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EV Battery management

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Introduction

- In this project, we’ve designed a simple system called EV battery management system. Electric Vehicle plays a major role but charging their batteries takes large time and get heated.
- To control overheating we have created a EV battery cooling system.
- Our system will control over heating of batteries while charging and stretching the batteries for fast charging. But when we stretch the batteries by the BMS it will increase the charging efficiency.
- Heat is exposed heavily. To control heating liquid cooling is added to the system which will maintain lower temperature.
- When EV is in off condition in a warm environment the battery may get heated. When the heat becomes higher our EV cooling system will detect and turn on cooling

Project Objectives

- To creating a cooling system while charging the batteries.
- Maintaining the battery temperature while in hot environment.
- Stretching the batteries for fast charging.
- Increasing the efficiency of the batteries.
- Our cooling system is a separate mode of connection which will accessed in vehicle off condition.

Literature review
Analysis the liquid of EV battery pack

- Lithium-ion (Li-ion) batteries are widely known for their energy efficiency and are becoming the battery of choice for designers of electric vehicles (EVs). However, these batteries lose efficiency quickly with sudden changes in temperature.
- One way to control rises in temperature (whether environmental or generated by the battery itself) is with liquid cooling, an effective thermal management strategy that extends battery pack service life.
- To study liquid cooling in a battery and optimize thermal management, engineers can use multiphysics simulation.

Thermal Management of a Li-Ion Battery in an Electric Car

- Li-ion batteries have many uses thanks to their high energy density, long life cycle, and low rate of self-discharge. That’s why they’re increasingly important in electronics applications ranging from portable devices to grid energy storage and they’re becoming the go-to battery for EVs and hybrid electric vehicles (HEVs) because of their high energy density compared to their weight.
- Despite their many advantages, Li-ion batteries are especially sensitive to extreme low and high temperatures. When a Li-ion battery pack gets too hot or cold due to environmental factors or by its own charge or discharge rate, its performance and life cycle can decrease significantly.
- Not only that, but once the battery pack is heated or cooled outside its optimal temperature range of 20 to 40°C, even a one-degree change in temperature can make a difference in the safety, charge acceptance, and reliability of the battery management system and the car itself

Research on Electric Vehicle Cooling System Based on Active and Passive Liquid Cooling

- Compared with internal combustion engine automobile, the battery capacity and motor conversion efficiency for electric vehicles (EV) are limited, which means it requires lower energy consumption.
- To this aim, EV needs more complex thermal management system and higher thermal management requirements. This paper proposes an active and passive liquid cooling-based system cooling scheme. Coolant circulation's components model and refrigerant circulation's components model are built.
- The performance parameters for the components are obtained by fitting the experimental data. To demonstrate the performance of the proposed method, simulation experiments are conducted.
- The results show that it is feasible and robust to cool and heat the battery using passive cooling circuits in low and medium temperature environments. During critical conditions where the ambient temperature changes from 28 ° C to 32 ° C, the active and passive liquid cooling-based scheme can not only guarantee the battery operating temperature, but also save energy.

A Review on Thermal Management in EV Battery System by Liquid Cooling

- With the advent of sophisticated technologies and complexity of electronics and mechanical system for mobility applications, the challenges for better heat management is paramount. The challenge is largely driven by integration of most innovative auto subsystems and their demand of being tightly packed into a lower volume, mass and relatively higher power consumptions compared to the older version.
- One of the examples is the thermal management in electric vehicle battery system. The thermal management issue is the primary concern that impedes the widespread applications of lithium ion batteries in electric vehicles. It significantly affects not only the life cycle of the batteries, also the performances of the electric vehicles.
- A thermal runway often happens due to different kinds of abuse conditions like mechanical, electrical, and thermal abuse. There are several aspects that need to be addressed like choice of efficient battery materials, good battery design, incorporation of thermal management solutions for electronic components, proper cooling systems (traditional air, water -glycol cooling to 3M engineered fluid Novec TM and passive defense against the practical abuse conditions would ensure the shield against the thermal runaways.
- The current paper is focused on efficient alternative cooling technology for EV battery system

