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ARDUINO-BASED BATTERY MONITORING SYSTEM WITH STATE OF CHARGE AND REMAINING USEFUL TIME ESTIMATION

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ABSTRACT

This paper presents a battery management system for lead-acid battery banks used in evehicle. It is incorporated with a diagnostic, measurement, and monitoring system for improving Lead-acid battery performance up to its efficiency and conservation. This matter calls the need for research on traction batteries as an insatiate demand exists for smaller vehicles with lightweight and portable equipment. The estimation of State-of-Charge, State-of-Health, Discharge Rate, and Remaining Useful Life are then derived by utilizing the concept of correlation and regression from the yielded realtime parameters recorded to the SD card module. This study paves the approach for the comprehensive and continuous progress of battery identification, monitoring, and diagnosis that is a thorough advancement in the E-Vehicle industry.

I. INTRODUCTION

The utilization of commercial transportation is a facet of economic growth that the nation continues to progress. With developing technologies of transportation in the India, e-vehicles turned into a trend started last 2015, attracting manufacturers for production.

Electromechanical batteries are constructed in distinction to electrical analogy through means of having a prominent network of electrical components such as electromotive forces and passive components. Research Article Abstract This paper presents a battery management system for lead-acid battery banks used in e-vehicle. It is incorporated with a diagnostic, measurement, and monitoring system for improving Lead-acid battery performance up to its efficiency and conservation. This matter calls the need for research on traction batteries as an insatiate demand exists for smaller vehicles with lightweight and portable equipment.

II. LITERATURE SURVEY

Diao determined if batteries have reached their limit by using internal resistance to evaluate the state of health (SOH). However, due to capacity independence from the internal resistance, it can bring about contradicting outcomes for the SOH of the battery. The SOH is more accurately defined as the present battery status with relation to the capacity and power SOH, in which degradation, internal resistance, and inconsistency of capacity are all considered. With the use of this method, a clear advantage can be seen by analyzing data and by comparing it to other methods.

Liu. Researchers utilized probability distribution and adopted the concept of Monotonic echo sate Networks or MONESNs algorithm for tracking nonlinear degradation patterns of battery RUL estimation. Correlation model between health index and battery capacity is developed. Two sets of data of lithium- ion batteries are used to prove the efficiency of the proposed method. Hou propose calculation and monitoring of the electric vehicle's SOH, SOC, and state of function (SOF).

