SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU-572103
(An Autonomous Institute under Visvesvaraya Technological University, Belagavi)

Mini Project Report
On

BATTERY MONITORING SYSTEM

Submitted in partial fulfillment of the requirement for the completion of VI semester of

BACHELOR OF ENGINEERING
in
ELECTRICAL AND ELECTRONICS ENGINEERING

SUBMITTED BY

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2021-22

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BONAFIDE CERTIFICATE

This is to Certify that the mini project work entitled **"BATTERY MONITORING SYSTEM"** is a bonafide work being carried out by in partial fulfillment by

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ABSTRACT

Battery monitoring system ensures the optimal usage of energy inside the battery powering the product. It smartly operates by preventing costly downtime due to unexpected battery failures. Traditional estimates, with proper management system can make battery life reach the level of design expectations.

One can effectively avoid the over-charging or under-charging of batteries to maintain uniformity among batteries to increase its shelf life. Analysis of data allows remedial action for individual cells to extend their life. Enables procurement of batteries though planned schedules, not emergency replacement. It can be left unattended at sites for data collections, or, by its integrated alarm features that assists the user to initiate the charge/discharge cycles. Monitors functions that involve the measurement of battery voltage, battery temperature, charge status or load activity. Control functions act on the charging and discharging processes of the battery based on these measured parameters.

CONTENTS

LIST OF FIGURES

CHAPTER 1-INTRODUCTION

INTRODUCTION

Battery Monitoring System (BMS) needs to be enhanced in order to provide a better performance. Battery monitoring system (BMS) is required in order to monitor the operational system, performance and battery life such as charge and discharge process. Battery monitoring system consists of measuring devices to measure parameters such as battery voltage, current, efficiency, rate of charging and discharging and temperature. These parameters can be processed to estimate the state of charge and state of health of the battery.

Battery Monitoring products provide crucial data to determine if reserve power batteries will perform as expected when critical power is interrupted. Without proper monitoring of battery system status, there is a risk of catastrophic loss.

Using BMS, weak/damaged battery in a bank can be identified prior to the occurrence of failure through net charge & backup calculation by which loads can be planned & other means of a power source like a generator can be turned on. By replacing the particular failed/weak battery, remaining batteries in a bank will not be damaged, instead they will be properly utilized without replacing the entire bank. The life of the weak battery can be extended to some extent by individual charging methods or by adding distilled water/acid if it is a maintenance battery.

The BMS sends alerts of Alarm status, battery parameters during exigencies, battery summary through E-mail/SMS. It also provides warnings of impending malfunction based on set limits of voltage, current and temperature and displays the status of system on screen.

1.1 PROBLEM STATEMENT

To prevent battery failure and mitigate potential hazardous situations, there is a need for a supervising system that ensures that batteries function properly in the final application. This supervising system is referred to as a Battery Monitoring System (BMS).

Battery Monitoring System is an analogue and/or digital electronic hardware device complemented with specific software, that is added to a battery system.

The primary function of a BMS is to fulfil safety requirements. But there's more to it. Objectives related to the more efficient usage of battery cells and a prolongation of their lifetime are also being increasingly integrated into the design of BMS.

1.2 OBJECTIVE OF THE PROJECT

To design the Battery Monitoring System for industry using arduino.

The main objective of the Battery Management System (BMS) is to inform the users regarding the present state of the battery bank, health of each individual battery in a battery bank, failure conditions of batteries and alert the users about the net charge present in the battery bank and the backup time.

1.3 MOTIVATION

The main motivation behind this project is energy saving and cost reduction by preventing the unwanted replacement of batteries. The product gives indications of how long the battery will last at a given load.

It monitors battery as a whole unit and for individual batteries that gives the information of each battery's life. Hence the entire unit is not required to be replaced with the increased degradation of a single battery. The system also provides information on how long the battery can be used based on the current load and its state of charge. Therefore, the user is given the opportunity to prioritize his/her usage and have a seem less usage of battery power as well.

CHAPTER 2-HARDWERE DISCRIPTION

2.1ARDUINO UNO

The Arduino Uno is an **open-source microcontroller board** based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.
The Arduino connects all the sensory systems to the screen and the required systems. It functions according to the specified terms and conditions for the best usage of the battery completing the objective of the battery monitoring system .

