# Wireless Monitoring System of Lead Acid Battery Using GSM Technology

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***Abstract***—Wireless monitoring of lead acid battery system using GSM technology has been developed for monitoring acid level, voltage and temperature of battery [1]. To use battery safely and prevent from damage our system can continuously monitor battery parameters. This parameters monitoring by using combination of hardware's (sensors, a microcontroller, a GSM module, LCD display, buzzer, an Android smart phone) & software. It was designed by a cost effective microcontroller ATmega328P. The information from the voltage divider circuit, temperature sensor (LM35) and electrolytic sensor are senses first and then processed by an ATmega328P. This ATmega328P sends the data to both GSM communication system and LCD display, via SMS. Real time voltage, acid level and temperature of battery will be shown on LCD display. If any unexpected condition occurs in battery, user will get SMS on smart phone and also buzzer makes sound to alert, user will take timely action, which will prevent battery from damage and increase battery life [2]. The study of monitoring for the lead acid battery is to extend battery life, prevent from damage and save the cost.As initial stage, the system for lead acid battery is introduced in future system will also applied for lithium ion batteries for electrical or hybrid vehicles. For this purpose, we have done prototype model for 12v lead acid battery to monitor the parameters.

***Keywords— Lead acid Battery, ATmega328P, GSM, Sensors.***

## 1. INTRODUCTION

Now a day's electric power demand for industrial purpose is increasing rapidly. In industries requires continuous electricity. When regular power source fails an uninterruptible power supply (UPS) system also used backup power source for smooth operation. The UPS is equipped with lead acid batteries which one of another source of electrical power. In automobile, lead acid battery consist of six electrochemical cells to give 12v. The battery monitoring system (BMS) is one of main component in automobile. It is used for monitoring of voltage, temperature and acid level.

The ATmega328P has been selected for this project because it has 32KB internal flash memory, single board microcontroller, where simple and low cost prototyping tool for engineering and educational projects.

Battery is classified mainly into two types are Rechargeable and non-Rechargeable batteries. Recharges batteries are the most important energy storage device used for many applications like electrical vehicles, hybrid electrical vehicles, computer data centers, and power substation and household applications.

We made battery monitoring system using combination of hardware and software unit. It includes cells monitoring, state estimation, balancing, thermal management and communication functions. It is important to know that state of charge (SOC), state of health (SOH) of battery and acid density [8]. While charging and discharging this parameter change very fast therefore an automatic control is required. Here we analyze the temperature rise, acid level and real time voltage using various sensors. Fault diagnosis is an important function in the battery monitoring system. In this project real time monitoring system for lead acid batteries based on ATmega328P (Arduino UNO) suitable for industry environment.

The main components of lead acid battery are metallic lead, lead dioxide and sulfuric acid (H2SO4).The structure of lead acid Battery is shown in below.

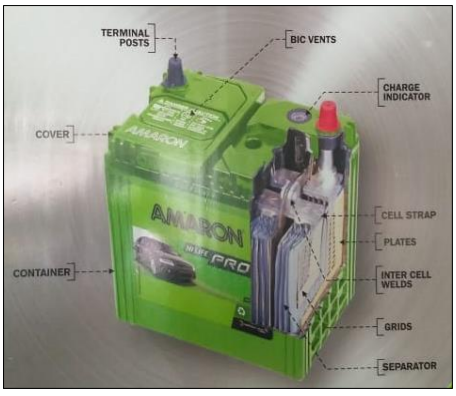



Figure1. Structure of lead Acid Battery

The rechargeable batteries are most resources used as backup resource. Some of the batteries are costly and also the negative impact on environment during the recycling process. Overcharging battery not only could significantly shorten the life of the battery, but also cause a

serious safety accident such as fire. To use this battery safely and protect them from damage and deep discharging there is need for a technology that can detecting faults early and providing control actions to minimize fault effects. However the lifetime of batteries reduces due to temperature rise and other issues. To detect the battery failure in time, monitoring battery state, determination of the battery is necessary. So, by considering above points we have to monitor the battery parameters such as temperature, voltage and acid level which will be important to functioning of battery. In this paper real time monitoring system for lead acid batteries based on ATmega328P suitable for industry environment.

