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# AUTOMATIC BATTERY CHARGING USING BATTERY HEALTH DETECTION

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**Abstract- Most of the vehicles uses electrical system. In that Battery plays a vital role. There is a problem regarding battery discharging when vehicle is not in use for a long period of time. So by disengaging the battery terminals using relays the parasitic drain of battery can be reduced. Ideally, this present work can be made more convenient to user when it is interfaced with wireless communication system such as GSM mobile phone to engage or disengage the battery terminals. Other enhancement that can be done to the present work is to actuate the automatic ignition starting system. Whenever the vehicle battery health is poor then it will be sensed by the system present in the vehicle which will send SMS to the user and when the user reply for that SMS, the system will check the fuel level and gear position. When gear is in neutral position and sufficient fuel is present in the fuel tank then the system will actuate the ignition system and the engine will be cranked automatically. The engine should run until the battery is charged fully. Then it should be switched off automatically when the charging is completed. While cranking the engine, provision should be made to see that if any one tries to open the door then the engine cranking should be stopped and again automatically the battery terminals should be disengaged.**

***Keywords- Normally Open (NO), Normally Closed (NC), Short Message Service (SMS), Global System for Mobile Communication (GSM), BCI (Battery Council International).***

## I. INTRODUCTION

Nowadays most of the vehicles use electrical systems extensively. In that case battery plays a vital role. All the vehicles depend on battery to run different accessories present in it even when the engine is not running. Almost 40% of the cost of a vehicle is determined by electronics and software present in the vehicle. So to run these electronic accessories battery must be healthy enough. Premium cars have up to 70 ECU's. These ECU's will continuously take power from battery even when it is in off condition. When the vehicle is not used for a long period of time then there is a battery discharging problem. This problem arises due to parasitic drain [1, 2]. The electrical devices such as radio pre-sets, the internal memory of engine computers, body-control modules, security alarms or clocks continue to run even if the ignition is switched off [1, 2]. They are responsible for battery drain and this type of drain is called parasitic drain. Parasitic drain below 75 milliamps is tolerable but if drain exceeds beyond this limit then it drains the battery within a short period of time [2]. So to avoid this problem we are implementing a system called Automatic Battery charging using battery health detection which disengages the battery terminals whenever the vehicle is not in use for a long period of time by checking the status of ignition system and if battery health goes down then engine will be cranked automatically using the relay system. When the battery health goes down below certain level then it is sensed by the system present in the vehicle and using GSM module SMS will be sent to the user for further activation of the battery charging system. When the system gets authentication from the user for further action then fuel level and gear position etc. will be sensed and if there is any error then it will send error message to user otherwise starting system will actuate to charge the battery. In this way the problem of parasitic drain of the battery in vehicles can be solved.

## II. WORKING & CIRCUIT DIAGRAM

The main aim of the present work is to solve the problem of battery drain caused because of parasitic drain and develop an advanced automatic system which charges the battery automatically. The power required by the on-board devices and integrated circuits is fed through an on-board power supply [8]. When the user sends the message from the mobile, it is received by the GSM modem and retrieved. This information is then sent to the microcontroller for further processing the data according to the program fed inside it. For example if the received message is to crank the engine then it will crank the engine using relay system. Similarly different commands can be given to activate different functions inside the vehicle by sending the information to the microcontroller

using GSM modem. Using GSM Modem the range constraints are removed and the data will be processed by the microcontroller on both ends. The main components used in the system are microcontroller, GSM Modem, MAX232, Relay. MAX232 is used for the serial transmission of AT commands [7]. In response the modem transmits the stored message through the COM port.

The microcontroller performs the task as programmed. In this project we are using P89V51RD2 microcontroller which consists of 40 pins [5]. The on board power supply system which consists of step down transformer, bridge rectifier, filter and voltage regulator provides +5V to the microcontroller. To interface microcontroller and GSM modem, level shifter IC MAX232 is used. RTS and CTS signals of serial port interface of GSM Modem are connected with each other [7]. The transmit signal of serial port of microcontroller is connected with transmit signal (TxD) of the serial interface of GSM modem while receiving signal of microcontroller serial port is connected with receive signal (RxD) of serial interface of GSM Modem [7]. T1IN and R1OUT pin of MAX232 is connected to RxD and TxD pin of microcontroller. 39$^{th}$ pin is connected with pull up resistors of 10K each [5]. This pin is then connected to the starter relay circuit to activate the ignition system using relay driver IC [3, 4].