Parametric Optimization of a Direct Liquid Cooling

- To control the working temperature of the battery system, in recent years different cooling strategies have been considered. These strategies are generally classified as air cooling, liquid cooling (LC), phase change materials (PCM), heat pipes (HP), and thermoelectric coolers (TEC) .
- Among these technologies, owing to the thermal conductivity an heat capacity of the implemented fluids, strategies based on liquid cooling (LC) predominate the thermal management of the electric vehicle sector .
- LC strategies can be divided into two main groups, indirect liquid cooling (ILC) and direct liquid cooling (DLC). Today, ILC is the leading strategy in the field of electric vehicles. However, the fluids used in ILC are electrically conductive, a nature that avoids direct contact with the battery cell.
- This characteristic decreases the cooling capacity of the strategy compromising the performance of the system . Consequently, DLC has been the subject of many studies in recent years. DLC strategy uses fluids with high dielectric strength that enable direct contact between the heat generation source (battery cell) and the refrigeration fluid, improving the thermal management efficiency of the system.

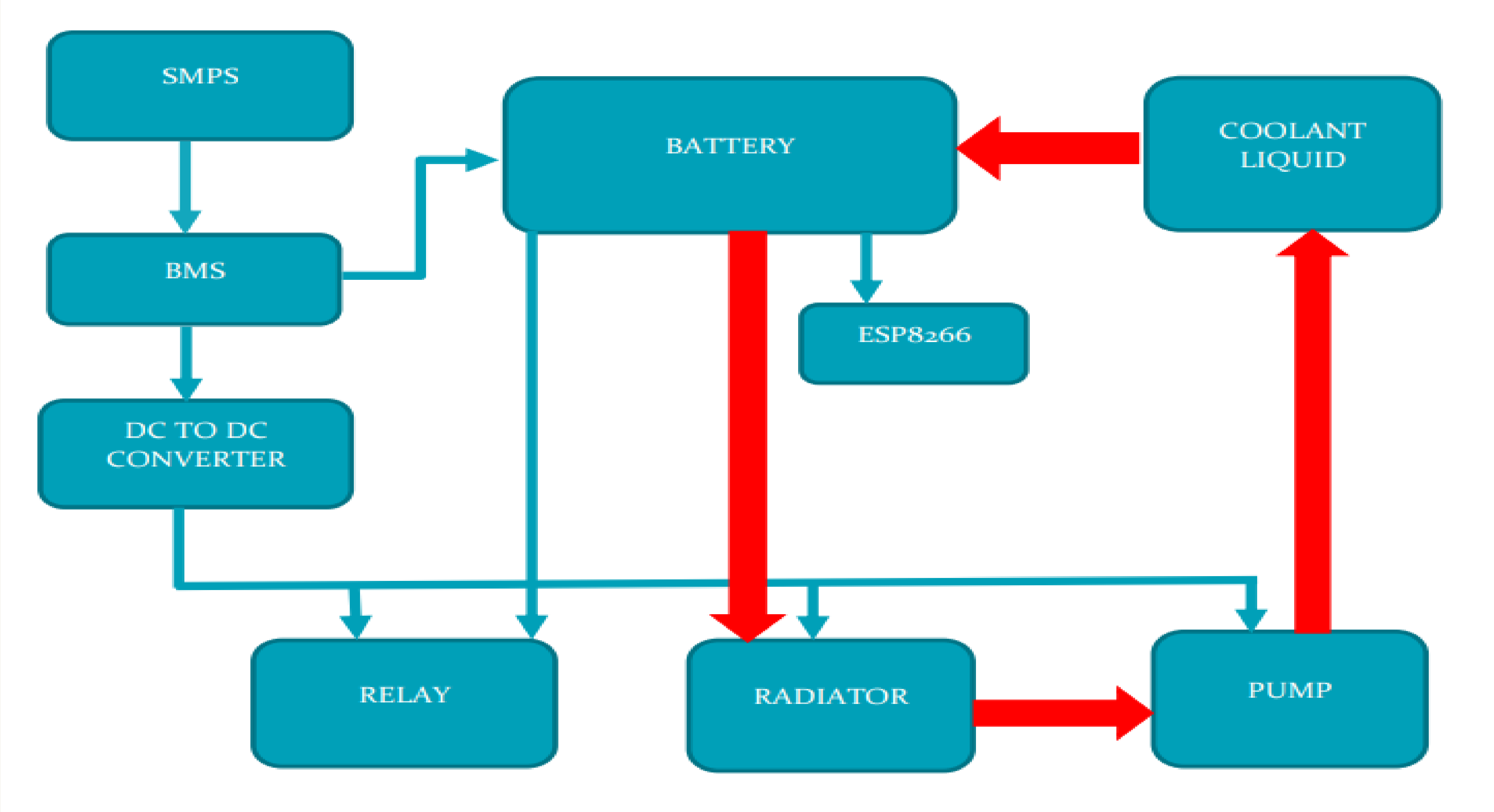
Proposed Methodology

- The proposed method includes the design of the EV battery management and cooling system.
- The major blocks of the block diagram are battery, BMS, thermostat relay, radiator.
- We increase the efficiency of the battery.

Abstract

In our developing country Electric Vehicle plays a major role but charging their batteries takes large time and get heated. To control overheating we have created a EV battery cooling system. Our system will control over heating of batteries while charging and stretching the batteries for fast charging. But when we stretch the batteries by the BMS it will increase the charging efficiency. Heat is exposed heavily. To control heating liquid cooling is added to the system which will maintain lower temperature. When EV is in off condition in a warm environment the battery may get heated. When the heat becomes higher our EV cooling system will detect and turn on cooling.

