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LITHIUM ION BATTERY TECHNOLOGY WITH RELAY CONTROL SWITCH AND MICRO CONTROLLER BASED VOLTAGE MONITORING SYSTEM

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Abstract –

Lithium ion batteries are one of the most commercially used batteries. They are widely used in mobile phones, laptops and other consumer electronics, Electric Vehicles and Robotics concerns related to their safety and efficient operation still persists. In this work, we designed a lithium ion battery protected with battery management system (BMS) with inbuilt a radio frequency single relay channel controller that controls the power supply to external circuit and digital voltmeter indicated the rated voltage supply and we developed a micro controller based IOT system that monitor the battery voltage. We expect the proposed strategy and technology improve battery capacity and prolong lifespan. This Lithium-ion battery have the characteristics of high-power density, long life, low self-discharge, low maintenance costs and low environmental impact. However, lithium has high reactivity, so there are technical limitations related to the safety of building batteries.

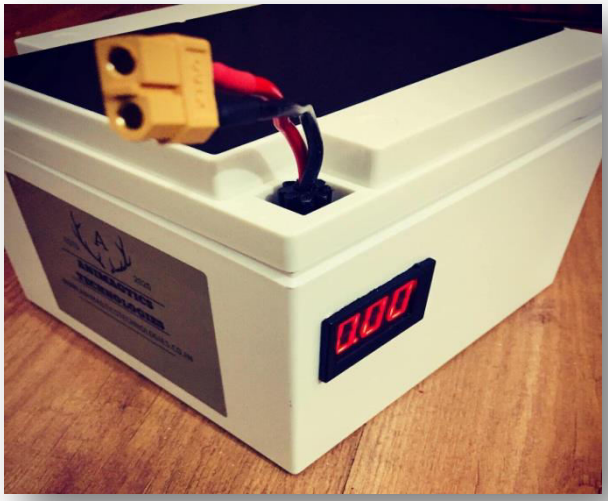

FIGURE-1 LITHIUM ION BATTERY

***Key Words*:** Lithium-Ion Battery, Lithium Ion battery technology.

1.INTRODUCTION

A lithium-ion battery is a family of rechargeable battery types in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. Lithium ion batteries is based on two or more electrochemical cells, electrically interconnected. Each of which contains two electrodes and an electrolyte. The redox reaction (Oxidation And Reduction) reactions that occurs at these electrodes and convert electrochemical energy into electrical energy. This Lithium Ion battery is a combination of many cells. These cells are called secondary cells.

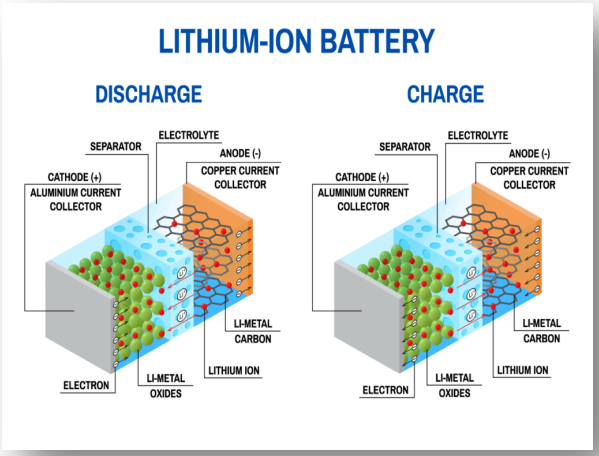

FIGURE-2 LITHIUM ION BATTERY REDOX REACTION

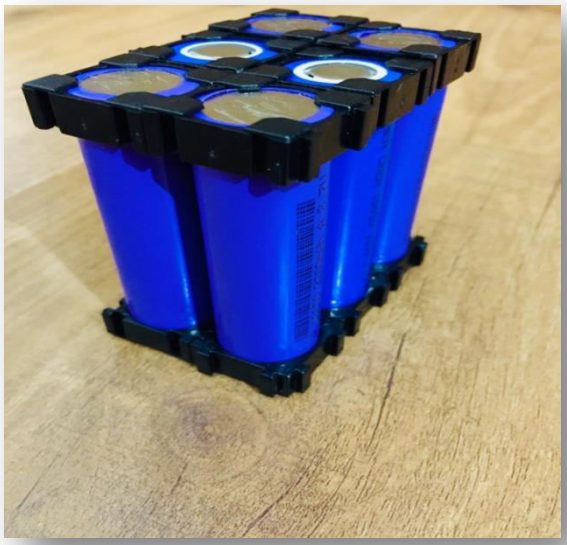

FIGURE-3 LITHIUM ION CELLS

2) DESCRIPTION OF PRODUCT -

This lithium ion battery is used for robotics purpose and output volltage of battery from 12 Volt to 36 Volt with capacity of 5000Mah to 8000Mah.This lithium ion battery is protected from 12 Volt 40 amps Battery Management System (BMS) that monitors all the combination of cells in a lithium ion battery pack,Balance all the cells voltage equally and doesn't allow the cells from over-discharged and protect the battery from fire and explosion.The maintainance cost of this lithium ion battery is very low,We can easily replace the cell if any of cell is damaged or not working but in traditional battery it was not possible.

The technology we used in Lithium Ion battery is

1) A digital voltmeter that monitor the output voltage to external circuit.