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III. SYSTEM DESCRIPTION

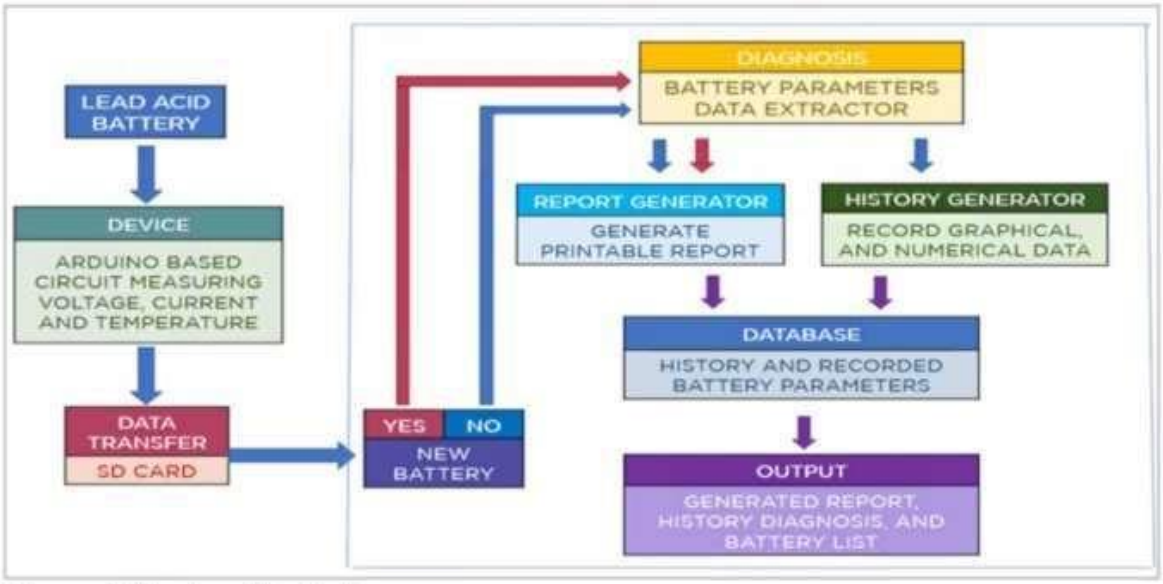

Figure 1 System block diagram

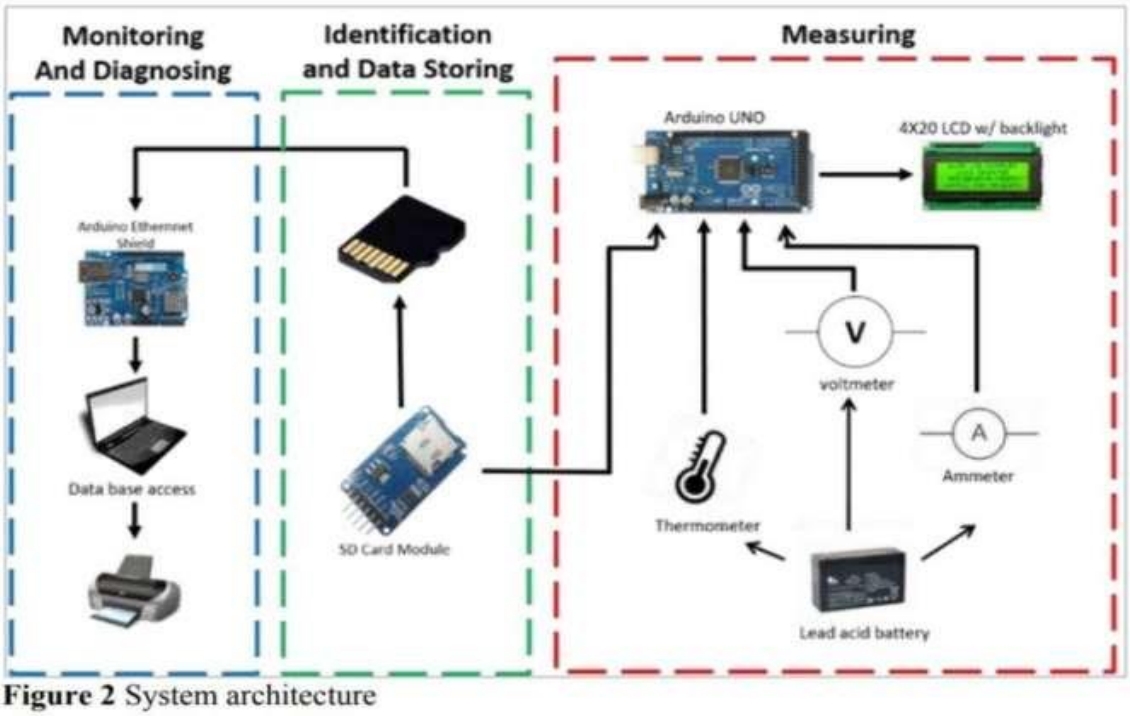

Figure 2 System architecture

Figure 2: Block Diagram of the System

16*2 LCD DISPLAY:

Table 1. Components with Specification

COMPONENT	SPECIFICTION	QUANTITY	Cost (for 1)	Total cost
Microcontroller	Arduino uno	1	950	950
Transistor	BC547	1	5	5
Bluetooth Module	HC05	1	450	450
Resistors	1k,10k,Random	8	1	8
Capacitor	0.1uf,0.01uf	7	3	21

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Diode	1N4007	2	3	6
Current sensor	5A Analog out	1	350	350
LCD Display	16*2	1	220	220
voltage sensor	Analog out	1	120	350
Battery	4V, 1.5ah	6	120	720
Temp sensor	Analog out(LM35)	1	150	150
Relay	12V SPDT	1	40	40
CAPACITOR	450uf/25V	1	10	10
DC Motor	12v ,10rpm ,DC gear Motor	1	260	260