## 2. LITERATURE REVIEW

Before going to the designing part of the system, it was found necessary to go through the various papers, books and other related literature and guidelines for the necessary pathway. Hence the following literature were reviewed for the knowing the things. The following researchers have been working in the field of research on Battery Monitoring System (BMS).

Anif Jamaluddin [1]: In his research paper, a Wireless Battery Monitoring System (WBMS) for electric vehicle has been developed for monitoring voltage, current and temperature of battery. This system consists of hardware (sensors, a microcontroller, a Bluetooth module, an Android Smartphone) and software. It was designed on a low cost microcontroller ATmega328 (Arduino UNO). Voltage, current and temperature data are transferred to microcontroller, and then data of battery is transferred using Bluetooth communication to display. In this research, data of battery monitoring are displayed on Personal Computer (PC) and android smart phone. The monitoring system was able to show real-time data of voltage, current and temperature and display data on android smart phone and PC simultaneously.

Joy N. Carpio [2]: The Car Battery in the Philippines can only last for an average span of 6 to 12 months. When a battery hits the 6 months margin, it will start showing unwanted responses such as unstable start up and quick discharge. These responses must be avoided specially in times that the car is significantly needed to be in good condition, such as during an emergency. As a solution, the researcher designed a device that can automatically checked for the temperature, load current, voltage level, number of hours left before reaching critical voltage level and state of charge of a car battery via wireless technology in a real time manner using a mobile application with a dedicated storage for recording data every given period. The system communicates using GSM, internet and Bluetooth to increase its reliability. The user has the options to manually or remotely switch loads in the vehicle. If in the event that the communication is loss, and the vehicle is approaching critical level, the device can be set to an "auto-off" mode which automatically switch the loads off.

Simon Siregar [3]: In his research paper, he worked on solar panel and battery street light monitoring system using GSM wireless communication system. The use of ACS712 current sensor and voltage sensor using voltage divider circuit with GSM communication system allows monitoring both the battery and the solar panel. The information from the current sensor and voltage sensor then processed by a microcontroller. This microcontroller then sends the data through a GSM communication system to a server, via short message service (SMS). This server then processed the data by passing the information from the SMS, and sends the data to a web server database. This information then can be accessed by internet.

## 3. SYSTEM ANALYSIS

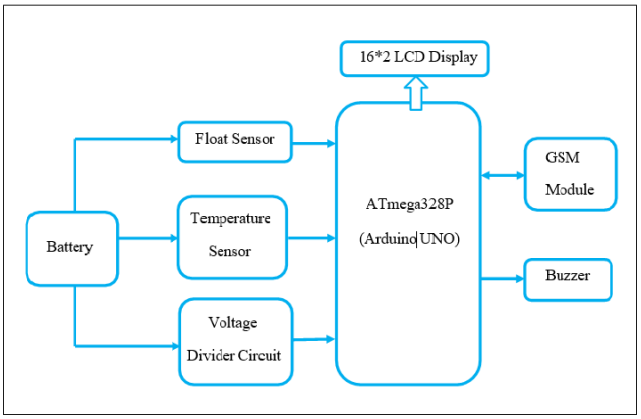



Figure2. Block diagram of Wireless Monitoring of Lead Acid Battery Using GSM Technology

As the system consist of LM35 temperature sensor and float sensor. Temperature sensor is used to determine the temperature of the battery and float sensor is used to determine the acid level in battery. Also we used voltage divider circuitry to determine real time value of voltage of the battery. We will use 12V rechargeable lead acid battery and the sensors are used are analog sensors. We use ATmega328P as our main controller. The output of the sensors is fed to the ATmega328P and it is analyzed by using ATmega328P controller. All the programming will be stored in it. For the data transmission to the user we are using GSM module. Buzzer is used for quick attention of the user. LCD is used for displaying current situation of the battery. Now when the battery parameters like temperature, voltage exceeds the reference value and acid level decreases below the reference value then this data is collected by ATmega328P with the help of sensors and fed it to GSM module, GSM will send the message to the register mobile number in the program, and also buzzer creates sound which takes attention of user.

