IOT BASED BATTERY AGING FACTOR ANALYSING SYSTEM FOR E-VEHICLES

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***Abstract*-The battery is a forming foundation ingredient of Electric Vehicles. An electric vehicle entirely depends on the source of energy from a battery. This manuscript firstly reviews the majority fascinating model approach intended for predicting the battery performance along with the Life time of the Battery. Since an electrochemical product, a battery acts differently under unusual outfitted and ecological circumstances like State of Health, Number of Duty cycles obtained are reported. The intention of the Cell analyser is headed for assuring the Battery's performance. To preserve the aging of the battery, state of health assessment, Charge/Discharge control, and End-of-Life are functionalities that contain be implemented in this system. A well-organized and low outlay manner to quantify these ideal through using a microcontroller such as the Arduino controller. The Arduino determines typical discharge current as well as trace the time to estimate the Ah rating of the battery. The voltages, Current values, SOH, EOL were after that plotted in Matlab as well as viewed on mobile phones throughout an Android Application employing the microcontroller and Internet of Things (IoT).**

Keywords :Arduino, Android App, Cell Analyser, End of Life (EOL), Internet of Things, State of Health.

I.INTRODUCTION

At present, electric vehicle (EV) has to turn into trendy, because the fuel price fetching more costly. The utilization of electrical energy sources could pick up the surroundings because there is a reduced amount of pollution. Besides, EV produces huge rewards in terms of energy economy and ecological safety. Lithium-ion (Li-ion) batteries are an excellent option for primary energy storage devices as it is capable of delivering a high power rate in a relatively small and lightweight package with low self-discharge rate and no memory effect.Life cycle cost assessment is an important tool in order to optimize a system with respect to its total cost over the system lifetime.The majority of E-Vehicles use rechargeable batteries which are a lithium-ion (Li-ion) battery. It is slighter to be comparable among Lead-acid (Pb) Battery. Inreality, it has a stable power, and energy's life cycle is 6 to 10 times superior comparable with a lead-acid battery. Lithium-ion battery life cycle can be reduced employing various reasons such as overcharging and deep discharges [1]. These require the acceptance of an appropriate Battery Aging Factor Analysing System to preserve each cell of the battery contained in its End of Life. Battery Analyserought to approximate the battery status to forecast the actual amount of energy that be capable of still be delivered to the load. An additional significant role of a Battery Analyseris to enlarge the battery life by facing the Quick discharge, or Unstable Voltage to the E-Vehicle. On every occasion any abnormal conditions, for instance, un-usual discharge or Excess duty cycle completed are detected, the Battery Analyserbe supposedto advise the user and accomplish the preset modification course of action [2].

II. RELATED WORKS

The aging of batteries is very complex due to thecomplexity of its electrochemical nature. When talkingabout aging, it is important to differentiate between agingeffects, aging mechanisms and impactfactors.

Aging Effects: The aging effects describe the changein battery behavior at the terminals thus are important forthe operator and have to be considered during batterydesign for a given application. The most obvious agingeffectsarethedecreaseofcapacityandtheincreaseofthe internal resistance. For most applications the end oflife (EOL) of a battery is determined by the minimumallowed remaining capacity and the maximum allowedinternal resistance and therefore depends on the agingeffects.

The impact factors areenvironmental and operation parameters influencing theagingofabattery.Intermsofmodelingtheycanbethoughtofastheinputparameters.Wellknownistheinfluence of the potential, the temperature and the cycledepth ΔSOC ofacycle [3].

III. PREVAILINGCREATURE OF BATTERY ANALYSER

Observing the cell voltage of every cell in a battery pack is indispensible to govern its overall health. All cells have an operating voltage frame where charging/discharging should arise to certify apposite action and battery life [4]. If an application is using a battery with a lithium chemistry, the operating voltage characteristically ranges among 2.8 and 4.2 V. Voltage range is chemistry-dependent. Operating the battery outside the voltage range expressively shrinks the lifespan of the cell and can render it useless.