Fig 2.1: Arduino

Pin details :

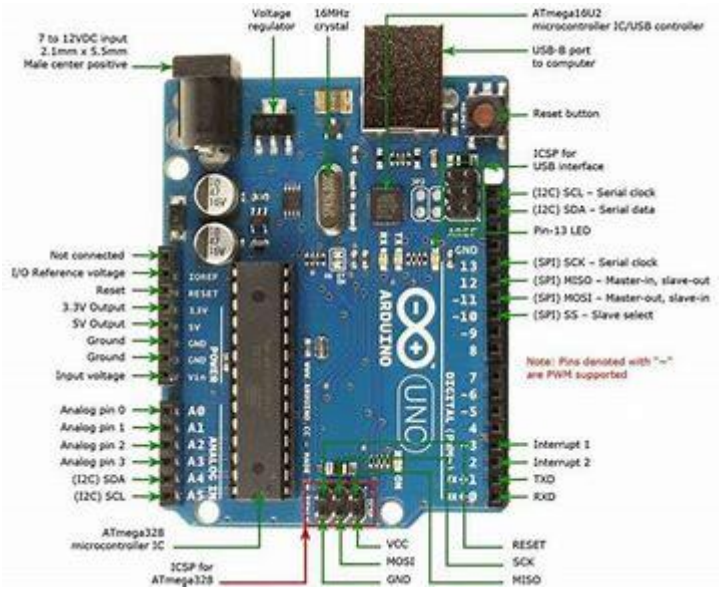

Fig 2.2 Pin diagram

2.2 CURRENT SENSOR

The battery current sensor helps to indicate the amount of current being utilized by the system from the battery thus helping in improving the battery performance accordingly.

Fig 2.3Current sensor

2.3 VOLTAGE SENSOR

The battery voltage sensor helps to indicate the voltage of the battery of the system thus helping in improving the battery's rate of charging and in overall performance of the battery.

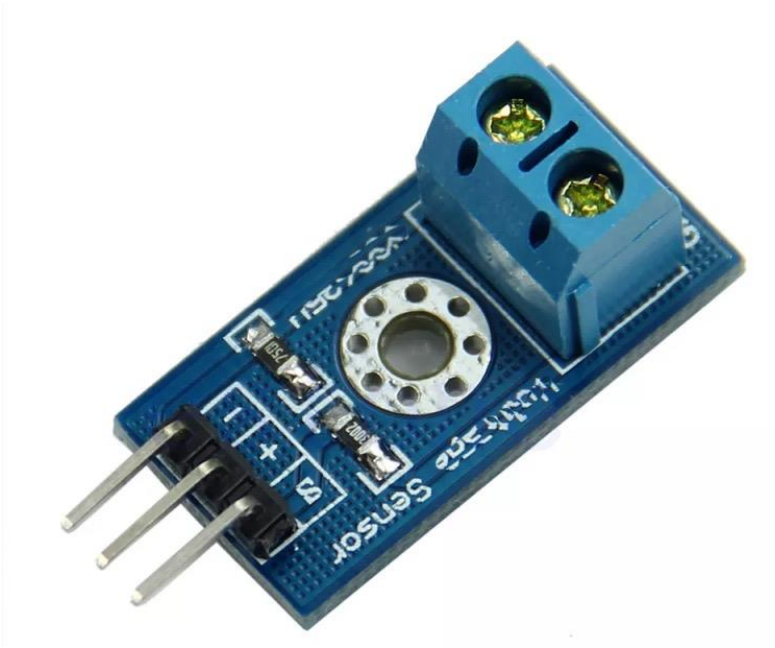

Fig 2.4 voltage sensor

2.3 TEMPERATURE SENSOR

The battery temperature sensor helps to indicate the temperature of the battery of the system thus helping in improving the battery's overall condition and prevent it from overheating and getting damaged.

Fig 2.5 Temperature sensor

CHAPTER 3 – SOFTWARE DESCRIPTION

3.1 Arduino Programming

We are using **Arduino IDE** to program. Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

- The Arduino Programming Language is basically a framework built on top of C++.
- A program written in the Arduino Programming Language is called **sketch**. A sketch is normally saved with the .ino extension (from Arduino).
- The main difference from "normal" C or C++ is that you wrap all your code into 2 main functions.
- One is called setup (), the other is called loop (). The first is called once, when the program starts, the second is repeatedly called while your program is running.
- We don't have a main () function like you are used to in C/C++ as the entry point for a program. Once you compile your sketch, the IDE will make sure the end result is a correct C++ program and will basically add the missing glue by preprocessing it.