### 3.1 Temperature Sensing:

Temperature rise problem affects the performance of lead acid battery. Normally battery performance better working condition temperature varies between 20 to 30°C. The battery life is also depends upon the temperature of working lead acid battery. Due to high temperature acid (H2SO4) begin to heat up. When battery temperature increases causes degradation of separators. The acid of lead acid battery starts to evaporate and separation of gaseous this process carried out inside battery device. When acid boils then water inside the battery reduces. The chemical reaction of battery changes faster inside the battery, so that life span of battery will be reduced. Every 8°C rise in temperature cuts the battery life in half. Heat is big cause of battery failure because it makes batteries work harder. Extreme heat can lead to battery corrosion. If temperature is increased the lead acid battery will allow more current. Due to this reasons temperature sensing is important parameter for battery. LM35 temperature sensor is used in our proposed work. This temperature sensor is used to detect precise centigrade temperature. The operating voltage range of this sensor ranges from -55 to 100°C. It has low self-rating and is operated under 4 to 30 Volts. LM35 temperature sensor having three terminals ground, VCC and output. It has less weight and cheap in cost. It is suitable for temperature sensing in our proposed system.

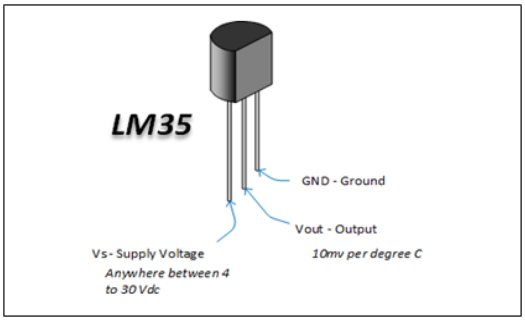



Figure3. LM35 Sensor

### 3.2 Voltage Sensing:

The various methods can be implemented to measure the battery voltage. Direct voltage sensor can be used for voltage measurement. The voltage divider circuit is the main basic concept [3]. The voltage divider circuit form with two resisters. One is 100k ohm and other is 10K ohm connected in series. The below figure 4 is designed for battery voltage. The voltage input (Vm) from the battery is applied across the series connected register.

$$Vout = Vin*R2/(R1+R2)$$

$$Va = 5* \text{Analog read} / (1023)$$

Voltage divider rule is very simple and small in size. The voltage sense is done by using voltage divider circuit. The voltage measurement is also important factor to check battery health. Proper charging and discharging problems occurs due to improper voltage output of battery. If the voltage is low then the more heat produced inside the battery and the performance of battery will be affected. Charging and discharging time extended so that voltage is more important parameter. Fully charged 12 Volt batteries are around 12.8 to 12.9 Volts.