Relay driver is nothing but a set of inverters which convert logic 0 to logic 1 and so on. The input to relay driver is given through microcontroller. When logic 1 is given to the relay driver input pin then it converts that logic 1 to logic 0 at respective output pin. As shown in fig. 2 the one terminal of relay coil is connected to 12V supply and second coil terminal is connected to output of relay driver [3, 4]. When we got logic 0 on this second terminal of relay coil then the current starts flowing through the coil and the relay will be activated which engages or disengages the battery terminals of vehicle. GSM SIM900 is used to communicate with user by sending and receiving message for getting authentication and sending error message [7]. Battery voltage detector circuit is used to detect the battery health using the voltage method. The normal fully charged battery voltage for vehicle is 12.65 while fully discharged battery voltage is 11.89 [9]. So using this data we can set the threshold limit as 12V which tells that battery is 50% charged. So when this limit is reached then the comparator will compare the battery voltage with reference voltage and when battery voltage is less than this reference voltage then it will interrupt the microcontroller which will then actuate the relay according to the program fed to it.

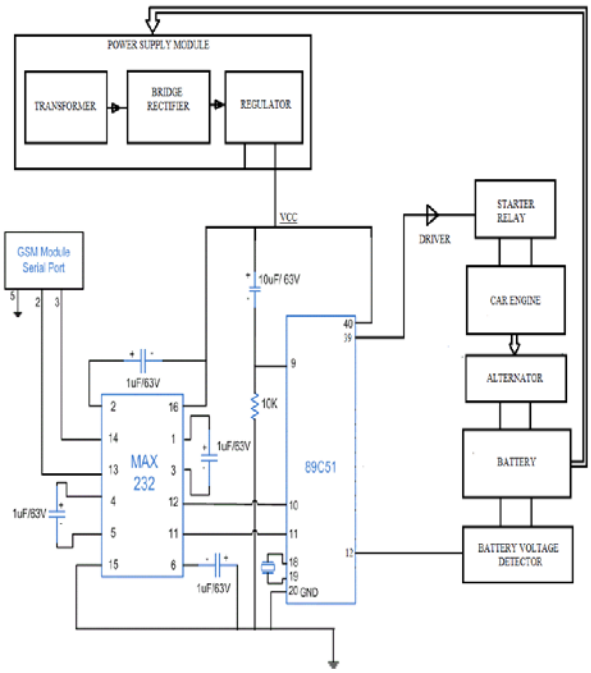


**Fig. 1: Circuit diagram of Automatic Battery Charging Using Battery Health Detection.**

## III. IMPLEMENTATION

- The main objective of the proposed implementation is to charge the battery automatically and to disengage the battery terminals when vehicle is not in use for long period of time.
- Improving the overall life and performance of the battery, by lowering and solving the parasitic drain problem through relevant battery disengagement and charging automatically.

## IV. ENGINE STARTING/IGNITION SYSTEM

When the interrupt is generated at the microcontroller pin 3.2 (INT0) then according to the program, the relay which is connected to the pin 39 of microcontroller actuates which in turn starts the engine by activating the starter solenoid [5]. The starter solenoid pushes the starter gear forward to mesh it with flywheel of engine. The flywheel is attached to the engine crankshaft. The starter motor

spins, turning the engine crankshaft allowing the engine to crank [8].

