e1="Longitude:";
String e2,E2;
float a,a1; charbuf[50],buf1[50];
int potentiometer = A0;
int potentiometer1 =A1;
//The input from the potentiometer is A0
//The    feedback    input    is    A1        floatvoltage,voltage1,voltage2,voltage3;
int relay= 4;
//Initial value of PWM width LiquidCrystallcd(rs, en, d4, d5, d6, d7);
voidsetup() { lcd.begin(16, 2);
Serial.begin(9600);
mySerial.begin(9600); pinMode(potentiometer,INPUT); pinMode(potentiometer1,INPUT);
pinMode(2,OUTPUT);pinMode(3,OUTPUT);digitalWrite(2,HIGH);digitalWrite(3,LOW); lcd.setCursor(0,0);
lcd.print("BATTERY MANAGEMENT");
delay(1000);//    pinMode(feedback,    INPUT);    delay(1000);    Serial.println("AT\r");delay(1000);
Serial.println("ATE0\r"); delay(1000); Serial.println("AT+APBR=3,1,\"Contype\",\"G PRS\"\r"); delay(1000);
Serial.println("AT+SAPBR=3,1,\"APN\",\"internet\"\r"); delay(1000);
Serial.println("AT+SAPBR    =1,1\r");    delay(1000);    Serial.println("AT+SAPBR=2,1\r");    delay(1000);
Serial.println("AT+CLBSCFG=0,1\r"); delay(1000); Serial.println("AT+CLBSCFG=0,2\r"); delay(1000);
}
void loop()
{voltage = analogRead(potentiometer);voltage = voltage * 5.0/1023;
//Serial.println(voltage);
voltage1= analog Read (potentiometer1);voltage1 = voltage1 * 5.0/1023;
//Serial.println(voltage);lcd.clear(); lcd.setCursor(0,0); lcd.print("SYSTEM"); delay(1000);
//Finally, we create the PWM signal lcd.clear();lcd.setCursor(0,0);
lcd.print("BATTERY1Voltage");lcd.print("Voltage1:"); lcd.setCursor(0,1); lcd.print(voltage);
delay(1000); lcd.clear(); lcd.setCursor(0,0);
lcd.print("BATTERY2Voltage2");lcd.print("Voltage2:"); \ lcd.setCursor(0,1); lcd.print(voltage1);
delay(1000); if(voltage<1 &&
voltage1>1)Serial.println("AT+CLBS=4,1\r")
; s = Serial.readString();Serial.println(s); delay(3000);
intslen = s.indexOf(":"); intelen = s.indexOf("/");
s1 = s.substring(slen + 1,elen);s2 = s1.substring(3, 12);
s3 =s1.substring(13, 22); s2.toCharArray(buf, sizeof(buf));a = atof(buf);
b = atoi(buf);
s3.toCharArray(buf1, sizeof(buf1));a1 = atof(buf1);
b1 = atoi(buf1);
if (b < 10 && b1 < 10)
{
//Serial.println(a,6);
//Firebase.setFloat(firebaseData,path1,a);
}
else if (b > 10 && b1 > 10)
{
LAT=s3;LNG=s2;
lcd.clear()
```

6.RESULT AND CONCLUSION:
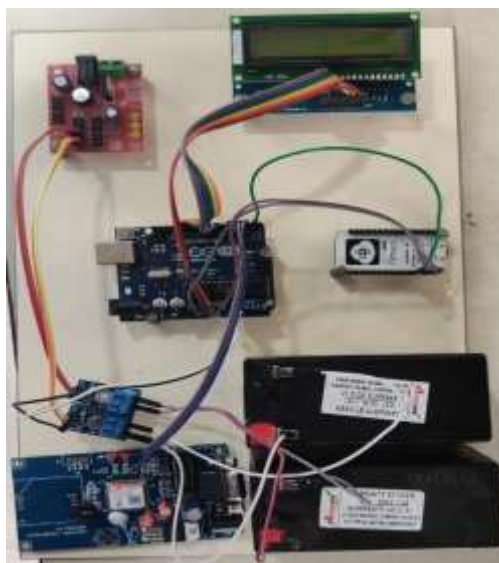
Fig 5. System prototype

This paper presents a detailed experimental design for a BMS with applicationsin electric vehicles. The designed hardware testbed is developed following standard industrial communication protocol. The functionality and the accuracy of sensors, processor and communications are discussed.This would considerably increase the run distance of the vehicle, two to three times.

7.FUTURE ENHANCEMENT:

The provision of suitable charginginfrastructure is critical to the quick adoption ofelectric vehicles (EVs). Access to such infrastructure would remove a number of roadblocks to EV mobility range expansion. A Battery Swapping Station (BSS) is an efficient way to deliver power to electric vehicles while avoiding long wait periods at a charging station (BCS). Unlike the BCS, the BSS charges the batteries ahead of time and prepares them for swapping in a fraction of the time. Because thesestations can act as a conduit between EV ownersand the power grid, they have the potential to deliver unique benefits to the power grid.

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