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# Design and Implementation IoT Based Smart Battery Management System for Electric Vehicles

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**ABSTRACT:** This thesis present an overview of issues and technologies related to proper design of charging infrastructure for road electric vehicles. The method of how to prepare smart battery management system which is IoT based. This project proposes an intelligent control algorithm for real time range estimation, indication of various parameters and generates alerts in the smart phone using Internet of Things (IoT).The objective of the project is to promote green power and to improve the smartness of work of batteries of electric vehicles to make the use of IoT. While one half is charging, the other half is discharging simultaneously. In this new battery management system, we divide the battery in two halves. One half is for charging and the other half is for discharging. For charging, we can use renewable energy sources such as solar panels, regenerative braking. Also in this project we can reduce the charging time of the battery and improve life of the battery. Charging, discharging, monitoring, controlling all activities done automatically on the basis of IoT with online Thingspeak cloud website. Also we can analysis it on the mobile with the application time to time.

**KEYWORDS:** Algorithm, Infrastructure, Battery Management System(BMS), Estimation, Smartphone, IoT(Internet of Things), Promote, Smartness, Renewable Energy Sources, Regenerative Braking,Thingspeak.

## I. INTRODUCTION

Electric vehicles becoming the influential means in the field of transport day by day. As these electric vehicles are free from pollution emission the world is looking to make transportation field electrified. World need renewable source-based energy supply. The major encumbrance for possessors of electric vehicles is Range Anxiety, the fear that arises to electric vehicles driver whether he might reach the destination makes the buyers back step to buy electric vehicles. Electric vehicles are powered by batteries that may be charged from renewable power generated from the wind, solar and other forms of renewable sources. among all batteries types the lithium-ion batteries a proper battery charging strategy is essential is ensuring BMS of EVs.an optimal charging operation will protect batteries from damage, prolong the service life as well as improve the performance. On the one hand long charging time will inevitably affect the convenience of EV usage and limit its acceptance by customers.

### A.Battery protection during charging

The battery surface and internal temperature may exceed permissible level. when it is charged with high current and overheating temperatures may intensify battery aging process and even cause explosion and fire in severe situation. Thus the battery charging time and energy loss and temperature rises are important factors to be considered in designing the battery charging process. For the controlling the whole body of projects the cooling fan is also connected.

### **B. Finding proper solution on main problem**

According to the buyer of EV, the main problem with EVs is the limited capacity of battery and charging infrastructure availability, which leads to a variety of concerns like drivers are afraid to drive an electric vehicle for far distances. These issues have importance comparatively cost of batteries and vehicles. Even with development of new battery batteries for electric vehicles, various concerns can limit the use of electric vehicles. In recent days, great efforts have been made to study range reduction concerns by improvising SoC (state of charge) range evaluation techniques in automotive battery tracking systems with low-cost microcontrollers. This project presents an easy way to represent the range in the vehicle's virtual dashboard. This paper proposes a solution that makes the electric vehicles smarter by display the parameter like range, speed, battery cycle, location in the mobile phone. Main problem is electric vehicles is whenever it is on charging or discharging mode at that time the temperature of the batteries is started to increase at it is risky in specially summer days. During the study we find out solution of that is we can control the temperature up to 45 degree celcius by using peltier plates . we used here DHT11 for the temperature sensing purpose. This device sense the temperature send the signal to ESP 8266. This project is based on IoT based hence the signal send to the online Thingspeak cloud (wireless connection) and we will be getting the updates of voltage, temperature and humidity readings time to time on this website.

## **II. LITERATURE SURVEY**

### **2.1. Battery Management System For Electric Vehicle Applications Rui Hu University of Windsor Hu, Rui, "Battery Management System For Electric Vehicle Applications" (2011). Electronic Theses and Dissertations. 5007.**

<https://scholar.uwindsor.ca/etd/5007>

- Governments all across the world are enacting electric car legislation to reduce reliance on oil, cut greenhouse gas emissions, and improve air quality.
- Annual global electric car sales have risen steadily in recent years, from just a few hundred in 2010 to over 500,000 in 2015 and over 750,000 in 2016. In September 2015, the global market for electric vehicles hit 1 million units, fast increasing to 2 million units in January 2017.
- The early market growth for electric vehicles continues, but several barriers prevent their more widespread uptake. The new technology's higher cost, relative convenience in terms of range and charge periods, and customer awareness of the technology's availability and feasibility are among these obstacles.