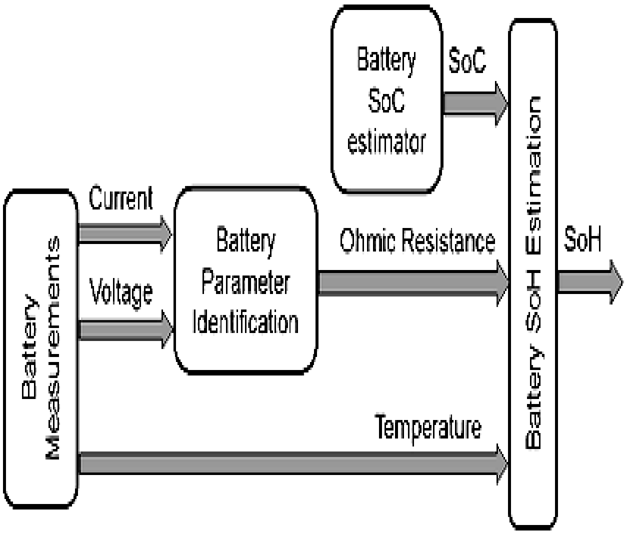

Figure 1: Prevailing Creature of Battery Analyser

Cells are connected in series and parallel to form a battery pack. A parallel connection increases the battery pack's current drive, while a series connection upturns the overall voltage. A cell's performance has a distribution: At time equal zero, the battery-pack cell's charge and discharge proportions are the same. As each cell cycle between charge and discharge, each cell's charge and discharge rates change [5].

IV. PROPOSED CREATURE OF BATTERY ANALYSER

Moreover, a vehicle's battery is intended not only to be a long-lasting energy organism, but also to be a high power system. In other verses, batteries for EVs and HEVs have to afford high voltage and high current. Due to the advancement in technology, now Internet of Things (IoT) can be used to notify the manufacturer and users remotely regarding the battery status. They can check the battery status of the car's battery on their smartphones from anywhere in the world and this is considered as one of the maintenance support provided by the manufacturer. IOT mechanism offers the primary segments like Battery's Voltage, Current, % SOH, Battery Duty Cycle to the user through Smartphone [6].

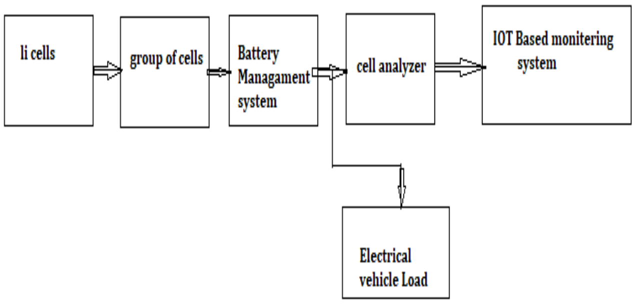

Figure 2: Proposed Creature of Battery Analyser

The arrangement offers inputs to the protection devices so that the monitoring circuits could generate alarms and even disconnect the battery from the load or charger if any of the parameters exceed the values set by the safety zone. The battery is the only power source in pure electric vehicles. Therefore, the Battery Analyserin this type of application should include battery monitoring and protection organisms, a system that keeps the battery ready to bring the full power when necessary and a system that can extend the life of the battery.

The voltage can be determined by using Voltage sensor circuit. The current flows through the motor can be prescribed by the current sensor unit. Temperature sensor is offered to measures the Battery's Temperature to avoid Battery Destruction.

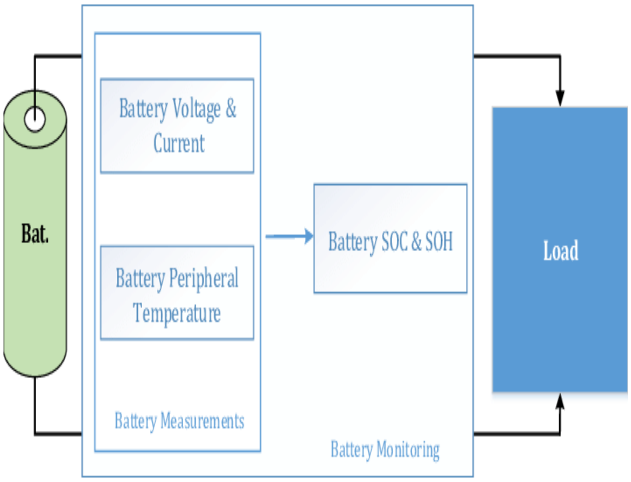

Figure 3: Operation ofBattery Analyser

In this venture, Arduino micro controller is used to performs the IOT platform for those Battery operations. Node MCU controller is used in Battery Analyserfor providing Better wireless communication to that user form the Battery Bank. The BLYNK Android Application is performs the IOT functions [7].

The basic task of Proposed creature of Battery Analyser

- It should confirm that the energy of the battery is enhanced to power the product;
- It should confirm that the risk of damaging the battery is minimal.

- It should monitor and control the charging and discharging process of the battery.

Battery AnalyserMain Module

Based on an electric model of a lithium-ion battery, this paper focuses on an advanced aging model. The battery model used is based on an impedance driven approach. The electrical behavior is represented by the open circuit voltage (OCV) of the battery that has been measured at different temperature and state of charge levels and is passed to the model via a look-up table depending on the states of ambient temperature and SOC at a certain time step.