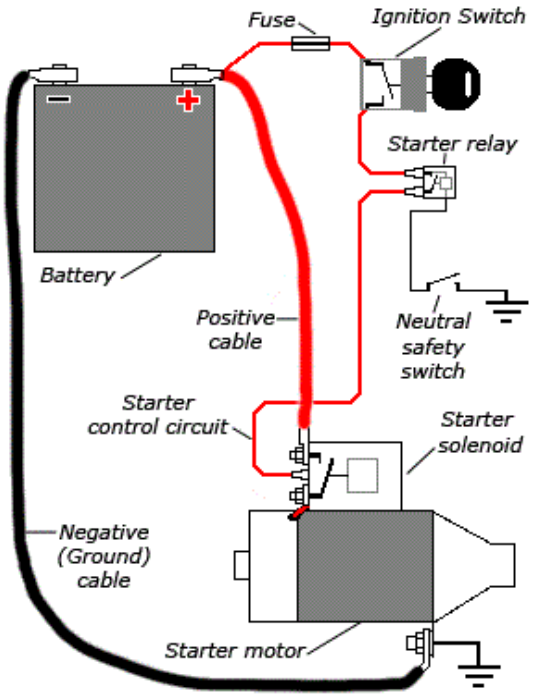


**Fig. 2: Engine Starting or Ignition System.**

## V. SYSTEM ELEMENTS

The constatnt interaction is needed between following hardware and software to implement all the features stated above.

- Microcontroller
- GSM module
- MAX232
- Relay
- Voltage Level Detector

### *A. MICROCONTROLLER*

Microcontroller is designed to perform specific task. In this project its function is to receive the control signals from the GSM module and work according to the program to activate the Starting/Ignition system [5].

### *B. GSM MODULE*

GSM (Global System for Mobile Communication) is used to describe protocols for second generation (2G) digital cellular networks used by mobile phones. GSM modules available in the market are SIM 300 and SIM 900. Here in this project we are using SIM 900. AT commands are used for the communication between GSM module and the microcontroller [7].

**Fig. 3: GSM Module**

It can be easily programmed to send a pre-defined message in the occurrence of particular event such as successful ignition of vehicle. When ignition is on then it can be sensed by the microcontroller. For example here in this project when battery health is low then GSM module will send SMS to the user and when user reply for that SMS then it will actuate the relay by making the pin 38 of microcontroller to logic 1. When this logic 1 is given to the relay driver IC ULN2003A then it will actuate the starter relay. So by using this information the ignition status can be sensed and then GSM module will send the pre-defined message.

### *C. MAX 232*

The MAX 232 is dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA232-F voltage levels from a single 5-V supply. When a MAX 232 IC receives a TTL level to convert, it changes a TTL logic 0 to between +3 and +15V, and changes TTL logic1 to between -3 and -15V, and vice versa for converting from RS232 to TTL [7].

### *D. RELAY*

A relay is somewhat similar to a switch [4]. It is an electromagnetic switch. As shown in fig. 4 if the voltage is given to the coil then the current will flow through the coil. The electromagnet will be energized which in turn will pull the armature downwards and when the current is not supplied to the coil then the electromagnet will be De-energized and the spring attached to armature will pull back the armature to its original position. Thus

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the armature pivots in between normally open (NC) and normally closed (NO) points of the relay.

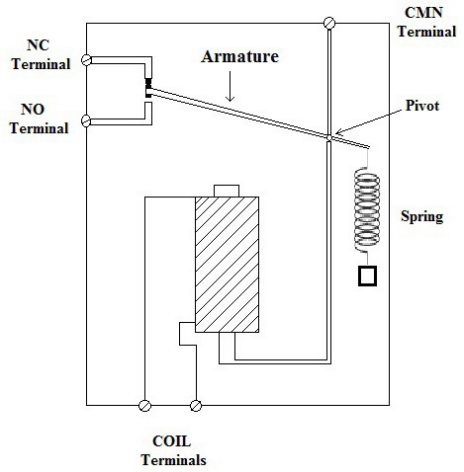



**Fig. 4: Relay**

## *E. VOLTAGE LEVEL DETECTOR*

Voltage Level Detector is used to detect the voltage level of the battery. As shown in fig. 5 when battery voltage falls below specified threshold then using LM339 which is a quad comparator IC it is detected and further actions are taken according to the program inside the microcontroller when interrupt is generated on the pin 3.2 (INT0) of microcontroller.