3.2 Code

```
#include <Servo.h>
#define ANALOG_IN_PIN A2
#define buzzerPin 8
#define LM35 A0

Servo servo;
int angle = 10;

float adc_voltage = 0.0;
float in_voltage = 0.0;
float R1 = 30000.0;
float R2 = 7500.0;
float ref_voltage = 5.0;
int adc_value = 0;

double Vout = 0;
double Current = 0;
const double scale_factor = 0.185;
```

```
const double vRef = 5.00;
const double resConvert = 1024;
double resADC = vRef/resConvert;
double zeroPoint = vRef/2;

float sensorValue1=0;
float sensorValue2=0;
float tempc;

float SOH =0;
float SOC =0;
float base_voltage=9;
float base_resistance=180;

void setup()
{
  Serial.begin(9600);
  servo.attach(9);
  servo.write(angle);
  pinMode (8, OUTPUT);
  pinMode (LM35,INPUT);
}


void loop()
{
  for(angle = 10; angle < 180; angle++)
  {
    servo.write(angle);


  }
    adc_value = analogRead(ANALOG_IN_PIN);
    adc_voltage  = (adc_value * ref_voltage) / 1024.0;
    in_voltage = adc_voltage / (R2/(R1+R2));
    Serial.print("Input Voltage = ");
    Serial.println(in_voltage, 2);

    for(int i = 0; i < 1000; i++)
    {
      Vout = (Vout + (resADC * analogRead(A3)));
      delay(1);
    }
    Vout = Vout /1000;
    Current = (Vout - zeroPoint)/ scale_factor;
    Serial.print("Current = ");
    Serial.print(Current,4);
    Serial.println(" Amps");

    sensorValue1 = analogRead(LM35);
```

```
  sensorValue2 = 150 - sensorValue1;
  tempc = sensorValue2 * 0.7045;
  Serial.print("Temperature = ");
  Serial.println(tempc);

  SOH = ((in_voltage/Current) / base_resistance) * 100 ;
  Serial.print("State of Health = ");
  Serial.println(SOH);

  SOC = (in_voltage / base_voltage) * 100 ;
  Serial.print("State of Charge = ");
  Serial.println(SOC);

  if(tempc > 30)
  {
  digitalWrite(buzzerPin , HIGH);
  delay(1000);
  digitalWrite(buzzerPin , LOW);
  delay(1000);
  digitalWrite(buzzerPin , HIGH);
  delay(1000);
  digitalWrite(buzzerPin , LOW);
  delay(1000);
  }


  if(in_voltage > 9)
  {
  digitalWrite(buzzerPin , HIGH);
  delay(1000);
  digitalWrite(buzzerPin , LOW);
  delay(1000);
  }

  if(in_voltage >9)
  {
    delay(20000);
  }
  else
  {
    delay(20);
  }

 for(angle = 180; angle > 10; angle--)
 {
  servo.write(angle);

 }
  delay(2000);
}
```

CHAPTER 4- LITERATURE SURVEY

LITERATURE SURVEY

Name of the paper	Year of publication	Conclusion
1 . Efficient Battery Monitoring System for E-Vehicles	2021	This battery monitoring system for electric vehicles can be used to monitor the real time health of the batteries present in electric cars, bikes or trucks.
2 . Experimental Battery Monitoring System Design for Electric Vehicle Applications .	2018	This paper presents a detailed experimental design for a BMS with applications in electric vehicles. The functionality and the accuracy of sensors, processor and communications are discussed.
3 . Research on Li-ion Battery Management System .	2010	This paper centers on measurement of battery voltage, temperature , voltage and battery current.