FIGURE-4 LITHIUM ION BATTERY VOLTMETER

2) A 12V single Channel Radio frequency Wireless Relay with Remote Control is a one channel latching relay. The output of the circuit is a passive output and it can be controlled by its 2-button radio frequency wireless controller, The operating frequency for the module is 433 MHz and the operating voltage is 12 Volt. This latching relay act as a switch that controls the power supply to external circuit.

3) Measuring voltage of batteries consumes a lot of time.Using multi-meter, opening the battery boxes and touching both the multi-meter leads to terminals of battery takes some effort.We developed an efficient IOT system through which you can see the status of your battery on your desktop and mobile web browsers.

A WiFi device which can connect to our local home WiFi, takes voltage reading from controller and updates the end user about the current battery level. For this purpose i decided to develop a device by using micro controller. It can not only work as controller but also it can connect it self to a WiFi network as server or client. Battery monitoring circuit is a traditional voltage divider circuit. I am going to measure 12 volt batteries and circuit can be modified to measure 24 volt batteries and even more 48 volts parallel battery cluster.

FIGURE-5 LITHIUM ION BATTERY VOLTMETER MONITORING MICRO CONTROLLER DEVICE

It is working on 3.3 volts its pins can source and sunk 3.3 volts only. Voltage greater than 5 volt may blow the pin or fry the micro controller. In our case we want to measure 12 volt battery and micro controller adc pins (analog to digital channel)can only accept 3.3 volts. We need to play smartly here. What we will do is divide the voltage between two resistors and measure only voltage across one resistor and remaining resistor voltage will be calculated mathematically

Voltage divider with battery circuit

3) FORMULA FOR LITHIUM ION BATTERY –

First we finalize the nominal voltage and capacity of the battery. Either it will be in terms of Volt,mAh/Ah or Wh.We have to connect the

cells in parallel, Series or parallel series combination.

a) VOLTAGE (Volt)

We developed 12 Volt Lithium Ion Battery with capacity of 5000Mah.

The desired nominal voltage of Lithium Ion battery 12 Volt.

The nominal voltage of each cell is 3.7 Volt

Number of cells required in series connection = Nominal voltage of lithium ion battery/ Nominal voltage of each cell.

12 Volt/3.7 Volt = 3

Number of cells required in series connection = 3S.

b) CAPACITY (mAh)

The desired capacity of battery pack = 5000mAh

Capacity of each cell = 2200mAh

Number of cells required in parallel

Desired capacity of battery/ Capacity of each cell

5000mAh/2200mAh = 2

Number of cells required for parallel connection = 2P

Total required cells 3Sx2P = 6 Cells required.

4) FORMULA FOR MEASURING LITHIUM ION BATTERY VOLTAGE

V(Output) = R2(Resistance)/ R2(Resistance) + R1(Resistance) x V(Input)

As per circuit diagram the voltage out at bottom resistance i.e R2 (Resistance)

R1 (Resistance) - Let be "x"

And we find the value of "x" resistance to complete the circuit.

let the R2 (Resistnace) is 10K ohms.

We find out the value of R1 (Resistance) i.e value of "x"

R1 (Resistance) = V(Output) = V(Input) x R2(Resistance)/ R2(Resistance) + R1(Resistance)

3.3v = 18v x 10K ohm/ 10K ohm + R1(Resistance)

10K + R1(Resistance) = 180K/3.3v

R1(Resistance) = 44.5K ohm.

R1(Resistance) 44.5K ohm resistance is not available and we can use 47K ohm resistance.

R1(Resistance) = 47K ohm. (Value of "x" = 44.5k ohm equivalent to 47k ohm)

5) ADVANTAGE -

a) High energy density.

b) Low self discharge.

c) Low cost of maintenance.

6) PRODUCT DESIGNING -

The tool or software we used for Product designing and 3D designing for battery enclosure and battery monitoring device enclosure are AutoCAD fusion, It Create high-performing product designs and production system layouts and extend product capabilities and prevent product failures.

7) PRODUCT PRINTING -

Using 3D printing technology for product development. The processes and materials using FDM technique, Fused Deposition Modelling (FDM) is a type of additive manufacturing technology that enables the construction of three-dimensional objects, prototypes and products through a computer-aided or driven manufacturing process. And material using ABS is a very mouldable material which makes it most suitable for a lot of applications. It is widely used in 3D printing due to its light weight, moldability and low cost.

8) CONCLUSION-

Compared to the traditional battery, This lithium ion battery technology charge faster, Last longer and have higher power density and low cost maintenance. we monitor the battery power supply and in case of short circuit condition we can easily switch off the battery anytime using radio frequency remote. lower self-discharge rate than other rechargeable batteries. This makes for better power efficiency as a single cell has longer charge retention than other battery types.

9) APPLICATION-

This project lithium ion battery technology offer power solutions across the spectrum from energy storage solutions to portable energy solutions. Some of the most common applications of this lithium-ion battery are:

a) Power backups/UPS.

b) Consumer electronic goods.

c) Small electric mobility.

d) Energy Storage Systems.

e) Robotics.

f) E-Bikes.

10) REFERENCES -

It is crucial for proper and effective for gathering information's on lithium ion battery technology in all aspects. The acquired information will serve as a groundwork for determining the requirements and design

A) Micro controller and wifi device for battery voltage monitoring.
B) Lithium Ion cells in series and parallel combination for desired voltage output.
C) Battery Management System (BMS) for battery monitoring and all the cells voltage equally.
D) Battery is protected from overcharged.
E) Single latching Relay channel control.
F) Design and developed by Kumar Ayan Ghosh
G) The lithium Ion Battery is product of Animagtics Technologies OPC Private Limited.