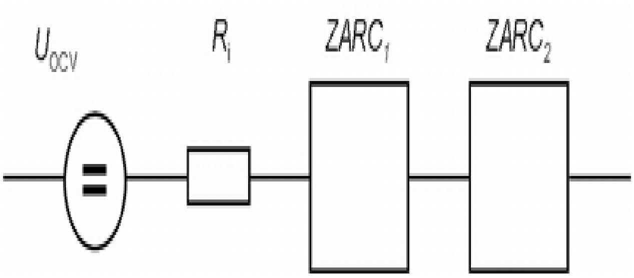

Figure 4: Battery model

The so called ZARC elements represent a parallel connection of a constant phase element and a resistance. It is a common representation for the semi-circles occurring in impedance spectra of batteries and can be modeled by a series connection of multiple parallel connected resistances and capacitors (RC elements) depending on the accuracy to be achieved. In the present model a series connection of 5 RC elements is used for each ZARC element [8].

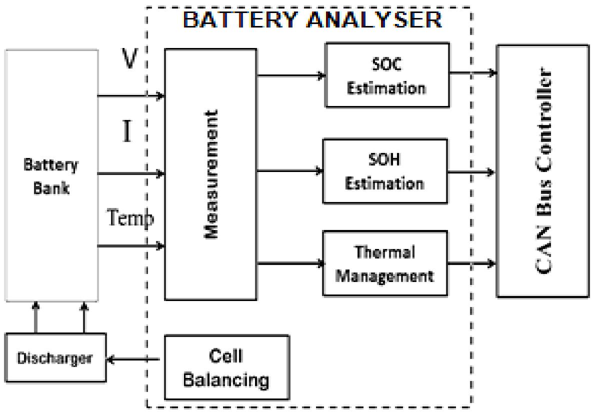

Figure 5: Arrangement of Battery Analyser

The battery is the only power source in pure electric vehicles. Therefore, the Battery Analyserin this type of application should comprise battery monitoring and protection systems, a system that keeps the battery ready to deliver full power when essential and a system that can extend the life of the battery. The

Battery Analysershould include systems that control the charging establishment and those that manage thermal issues.

S.No	Description	Value
1.	Capacity（25±5℃）	Nominal Capacity：2600mAh (0.52A Discharge，2.75V), Minimum Capacity：2500mAh (0.52A Discharge，2.75V)
2.	Nominal Voltage	3.7V
3.	Internal Impedance	≤ 70mΩ
4.	Discharge Cut-off Voltage	3.0V
5.	Max Charge Voltage	4.20±0.05V
6.	Standard Charge Current	0.52A
7.	Rapid Charge Current	1.3A
8.	Standard Discharge Current	0.52A
9.	Rapid Discharge Current	1.3A
10.	Life Cycle	1000 Cycles (Approx.)
11.	Weight	46.5±1g
12.	Max. Dimension	Diameter(Ø):18.4mm, Height(H): 65.2mm
13.	Operating Temperature	Charge: 0 ~45℃, Discharge: -20 ~60℃
14.	Storage Temperature	During 1 month: -5 ~ 35℃ During 6 months: 0 ~ 35℃

Table 1: Data Sheet of Li-ion Battery

V. BATTERY ANALYSERFUNCTIONS

Battery AnalyserSystem can performs the following Battery Functions:

- State of Health (SOH) Determination
- State-of-Life (SOL) Determination
- Cell DutycycleAnalysing
- Capacity Analysing

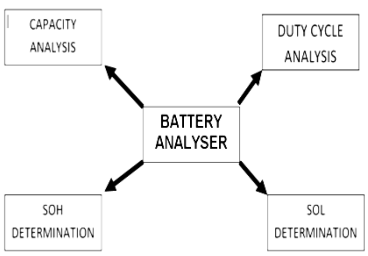

Figure 6: Functions of Battery Analyser

5.1.State of Health (SOH)

The state of health (SOH) is a measurement that reveals the general condition of a battery and its ability to deliver the specified performance associated with a fresh battery. Any parameter such as cell impedance or conductance that changes expressively with age could be used to specify the SOH of the cell. In practice, the SOH could be appraised from a single measurement of either the cell impedance or the cell conductance [9].