CHAPTER 5- BLOCK DIAGRAM

BLOCK DIAGRAM

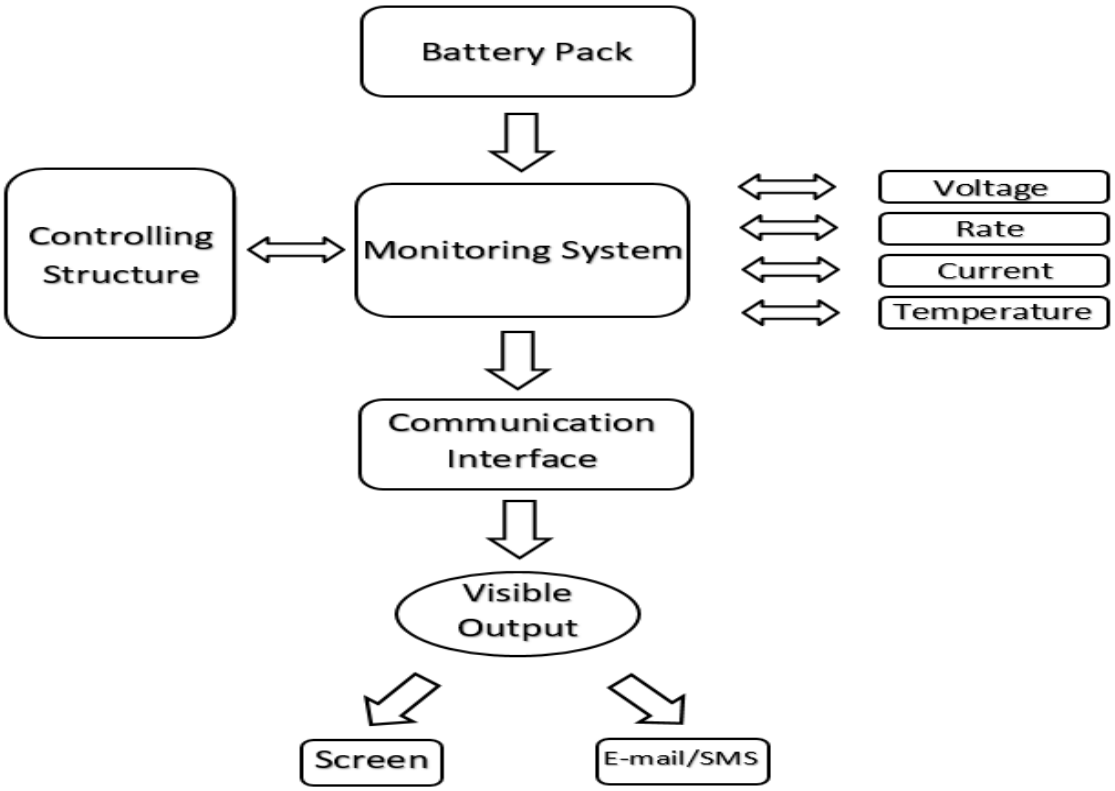

Fig 3.1Block diagram

Monitoring System: This particular phase measures the different parameters of the Monitoring System and functions accordingly.

Controlling Structure: It changes the position of the battery accordingly. If the charge percentage reaches below a specified level that particular battery is moved from the usage position to the charging position, and is charged up to the specified level using the accurate amount of current and voltage.

Communication Interface: It communicates between the sensors, the microcontroller, and the visible phase of the project and required action according to the circumstance is taken.

CHAPTER 6 – WORK DONE TILL DATE

- Circuit designing completed.
- Measurement of parameters (voltage, current, temperature, state of health, state of charge (discharging rate)).
- Changing the position of the battery.