### **2.2. IoT-Based Battery Monitoring System for Electric Vehicle Bharathi S.H1 Y.V Nithin Reddy2 Dinesh Ram Gopal4 1,2,3,4 Dept. of Electronics and Communication Engineering, Reva University, (India)**

- Governments at various levels, automakers and dealers, electric utilities, and other groups are all engaging in a variety of programmes to raise customer awareness of electric vehicles.
- These actions are essential because many prospective co understanding of what electric vehicles are, what benefits they offer, the available models, and the associated incentives.
- We define a Direct Programming way to deal with charge EVs that augment the usage of sun powered energy while keeping up comparative battery levels for all vehicles.

### **2.3. IoT-Based Battery Monitoring System for Electric Vehicle Bharathi S.H1 , Y.V Nithin Reddy2 , Dinesh3 , Ram Gopal4 1,2,3,4 Dept. of Electronics and Communication Engineering, Reva University, (India)**

- A deliberate investigation of the force misfortunes in the WPTBC segment has been likewise done. Thereafter, a prototypal WPTBC has been set up as indicated by the plan results and tried in various



working conditions. Various estimations acquired from the model have been accounted for that completely affirm the sufficiency of both the plan system and the misfortune investigation of the WPTBC 978-1-5090-5117-5/16/\$31.00 c 2016 IEEE • Shared Sun based controlled EV Charging

- Stephen Lee, Srinivasan Iyengar, David Irwin, Prashant Shenoy College of Massachusetts, Amherst • use of sun oriented controlled chargers has arisen as an intriguing chance. These chargers give clean power to electric-fueled vehicles that are themselves contamination free bringing about certain natural impacts.

In this paper, we plan a sun oriented controlled EV charging station in a parking garage of a vehicle share administration. In such a vehicles rabbit administration rental get and drop off occasions.