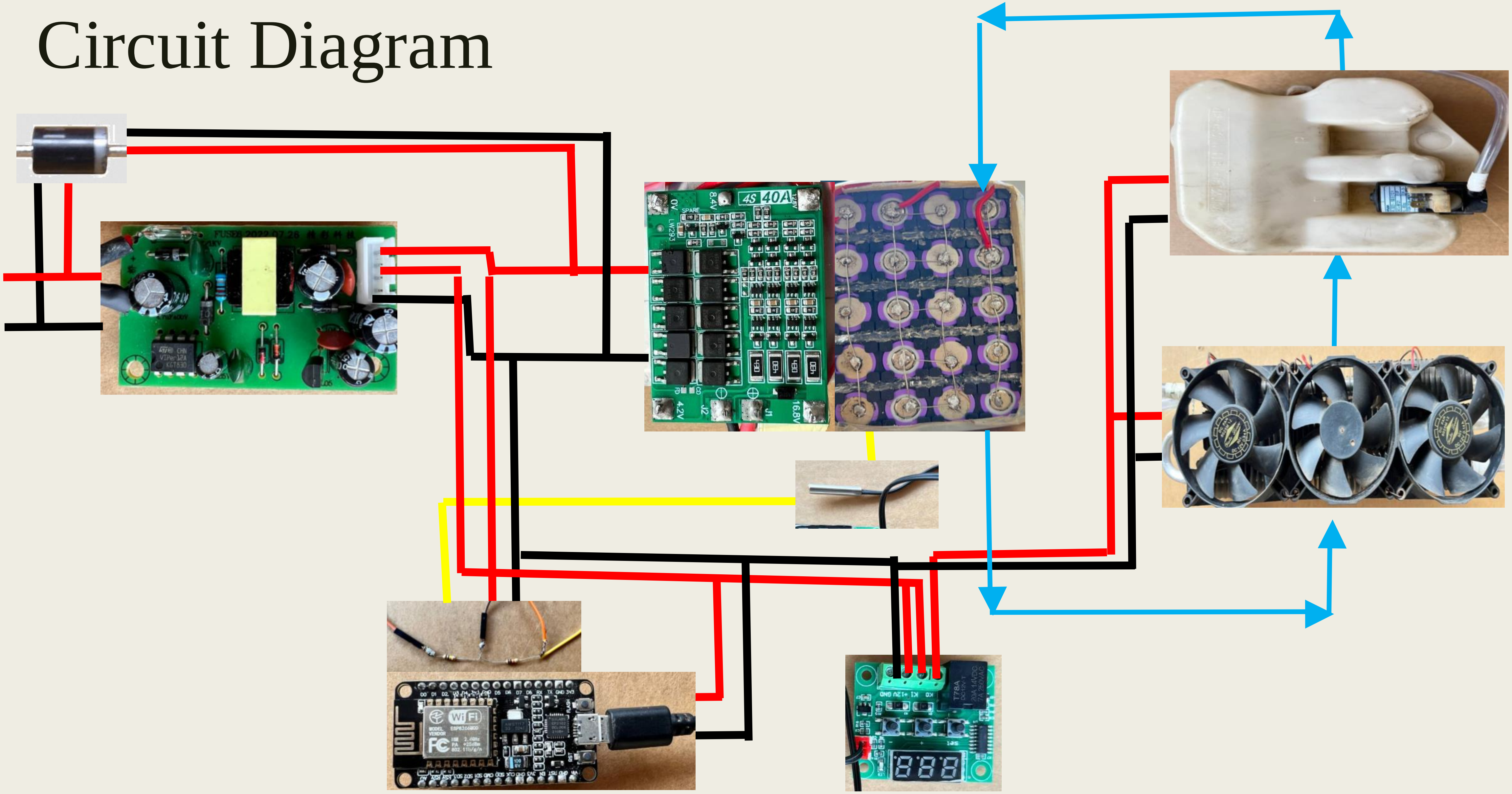
Block Diagram



Methodology

- Cooling system is activating when the temperature increases.
- The voltage level and battery level is shown in the software.
- Radiator cools the battery faster with high efficient cooling system.
- This system works in any condition.

Circuit Diagram



Components Used
BATTERY

- A 3.3V EV battery can be used as part of a larger battery pack that consists of multiple cells connected in series or parallel to achieve a higher voltage or capacity 12.
- For example, some electric vehicles may use a battery pack that has hundreds of lithium-ion cells that produce 3V each and are arranged in different configurations to meet the power and energy requirements of the vehicle.

Battery Management System

- A battery management system (BMS) is used to monitor and regulate the charging and discharging of batteries, such as lithiumion batteries, that are used in various applications, such as electric vehicles, portable electronics, energy storage systems, etc.
- Used to estimate the state of charge (SoC) and state of health (SoH) of the battery, using measurements of voltage, current and temperature.
- This can help improve the safety, efficiency and reliability of the battery and the application that uses it . Used to protect the battery from deep discharge and overvoltage, and provide a cell balancing function for multi-cell batteries.
- This can help prevent battery degradation or damage from various thermal thresholds and extend the battery life cycle and performance .

Thermostat Relay

- A thermostat relay is used to switch on and off the battery thermal management system (BTMS) that controls the temperature of the battery pack in electric vehicles or other applications .
- The BTMS can use different methods, such as air cooling, liquid cooling, phase change materials, etc., to maintain the battery temperature within a certain range that can prevent battery degradation or damage .
- Used to regulate the voltage of the battery pack by switching on and off a DC-DC converter that adjusts the output voltage of the battery pack to match the load demand .
- The thermostat relay can also protect the battery pack from over-voltage or under-voltage by PAGE 25 disconnecting the load or the charger when the voltage exceeds or falls below a set point .

DC to DC convertor

- A DC to DC converter is used to convert one level of DC voltage to another level, which may be higher or lower than the input voltage.
- This can be useful for various applications that require different voltage levels for different devices or circuits, such as portable electronics, electric vehicles, renewable energy systems, etc.