CIRCUIT DIAGRAM-

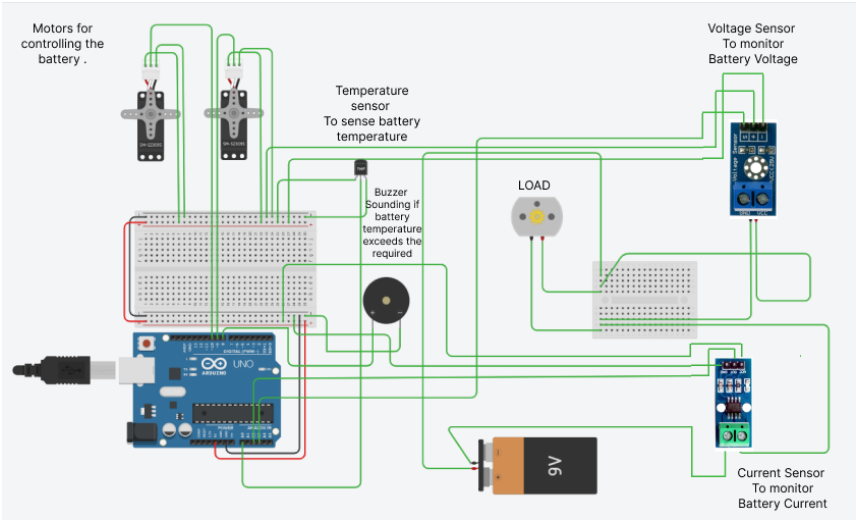

Fig 5.1 circuit diagram

Fig 5.2 Working circuit diagram

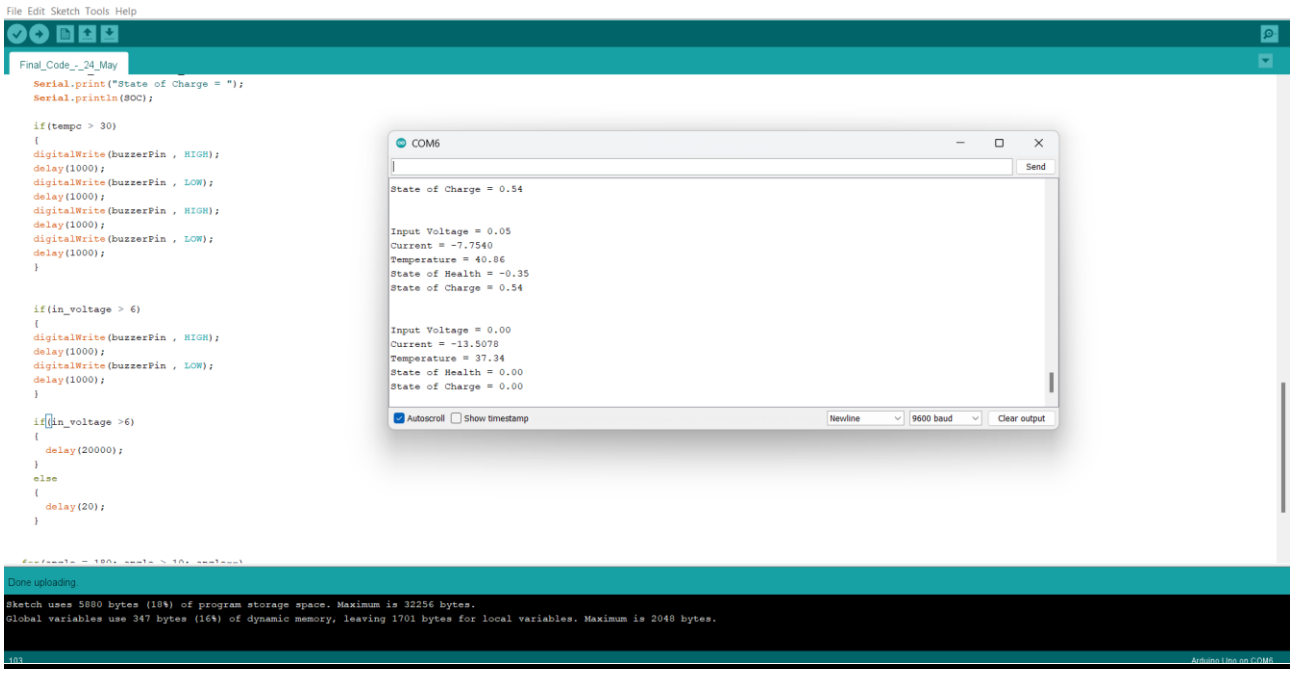

Fig 5.3 Serial Monitor Screen-shot.

CHAPTER 7 - RESULTS AND DISCUSSION

This project presents the idea for Battery Monitoring System. Here the battery parameters such as voltage, current, rate of charging and discharging and temperature are taken into consideration and the best possible action is taken to avoid any kind of catastrophic loss.

The Battery Monitoring System sends alerts of Alarm status, battery parameters during exigencies, battery summary through E-mail/SMS.

It also provides warnings of impending malfunction based on set limits of voltage, current and temperature and displays the status of system on screen.

CHAPTER 8 - CONCLUSION AND FUTURE WORK

8.1 SOH (State of Health):

State of health (SOH) is a figure of merit of the condition of a battery (or a cell, or a battery pack), compared to its ideal conditions. The units of SOH are percent points (100% = the battery's conditions match the battery's specifications).

Typically, a battery's SOH will be 100% at the time of manufacture and will decrease over time and use.

SOH = Total Capacity (Ah) / BOL Capacity (Ah)

(BOL – Beginning of life)

Alternatively battery Impedance can also be used for SOH calculation.