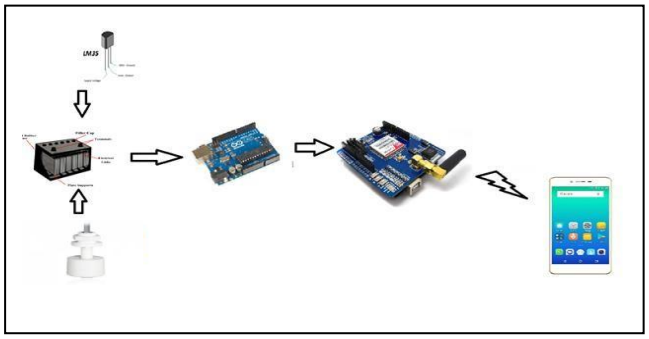


Figure4. Voltage Divider Circuit

### 3.3 Acid Level Sensing:

In the lead acid battery H2SO4 electrolyte is present for electrochemical reaction. Both the water and acid is used in battery for getting voltage. Ratio of water to acid is 3:1. In wet lead acid batteries water can pour when electrolyte level reduced. If level of electrolyte reduces it affects voltage and performance of battery. When level of acid reduced then it evaporates oxygen and hydrogen gas is formed. This gases increases with reduction in electrolyte. Explosion of Lead acid battery can be occurred so to check acid level is also important parameter of battery. Electrolyte level is serious problem it can be damage cell. Different techniques including capacitive liquid level sensor, resistance liquid level sensor have been used already to overcome this problem. In our proposed system we have used float sensor.

A float switch is a mechanical switch that glides on top of a liquid surface. As the liquid level goes up or down, it moves vertically with the liquid level. A float switch consists of a hollow floating body and an inward switch, likewise called a sensor. There are different kinds of inside switches, yet the functioning rule that they open/close because of gravity and water level moving the float switch vertically up or down is something very similar. Accordingly, the mechanical switch makes an open or closed electrical circuit.

Figure5. Float Sensor

### 3.4 ATmega328P Microcontroller:

We have used an 8bit microcontroller board based on ATmega328P. It has High performance Low power. The Atmega328P has 32Kb FLASH memory, 14 digital input output pins, 6 analog pins, crystal quartz oscillator of 16 MHz, Serial communication, voltage regulator for supporting ATmega328P microcontroller. The Device operates between 1.8 - 5.5 Volts. ATmega328P is used similar to any other controller. All there to do is programming. Controller just executes the program given by us at any instant. Without programming controller just waits without doing any kind of action. As said, first we need to program the controller and that is finished by writing the appropriate program file in the ATmega328P FLASH memory. Subsequent to unloading this program code, the controller executes this code and gives appropriate reaction.

**Application:**

1. Industrial control system
2. SMPS and power regulation system
3. Display unit

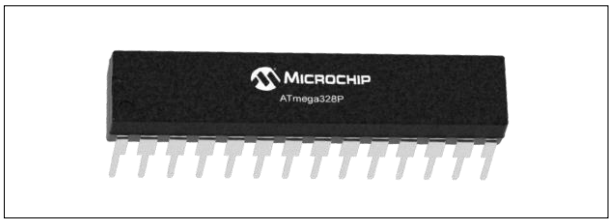



Figure6. ATMega328P

### 3.5 GSM SIM 808:

A Global System for Mobile Communication (GSM) module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network. SIM808 module may be a GSM and GPS two-in-one capacity module. It relies upon the most recent GSM/GPS module SIM808 from SIMCOM, supports GSM/GPRS Quad-Band network and combines GPS technology for satellite navigation. The GSM SIM808 is used to send the SMS to the user about the battery health. If any of the parameter exceed then GSM will send SMS to user's mobile number. The different techniques to send the data wireless are WIFI, Bluetooth, and GSM module but GSM work in wider range, and for indoor application the WIFI is appropriate. The GSM used for transmitting mobile voice and data and it is quad band module which supports 850/900/1800/1900MHz frequency. Only three connections are with ATmega328P microcontroller that is RX, TX, and ground. We have to enter the user's number in code and the SMS which have to be sent if the condition in code is true. The SMS will send by AT commands.


Figure7. GSM Module

### 4. METHODOLOGY

The implementation and prototype is shown in this section. The basic setup is shown in figure. The GSM SIM 900A module connected to the Arduino through input output ports. We have used analog pins of Aurdino to connect the analog inputs. We have mounted the temperature sensor and acid level sensor on battery. We use ATmega328P as our main controller. The output of the sensors is fed to the ATmega328P and it is analyzed by using Atmega328P controller. All the programming will be stored in it. For the data transmission to the user we are using GSM module. Buzzer is used for quick attention of the user. When the battery parameters like temperature, voltage exceeds than reference value and acid level decreases below the reference value then this data is collected by Atmega328P with the help of sensors and fed it to GSM module, GSM will send the message to the register mobile number in the program, and also buzzer creates sound which takes attention of user.