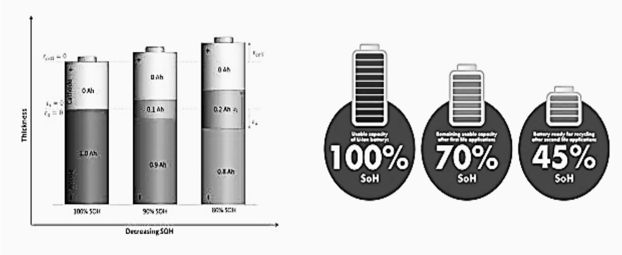

Figure 7:SOH Estimation of Battery Analyser

5.2.State of Life (SOL)

Battery Cycle Life is defined as the number of complete charge - discharge cycles a battery can accomplish before its nominal capacity falls below 80% of its initial rated capacity. State of Life is the total duty cycle is performed by the Lithium ion Battery corresponding to its operation. Key factors affecting cycle life are time t and the number N of charge-discharge cycles completed.

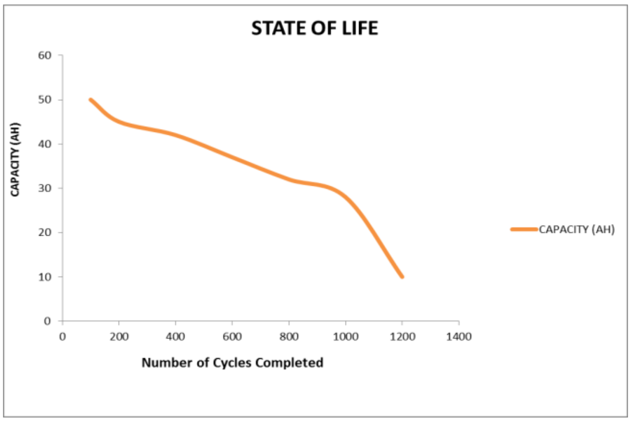

Figure 8:SOL Estimation of Battery Analyser

5.3.Capacity Analysis

Battery capacity" is a measure (typically in Amp-hr) of the charge stored by the battery, and is determined by the mass of active material contained in the battery. The battery capacity represents the maximum amount of energy that can be extracted from the battery under certain specified conditions [10].

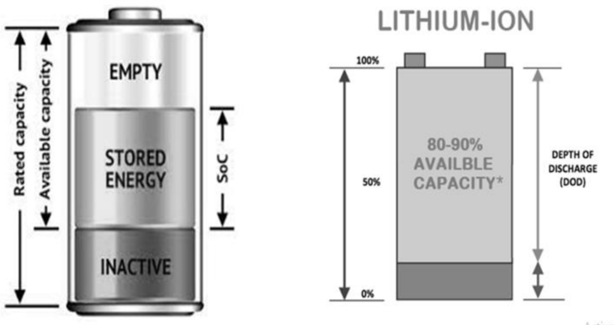

Figure 9: Capacity Analysis ofBattery Analyser

5.4.Duty Cycle Analysis

Duty cycle - Operating parameters of a cell or **battery** including factors such as charge and discharge rates, depth of discharge, **cycle** length, and length of time in the standby mode. Electrode - Electrical conductor and the associated active materials at which an electrochemical reaction occurs.

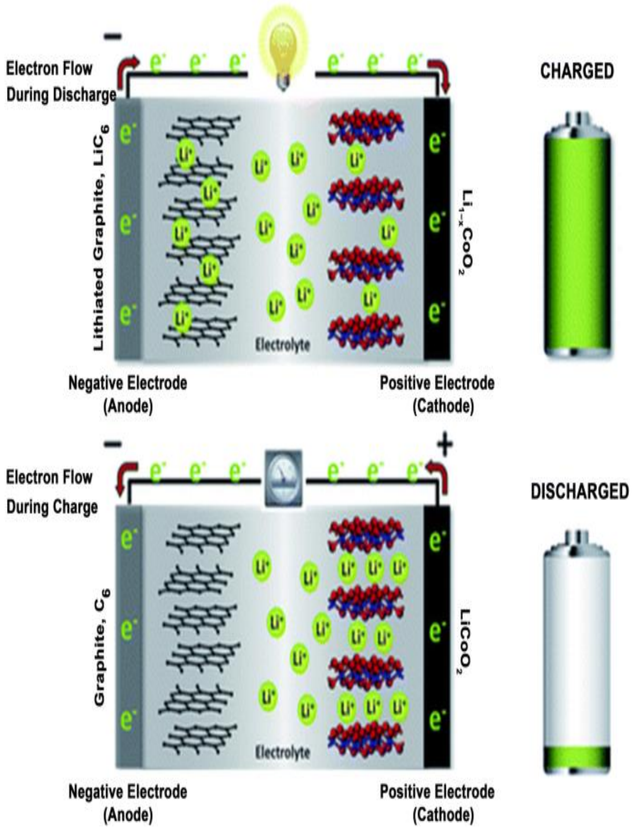

Figure 10: Duty Cycle Analysis of Battery Analyser

The crucial goal of a Battery Analyseris to preserve the battery from operating out of its safety zone. The Battery Analysermust protect the cell from any prospect during discharging [11]. Otherwise, the cell could operate outside of its confines. The battery stopped discharging and remained at the low voltage limit (2.75 V) when the battery was discharged with voltage protection. The cell was protected by discharging in this fashion [12].