### III. RELATED WORK

#### A. Construction of prototype model:

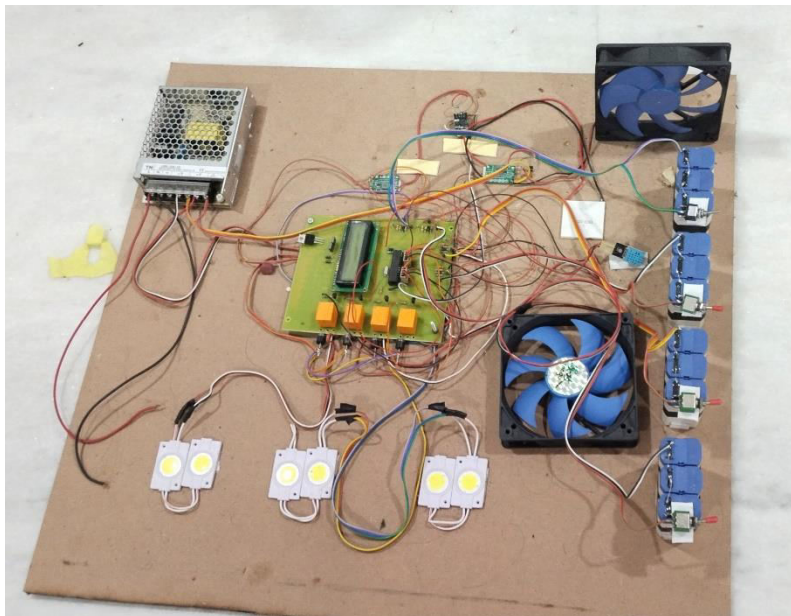


Image No.1: Prototype Model of Smart Battery Management System

The set up shown here is for Smart Battery Management System as shown in above. In this set up we have 12V, 1A four battery bank is connected in series and for charging purpose SMPS bank for great charging unit . 12V, 10A as a high ampere we denoted for fast charging technology. In this kit we having for temperature controlling Peltier plates are available which will not allow beyond the limits.so temperature will be controlled. For measurement purpose of temperature we have DHT11 which is temperature sensor for load. We have total four loads from that three are 12 V LEDS and one is BLDC motor according to the battery bank. The monitoring of the battery website cloud storing the data.of the parameters of the battery shown on Thingspeak through ESP8266. This module transfer the data by the controller to Thingspeak. So all this operation charging, discharging, cooling and monitoring on the cloud is controlled by the microcontroller AVR Atmega 328 p-pu as it supports IOT. Asit has inbuilt ADC ,PWM ,I<sup>2</sup>C, Serial communication all are inbuilt. also this controller in compact size and fastly respond.

#### B.Connection Diagram and its working:

If the battery voltage checks by the controller through ADC for this, we have feedback voltage of battery given through four voltage divider network output of this given to ADC pin IC. ADC pin is convert analog into digital and display all battery voltage result on the screen on display. Also controller compare the voltage. If the battery voltage is

less than 12V the battery will be the battery will be change in to charging mode through relay and for this relay command is given by the controller and for relay switching, we have transistor BC547 as a relay driver.

All logic is one relay will switch to charging mode and logic is zero. Other logic zero relay will switch load mode and it will be drive the load . so in this batteries higher voltage cut off/charging cut off is 12.6V . After reaching 12.6V battery will automatically change over to the load direction and this controller will simultaneously sense the voltage of the each battery bank and send the command to the ESP 8266 and will send the voltage to the Thingspeak.

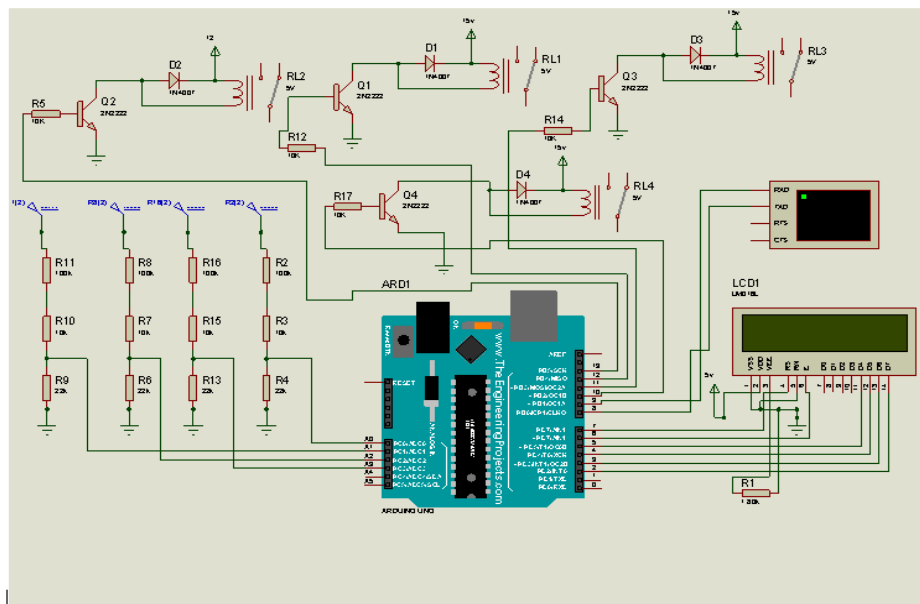


Image no.2 : Circuit diagram of project

Where cloud we can monitor the battery status from anywhere of the world. Display, sensor, controller is worked by 5v supply by using 7805 regulator. we convert the supply of the 12 v into 5v which is coming from SMPS Board. Near to regulator two capacitor are connected range of 0.1 microfarad for input and output harmonic reduction. This is providing also protection from reverse supply so it will be not damaged by reverse current. Temperature sensor module is DHT11 it will be sense the temperature of the battery. If temperature will rise above 45 degree the cooling system will be automatically turn on and if suppose we have getting temperature more than that the system will directly cut-off. Hence during the charging the protection is provided to the battery. Here ESP8266 Works by 3.3 V. so 15V is converted into 3.3V buck converter. We have buck converter from 12V/15V is converted into 5V for Peltier module to provide supply to the cooling fan which will cool the battery which will help for fast charging.