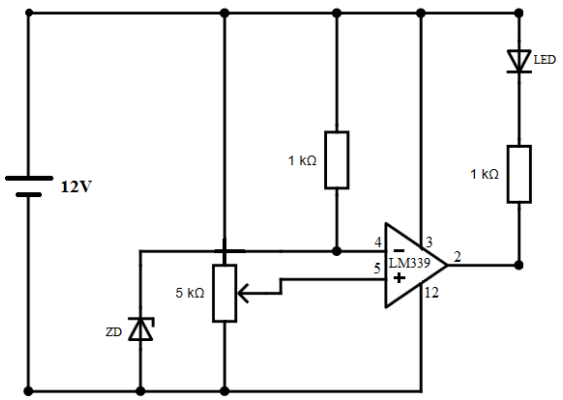



**Fig. 5: Voltage Level Detector**

As shown in Table 1 when the battery voltage is 12.65V then its state-of-charge is 100% [9]. When battery voltage is 11.89V then the state-of charge is considered as 0% [9]. So according to this BCI standard 12.24V is set as a reference voltage. When battery voltage falls below this voltage then it is detected by voltage detector system and specified task is performed.

| Approximate state-of-charge | Average specific gravity | Open circuit voltage | | | |
|---|---|---|---|---|---|
| | | 2V | 6V | 8V | 12V |
| 100% | 1.265 | 2.10 | 6.32 | 8.43 | 12.65 |
| 75% | 1.225 | 2.08 | 6.22 | 8. 30 | 12.45 |
| 50% | 1.190 | 2.04 | 6.12 | 8.16 | 12.24 |
| 25% | 1.155 | 2.01 | 6.03 | 8.04 | 12.06 |
| 0% | 1.120 | 1.98 | 5.95 | 7.72 | 11.89 |

**Table 1: BCI (Battery Council International) standard for SoC estimation of Lead-Acid Battery**

| Sr. Num. | Battery Voltage (Volts) | Approximate State-of-Charge (%) | Output voltage of LM339 (Volts) | Status of SMS |
|---|---|---|---|---|
| 1. | 12.64 | 100% | 11.64 | - |
| 2. | 12.16 | 50% | 0.54 | SMS sent |
| 3. | 12.06 | 25% | 0.54 | |

**Table 2: Testing results for State-of-Charge (SoC) estimation using Battery Voltage Detection**

# VI. ALGORITHM & FLOWCHART

### *Algorithm to start the engine*

**Step 1** Start.

**Step 2** Check the battery health.

**Step 3** Wait until GSM module receives a message.

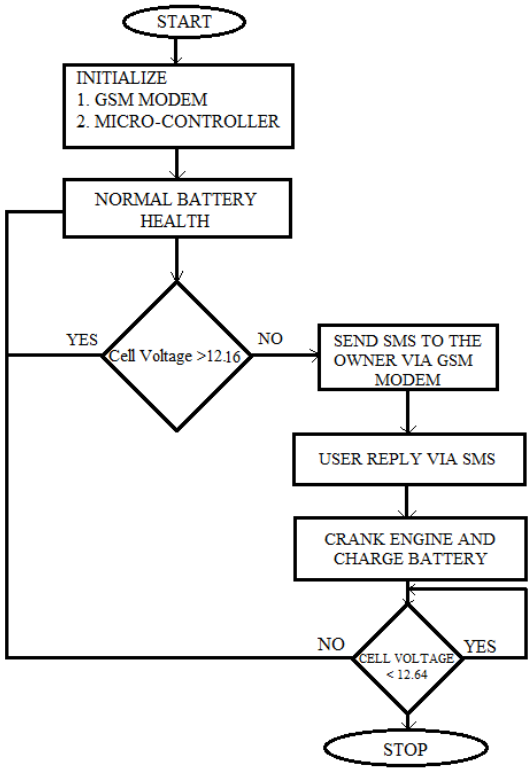
**Step 4** Read the message.

**Step5** Compare the message and if it is “ENGINE ON” then start the engine of the car.

**Step 6** Send acknowledgement to the user.

**Step 7** Go back to step 2.

**Step 8** Stop.




**Flowchart 1. Automatic Battery Charging Using Battery Health Detection**

## VII. CONCLUSION

A working prototype of 'Automatic Battery Charging using Battery Health Detection' was built to demonstrate a GSM module based Automatic Battery charging and vehicle engine control system using GSM network where turning on the engine when the battery health goes below certain threshold is demonstrated by glowing light using relay system. The system takes the advantage of existing GSM infrastructure that have virtually full coverage around the globe, which leads to low implementation cost, simple and easy installation of GSM module at user side. The use of GSM network thus enhances human comfort. Range constraints are not there in this system as we can use GSM system with any strong network.

## IX. ACKNOWLEDGMENT

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