VI. Output view through Android App

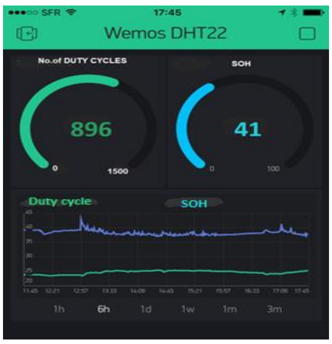

Figure 11: Output view through BLYNK App

VII. Simulation Circuit

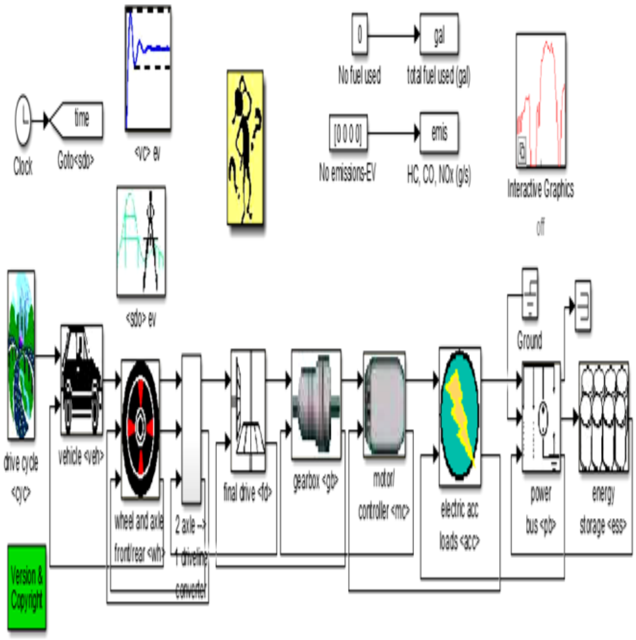

Figure 12: Simulation Circuit of Battery Analyser

VIII. Output Waveforms

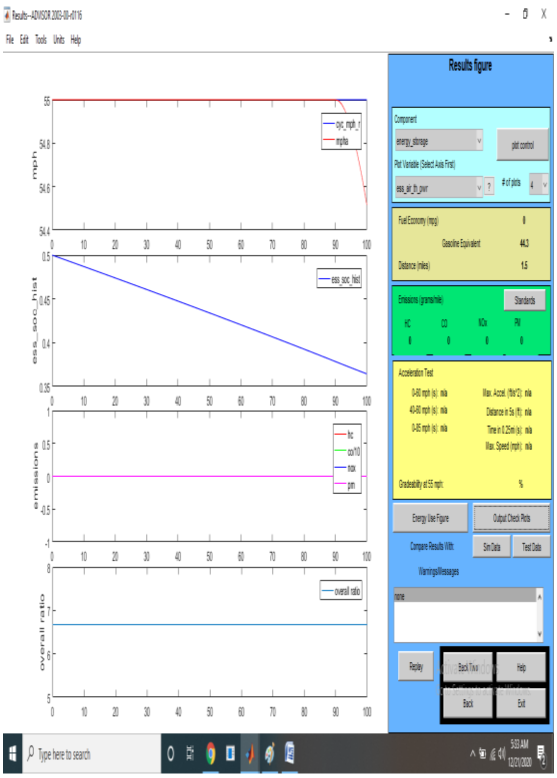

Figure 12: Simulation Circuit of Battery Analyser

IX. CONCLUSION

The main concerns in the design and management of a battery for an electric vehicle have been presented. After the definition of a flexible hierarchical platform for Battery Analyserexecution and an overview on the main techniques for charge balancing and state of charge estimation, we have pronounced the design and experimental validation of an innovative Battery Analyserfor an electric vehicle. The main issue of the electrical vehicle is life span of the battery back cannot be calculated without using AI. Once the battery life time is known depends on the duty cycle and Vehicle load current at the different climatic conditions, Weight of the vehicle. Advice tool in Matlab simulation is very much useful for find out the aging factor of the Li-cells and life time also determined by battery cell analyzer. Based on the specific situation, different strategies should be applied to improve and optimize the performance of Battery Analysersin future EVs and HEVs.

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