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

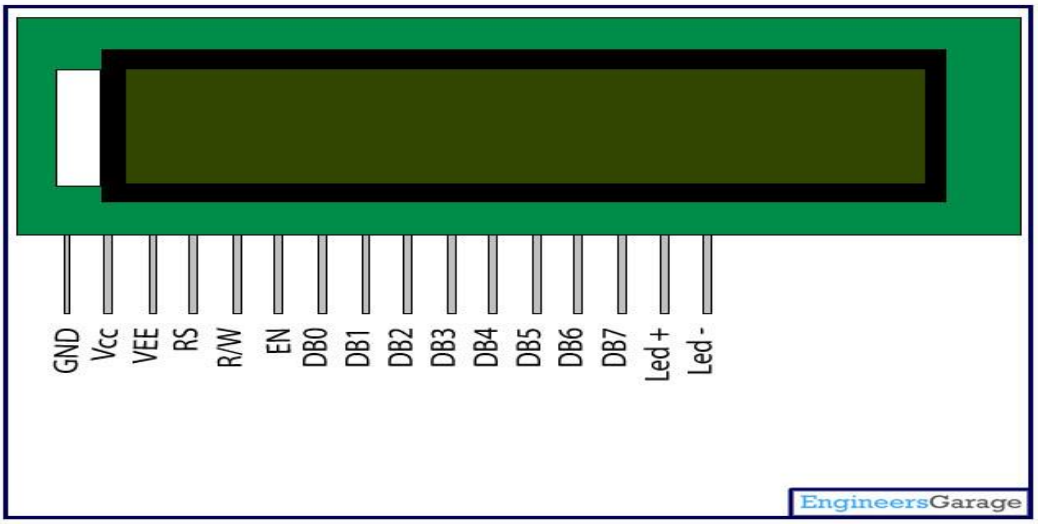

Fig 3: 16*2 LCD DISPLAY

Table 2: Pin Description

6. Interface pin description

Pin no.	Symbol	External connection	Function
1	Vss	Power supply	Signal ground for LCM
2	V_{DD}		Power supply for logic for LCM
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	LED+	LED BKL power supply	Power supply for BKL
16	LED-		Power supply for BKL

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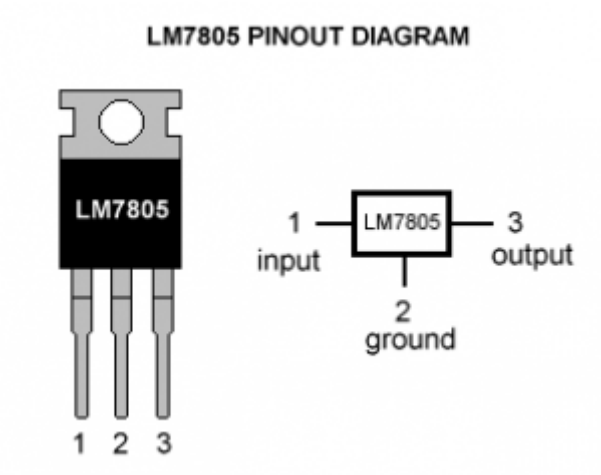

Fig 4: LM7805

LM7805:

Features

- Output Current up to 1A
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V
- Thermal Overload Protection
- Short Circuit Protection
- Output Transistor Safe Operating Area Protection

Description

The MC78XX/LM78XX/MC78XXA series of three terminal positive regulators are available in theTO-220/D-PAK package and with several fixed output voltages, making them useful in a wide range of applications. Each type employs internal current limiting, thermal shut down and safe operating area protection, making it essentially indestructible.