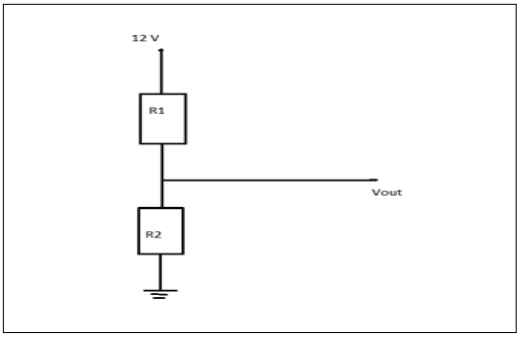



Figure8. Basic Setup of Proposed Work

### 4.1 Flowchart:

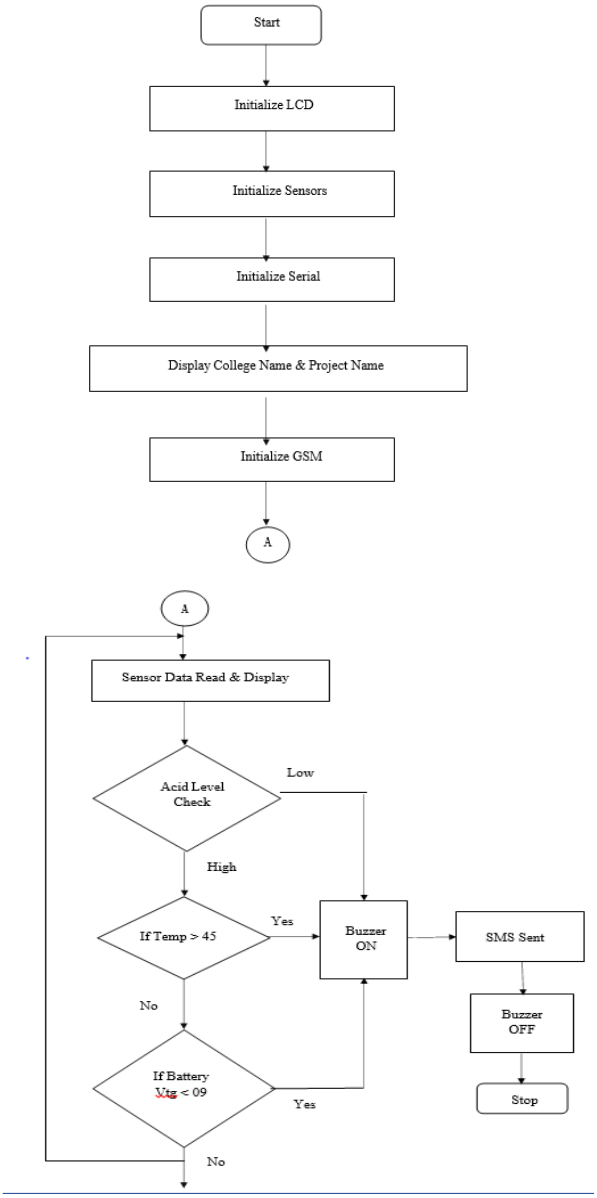



Figure9. Flowchart of Proposed Work

## 5. ACTUAL WORK IMPLEMENTATION

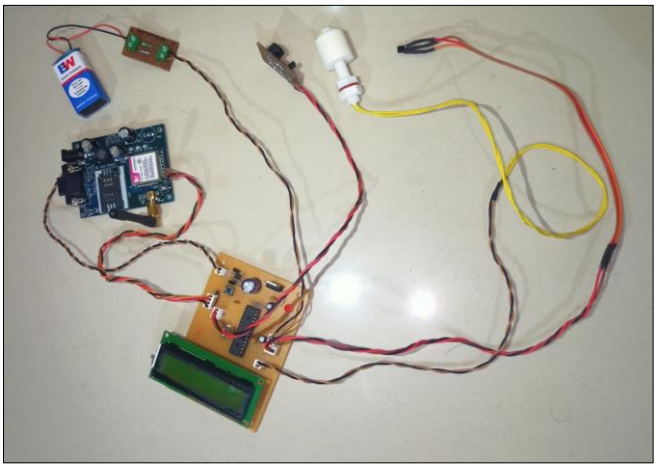
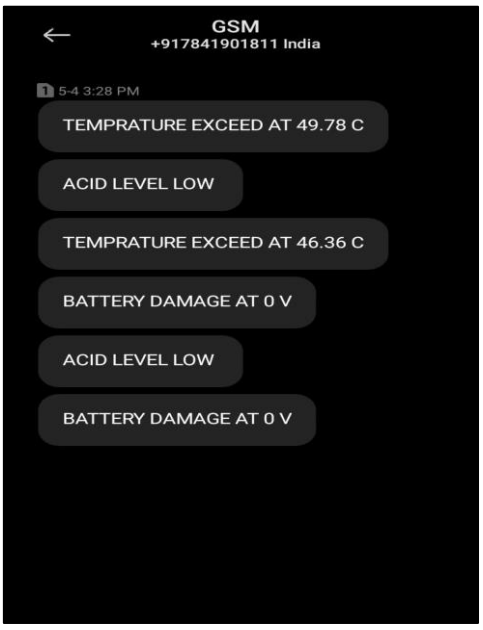


Figure10. Actual Work Implementation

## 6. RESULT




## 7. APPLICATION

1. This system is useful where the multiple batteries are connected to detect the faulty battery.
2. This is cost effective solution.
3. It is user friendly.
4. This system can applied on lithium ion batteries for electrical vehicle.

## 8. CONCLUSION

The wireless monitoring of Lead acid battery using GSM technology is useful to detect battery failure in time, so that timely action should be taken on battery problem which will beincrease the life of battery and prevent from damage.

## 9. FUTURE SCOPE

The wireless health monitoring system will be helpful for all type of backup batteries. Also to detect only faulty battery, this system can be implemented on multiple batteries connected in series. This system can applied on lithium ion batteries for electrical vehicles and hybrid vehicles.

## 10. REFERENCES

[1] Wireless Battery Monitoring for Electrical Vehicle: Anif Jamaluddin1, Fengky Adie Perdana2 Physics Education Program, Sebelas Maret University Surakarta, Indonesia 1elhanif@uns.ac.id 2fengkyadieperdana@gmail.com