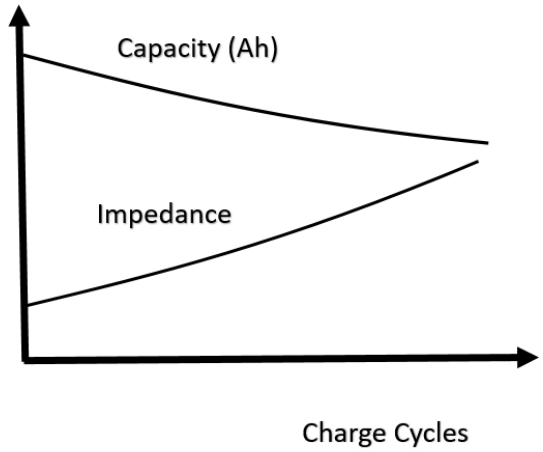

Fig 8.1 State of Health Curve

8.2 SOC (State of Charge):

State of charge (SOC) is the level of charge of an electric battery relative to its capacity. The units of SOC are percentage points (0% = empty; 100% = full). An alternative form of the same measure is the depth of discharge (DOD), the inverse of SOC (100% = empty; 0% = full).

SOC is normally used when discussing the current state of a battery in use, while DOD is most often seen when discussing the lifetime of the battery after repeated use.

SOC = Capacity Remaining (Ah) / Total Capacity of battery (Ah)

Alternatively open circuit voltage can also be used for SOC calculation.

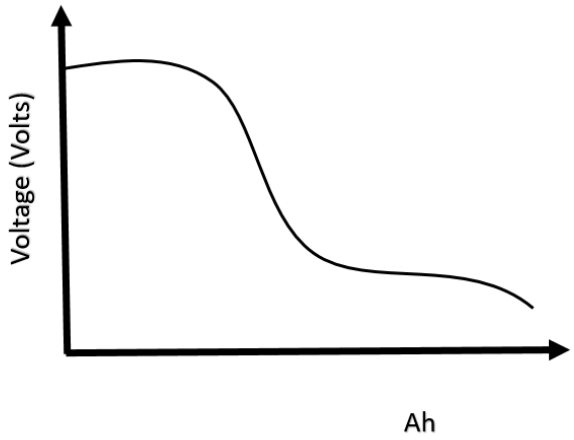

Fig 8.2 State of Charge Curve

8.3 SOA (Safe Operation Area):

For battery, the safe operating area (SOA) is defined as the voltage and temperature conditions over which the battery can be expected to operate without self-damage and best output performance.

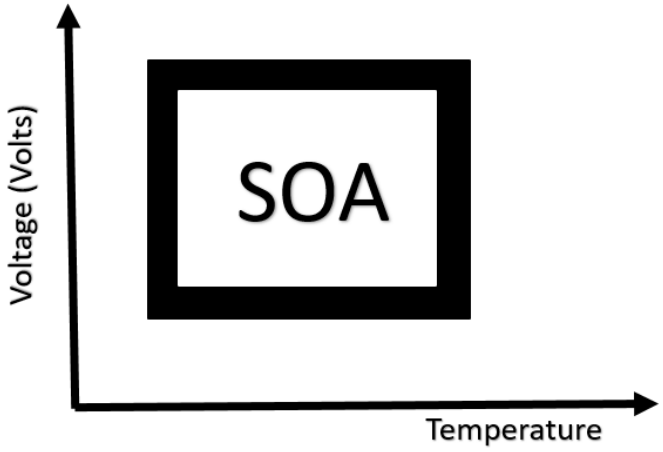

Fig 8.3 Safe Operation Area Curve

8.4 Future Work

- Analysis of the parameter.
- Showing the parameter through cloud computing.
- Adding the relay to the circuit.

CHAPTER 9 -REFERENCES

1. Efficient Battery Monitoring System for E-Vehicles.
   This battery monitoring system for electric vehicles can be used to monitor the real time health of the batteries present in electric cars, bikes or trucks.
   ISSUE:2021

2. . Experimental Battery Monitoring System Design for Electric Vehicle Applications . This paper presents a detailed experimental design for a BMS with applications in electric vehicles. The functionality and the accuracy of sensors, processor and communications are discussed.
   ISSUE:2018

3. . Research on Li-ion Battery Management System .
   This paper centers on measurement of battery voltage, temperature , voltage and Battery current.
   ISSUE:2010

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1. www.instructables.com