The Current Transformer

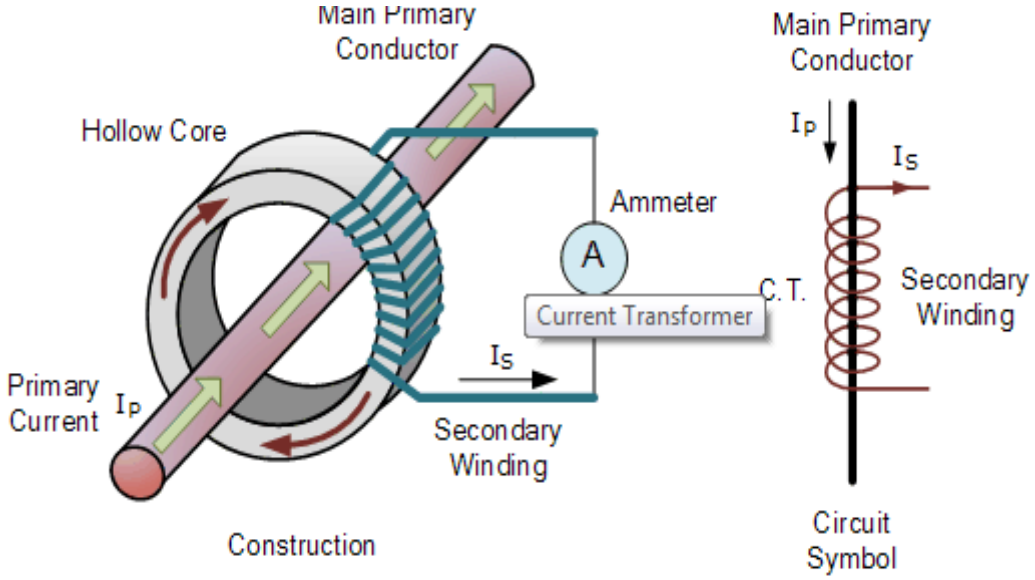

Fig 5: The Current Transformer

Current Transformers produce an output in proportion to the current flowing through the primary winding as a result of a constant potential on the primary. The **Current Transformer** (**C.T.**), is a type of "instrument transformer" that is designed to produce an alternating current in its secondary winding which is proportional to the current being measured in its primary.

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Battery -

12V 2Ah Rechargeable Lead Acid Battery is normally use for robots in competition. Wired or Wireless Robots runs for a long time with high speed with this type of battery. Seal Lead Acid (SLA) Rechargeable battery is the most common general purpose battery.

Low cost, robust and less maintenance required are the advantages of SLA. But it is considered heavy weight for certain robotic application. To charge SLA batteries, you can use any general DC power supply as long as it provides the correct voltage to your battery.

Features:

Rechargeable
Recyclable
No Memory Effect

Able to use for most of the 12V controllers, motors or any other appliances

Specification:

Voltage: 12V

Capacity: 2Ah

Size: 98mm x 43mm x 52 mm

Weight: 0.450kg

Package Includes:

1 x 12V 1.2Ah Rechargeable Lead Acid Battery

IV. RESULTS AND DISCUSSION

Received Log:
[May 25, 2022 5:13:28 PM] ASCII:
B.Temperature = 34.65 Degree Celsius
BAT Voltage:11.2V
Current:75mA
HEALTHY
Load OFF
B.Temperature = 36.60 Degree Celsius
BAT Voltage:11.2V
Current:75mA
HEALTHY
Load OFF
B.Temperature = 35.14 Degree Celsius
BAT Voltage:11.2V
Current:75mA
HEALTHY
Load OFF
B.Temperature = 35.14 Degree Celsius
BAT Voltage:11.2V
Current:75mA
HEALTHY
Load OFF
The button is being pressed
B.Temperature = 35.14 Degree Celsius
BAT Voltage:11.0V

Current:187mA

HEALTHY

Load ON

No Sent Log!

Calculating the Remaining Useful Life of the e vehicle battery in terms of cycle and time using SOHR is used, since the degradation of the battery is proportional to the number of cycles used. Cycles 1, 5 and 10 were chosen to serve as the initial, middle and final experimental setup.

The first experimentation is to make a comparison of the battery's degradation; for BattMan1, BattMan2, and BattMan3, using low current. Each battery has a different average Depth of Discharge. In each battery, three (3) SOH samples were taken on different cycles. It is greatly observed that the Decrease in SOH is very little among the three batteries due to the small difference in current. Also the big difference in the DOD among the three batteries didn't affect the Decrease in SOH.

V. CONCLUSION

In determining the battery's End-of-Life, parameters like no-load voltage, load voltage, mean current, maximum current, maximum temperature, DOD, and Charge- Discharge cycle should be carefully measured. Large battery consumption or DOD will occur if the discharge current is low. It showed in the data that DOD doesn't affect the battery life since the discharged current was low. However, based on the data, with low discharge current and low DOD, the battery's SOH continues to decrease due to its charge-discharge cycle. SOH still decrease no matter how efficient the battery was used.

VI. REFERENCES

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