[2] Real Time Monitoring Device for Car Battery with Remote Switching Capability via Mobile Application: Joy N. Carpio Email: jncarpio@ national-u.edu.ph

[3] Solar Panel and Battery Street Light Monitoring System Using GSM Wireless Communication System: Simon Siregar Telkom Applied Science School Telkom University Bandung, Indonesiasimon.siregar@tass.telkomuniversity.ac.id

[4] Battery Management Systems (BMS) for Increasing Battery Life Time: Prof. - Dr. Jiirgen Garche, Dr.-Ing. Andreas Jossen, Center for Solar Energy and Hydrogen Research, Ulm

[5] Design and Development of a Real-Time Monitoring System for Multiple Lead–Acid Batteries Based on Internet of Thing Ra Lee 1,Jae Min Jang 1 and So Young Shin1,*

[6] Health Monitoring of Li-Ion Battery Systems: A Median Expectation Diagnosis Approach (MEDA) Haris M. Khalid, Member, IEEE, Qadeer Ahmed, Member, IEEE, and Jimmy C.-H. Peng, Member, IEEE

[7] Study of equivalent circuit model for lead acid batteries in electrical vehicles. XueZhe.Wei, XiaoPeng.Zhao, yonggun. yuan. College of automotive engineering.

[8] Automotive Lead-Acid Battery State-of-Health Monitoring System. Ross kerly, Jihoon hyun and dongsamha multifunctional integrated circuits and System group.