The difference between conventional charger and our charger is charged battery in very less time as compare to the conventional charger.

#### IV.METHODOLOGY

This System is for battery charging, discharging, controlling, monitoring purpose on the IoT based Thingspeak cloud which is wireless connection. Initially the supply is sending from SMPS board i.e. 12V, 10A supply given to the battery bank as per battery rating whether the battery connected to drive to the load or connected to the charging. This will be deciding by the microcontroller while measuring the battery voltage. So in this we have 12V,10A battery charger (SMPS) unit load to discharge the batteries. In total four loads are connected here from that three are LED lamps and one is BLDC motor is connected simultaneously to the serially battery bank. For cooling system fan also

connected. Also for sensing the temperature Peltier plates is used. Fan is used remove the excessive heat of the body of the model. DTH11 is used for sensing the temperature and humidity and it display on the screen.

For IoT unit ESP8266 which will monitor the battery and send voltage and temperature to Thingspeak website. If one load is off and other three are on It means Other three are battery voltage charged is full. It is connected to the load and one is deep discharged so it is connected to the charging mode. While charging of the battery load will automatically disconnected and while discharging of the battery charging point will automatically connected. Hence for this battery voltage divider unit four unit is measured for this four voltage battery bank. Due to ADC pin connected to controller Atmega which is convert analog into digital. If this device compare battery voltage is less than 12V then charging mode is on automatically and if battery voltage greater than 12.6 V then battery will be connecting discharging mode Or connected to the load.