Radiator

- A radiator is used to release the heat from the coolant fluid that circulates through the battery pack and absorbs the excess heat generated by the battery cells .
- The radiator can use air or water as the cooling medium and can be located at the front or rear of the vehicle .
- A radiator is used to regulate the temperature of the battery pack by adjusting the airflow or water flow through it .
- The radiator can be controlled by a fan, a valve, or a thermostat relay that responds to the temperature sensors in the battery pack

ESP8266

- ESP8266 is a low-cost Wi-Fi microchip that can be used to connect a BMS to the internet and send the battery status data to a cloud platform, such as Arduino IoT Cloud.
- Using this system, we can monitor the battery voltage and percentage from anywhere in the world using a web browser or a smartphone app .
- ESP8266 can be used to communicate with the BMS using a software-based serial UART port on GPIO pins 4 and 5 .
- This can enable the ESP8266 to read the data from the BMS, such as state of charge, state of health, current, temperature, etc., and display it on a web page or send it to a cloud platform

SMPS

- A 12V AC to DC adapter is used to convert the 12V alternating current (AC) from a wall outlet or a transformer into 12V direct current (DC) that can power various devices that require a stable and regulated voltage supply .
- A 12V AC to DC adapter is used to match the voltage and polarity of a device that has a DC input of 12V .
- For example, you can use a 12V AC to DC adapter to power a device that has a DC input of +12V / 5.4A, as long as the adapter has the same output voltage, current rating

Software Used

- Arduino IDE - The Arduino Integrated Development Environment-or Arduino Software(IDE)-contains a text editor for writing code, a message area, a text console , a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Code

```
#define BLYNK_TEMPLATE_ID "TMPL36xoo78-6"
#define BLYNK_TEMPLATE_NAME "volt barttt"
#define BLYNK_AUTH_TOKEN "Tgsd-BMTEY47xJsFg15vfK_bUReMdd6U"
#define BLYNK_PRINT Seria
//#include <WiFi.h>
//#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
BlynkTimer timer;
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "qqqq";
char pass[] = "qwertyuiop";
int value = 0;
```

Code

```
float voltage, battery, q = 18;
void eee(){
  value = analogRead(A0);
  value = value-5;
  voltage = value * 0.034;
battery = (voltage*100)/q;
  Blynk.virtualWrite(V0,voltage);
  Blynk.virtualWrite(V1,battery);
  Serial.print("Voltage       = ");
  Serial.println(voltage);
  Serial.print("Value         = ");
  Serial.println(value);
  Serial.print("Battery level = ");
  Serial.print(battery);
  }
```

Code

```
void setup(){
  Serial.begin(9200);
  Blynk.begin(auth, ssid, pass);
  timer.setInterval(100L,eee);
}
void loop(){
  Blynk.run();
  timer.run();
}
```

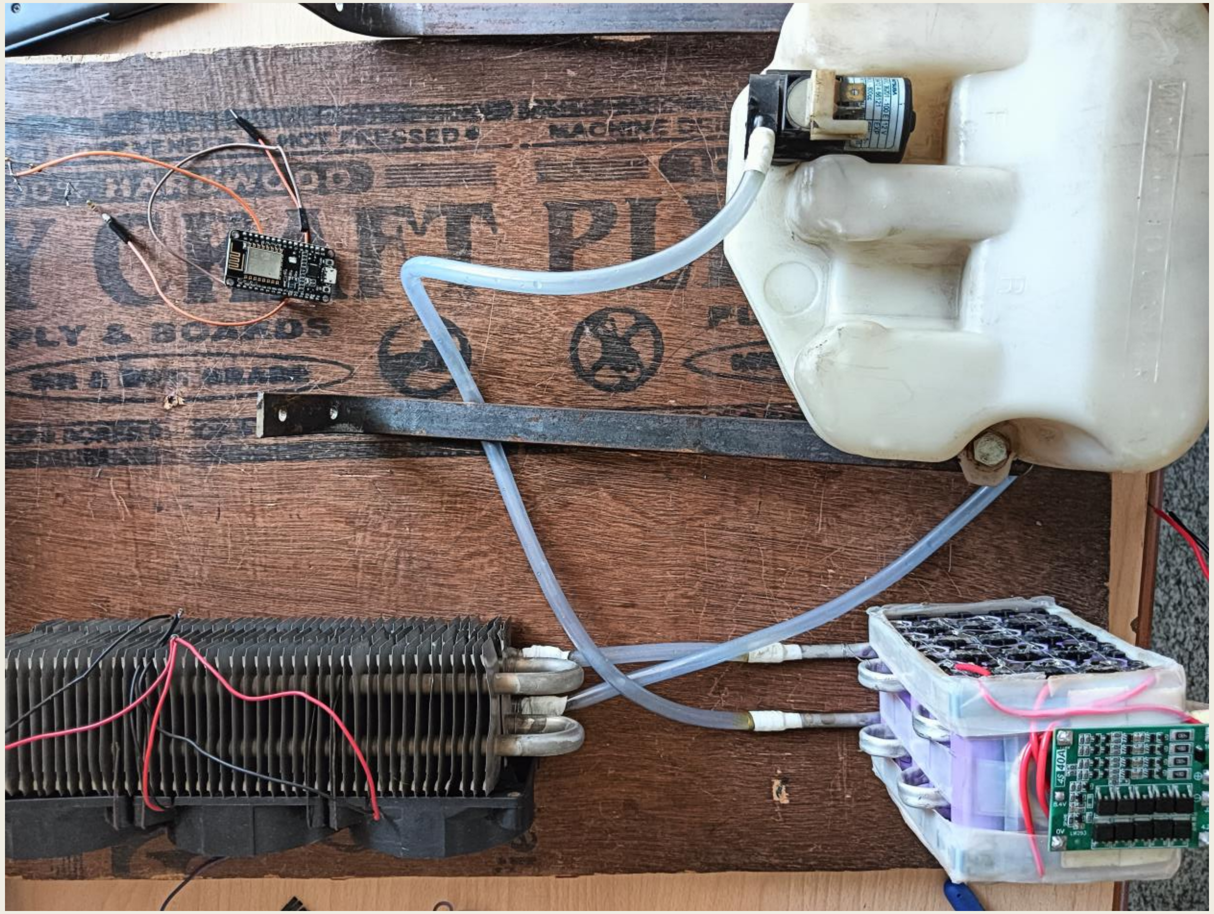
Working

- A 12 v AC to DC adapter supply is given to the BMS and the BMS is connected to a DC to DC converter in which the fixed dc current is transformed into variable dc to give supply to other components.
- 4 parallel and 5 series connected battery is connected to the BMS A radiator is connected to the battery with the help of thin pipes which is used to transfer coolant liquid.
- A thermostat relay sensor is connected between the radiator and Battery which will detect the heat produced by the battery and start to pump the coolant into the pipes across the battery ESP8266 is connected to the battery, with the help of two resistor of 100kΩ and 10 kΩ for the protection of ESP8266.
- It is used to monitor the battery voltage and percentage from anywhere by using a smartphone application When the battery gets overheat the thermostat relay sensor detects the heat and give signal to the radiator and the cooling system was initiate immediately.
- After that the battery heat reduces and it can work more efficient and we can charge the battery even faster than before

Working

- When fast charge the battery it starts to get heat.
- At this situation, when the battery starts to get over heated the Relay Module Thermister Temperator Sensor Module will detect the temperature.
- And if the temperature is higher it will trigger the cooling system.
- In case of the vehicle is in off condition, if the environment temperature heats the battery our cooling system will be triggered to cool down the temperature.

Experimental Setup



Program Status

- Completed

Components

Components	Quantity	Amount
Battery	16	2500
BMS	1	300
Thermostat relay	1	300
Battery holder	32	200
ESP8266	1	500
Resistor	2	10
Radiator	1	950
SMPS	1	300
Coolant	1	60
Battery packing cover	1	250
TOTAL		5370

Conclusion

The installation of our EV battery management and cooling provides more efficient protection to electric vehicles. The BMS equally charge the battery and when it reaches 40 degree Celsius the sensor detect and radiator was ON and cooling occurred. The Battery and voltage level are shown in the software. This system works in any condition.

THANK YOU