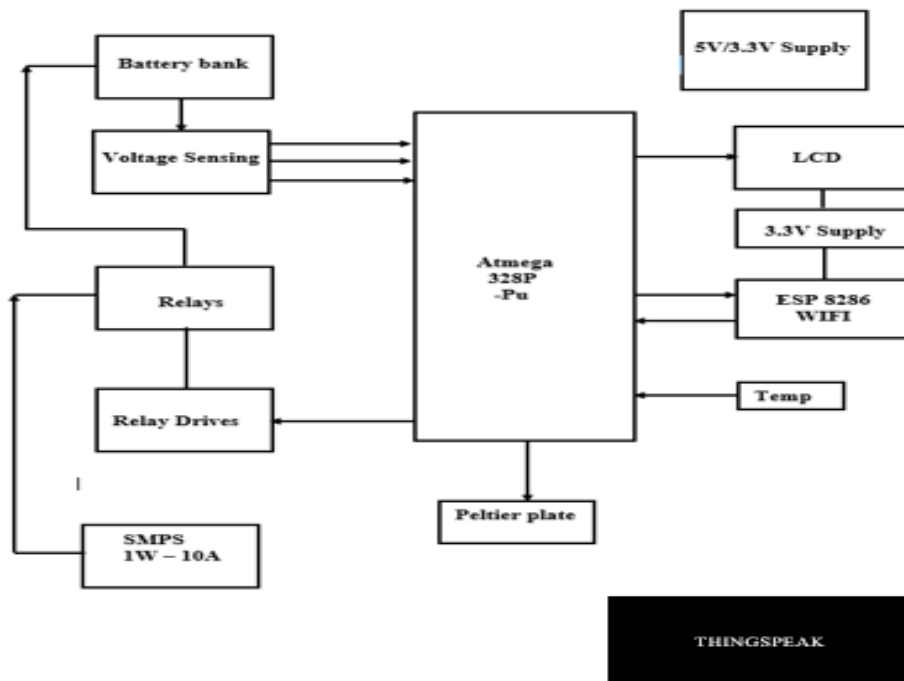


Fig:-Block Diagram of Project

For selection of charging and discharging we have relays. This relay drives worked by the NPN transistor, crystal oscillator 16 MHZ which provide the clock signal to the controller for serial communication of ESP8266 and controller done its work then send signal to the Thingspeak. ESP8266 required 3.3 V relay load and Peltier will required 12 V for cooling purpose. We use 5V supply for Peltier plates. If battery voltage below or equal to 12 V battery will shut down and this battery is connected to the charging mode automatically. Here possibility is reversed biasing system means possibility of battery can again send voltage to SMPS. Hence for avoiding this problem here forward biasing diode is used.

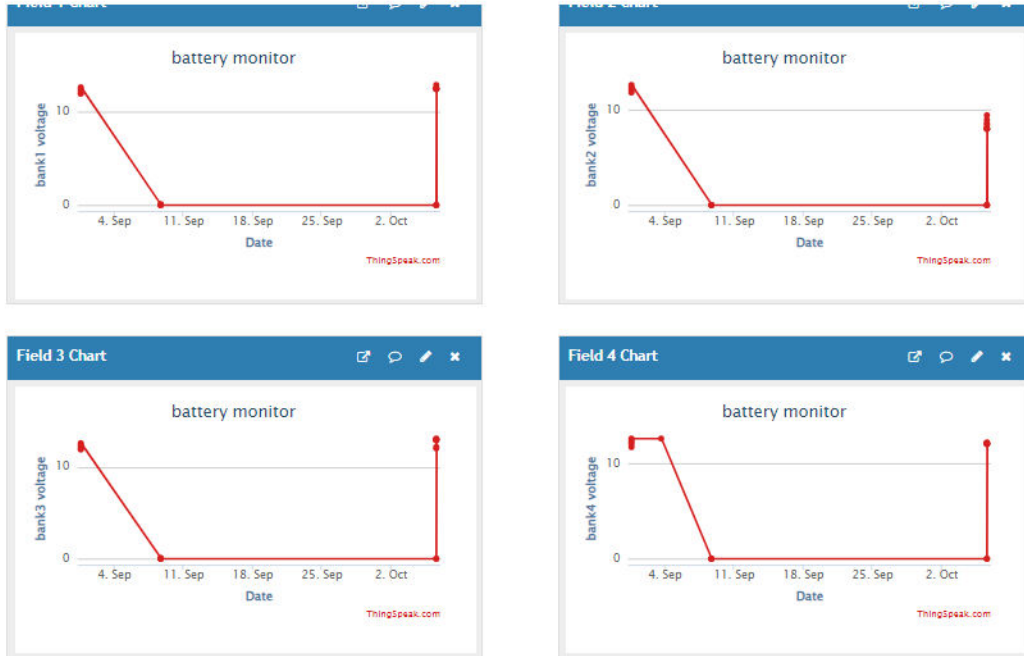


Image no. 3- Monitoring graph of four battery bank on Thingspeak cloud website  
This will getting updated reading each and every 30 seconds on this website also on our mobile application.

### V. EXPERIMENTAL RESULTS



In first picture the result of four battery bank. These are the initial voltage range of each power bank. It is now below in 12.6V. that's why it is all connected in charging mode. Whenever it is above 12.6 V then it will directly have connected to the discharging means its connected to the load automatically.

In second picture here the reading of humidity and temperature. if suppose the temperature of the system is above 45 degree Celsius then the system will automatically cut off then cooling system is turned on.

From this results we can definitely said that the health of the battery will increase and life of the batteries will improved and its getting fast charging.one battery bank is required half hour for full charging with two hours back up.

### VI. CONCLUSION

From this project we conclude that it is very fast charging system with the healthy operation. We have studied the behaviour of lithium ion battery with different charging rate and discharging rate. Also we can calculate charging time depends on SOC of the battery and display and monitor the temperature level of battery with Thingspeak cloud website anytime from anywhere.

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