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Comparison of SOC Estimation and Costs in Coulomb Counting Technique and Real Time UPS

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Abstract: The electric vehicle battery management system can works in the various environments. Hence for battery it needs charging to work the circuit. So this paper is focused on the CC method and the pulse charging technique by using this circuit we can reduce the charging circuit cost totally and it gives the efficient results also. Hence it is compared with the real time UPS charging circuit which is placed inside the ups. Where by this comparison of both the charging circuits, we can say that the charging circuit cost can be reduced and the results of the charging circuit to charge the battery and to discharge time is efficient. Mainly we used the CC method and pulse charging technique to charge the battery and with the help of Arduino Uno. Hence by this components, we can say this charging circuit cost is reduced and the charging circuit results are efficient than the real time charging circuit of ups.

Keywords: SOC (State Of Charge), CC Method (Coulomb Counting Method), Pulse Charging Technique, UPS (Uninterruptable Power Supply), Arduino Uno.

1. INTRODUCTION

Now a day, the batteries play a very important role in the environment. So the main one thing for the battery is battery life. We know that the battery is going to be charged with the help of charging circuit. Hence there are many charging circuits were implemented in the real time. Where, the device which is connected with battery is going to be charge by a charging circuit. And when the device battery gets full and going to discharge mode. If it discharges to 60% or 50% by connecting the device to the charging circuit again the battery getting into discharged mode[7]. By this there is a problem occurs, which is sulfation problem[1]. Hence by this the battery life is going to be drastically decreases. So, to eradicate that problem the one of the method used in this paper is coulomb counting method and the technique is pulse charging technique. Lead acid battery life is dependent on continuous charging and discharging. If a battery is not used properly its life drastically comes down. If a particular battery having X Amp-hr. capacity and only 20-30% of full capacity is used regularly for a period more than one month ,that battery's Amp-Hr. capacity will be reduced to 20% of X Amp-Hr. only. This deficiency is usually stated as memory i.e., leads acid batteries exhibits phenomenon of memory[2-4]. Also upon overcharging, porous amorphous lead plates convert into crystalline state which is quite stable and passive. This phenomenon is generally termed as sulfation. In order to avoid this; ideally a battery should be charged and discharged fully in a systematic way. For charging batteries, fundamentally there are two types of charging techniques are present[5]. One is Constant

Current method and other is Constant Voltage method. Along with these two types, pulse charging is the best method to improve the efficiency of the battery, as it provides some settling time for the neutralization of chemicals in the battery. While designing a charger of a battery, some parameters must be taken into

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consideration such as the State of Charge (SOC)[13], the lifetime of the battery, and the charging time. Which discuss about the increment of life time of battery by charging? Many charging techniques are there to improve the life time of the battery [6]. Improving battery performance is important factor in promoting the EV market by prolonging battery life, reducing the cost of manager and building confident to the potential customers[8].

2. CHARGING TECHNIQUES

There are many charging techniques to charge the battery in the charging circuit. Where there are constant current method and constant voltage method and the pulse charging technique and the two step method [9].

Constant current charging is the simplest method of charging employing single low level current to the discharged battery [10].

3. PULSE CHARGING TECHNIQUE

A pulse current is applied to the battery periodically, this provides the battery a relax time in charging process [11]. The electrochemical reaction and neutralization of battery internal electrolyte are helpful to enhance the life cycle of battery. Using a large pulse current will shorten the battery charging time. Figure shows the current waveform of pulse charging method seen in Figure 1.

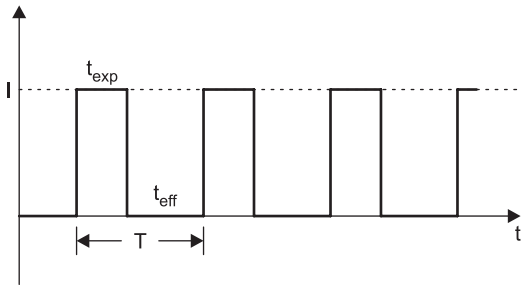

Figure 1: Pulse Charging method curve

4. RECTIFICATION

Ac power is converted into dc power using rectification block where we have used bridge rectifier and capacitive filter [12]. Below circuit represents schematic of rectification in Figure 2.

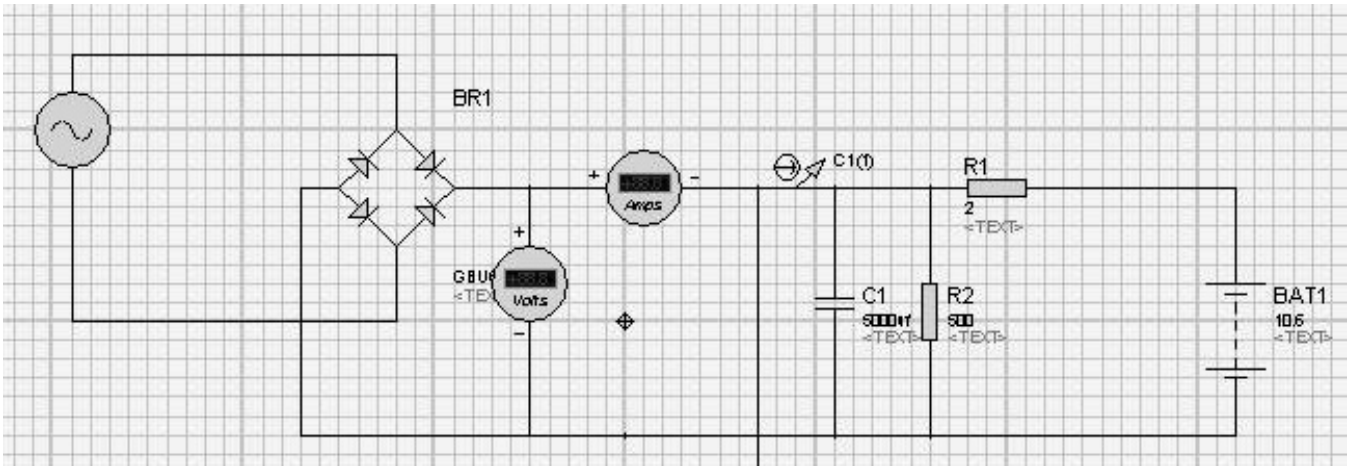

Figure 2: Rectifier Circuit

5. COULOMB COUNTING METHOD

The Coulomb counting method which gives the count to the circuit when the battery reaches to its maximum limit voltage level of 80% SOC and the minimum limit voltage level of SOC 20%[14-15]. Hence it is connected with a current sensor because to measure the input current in the Arduino. Hence it can be seen in Figure 3.

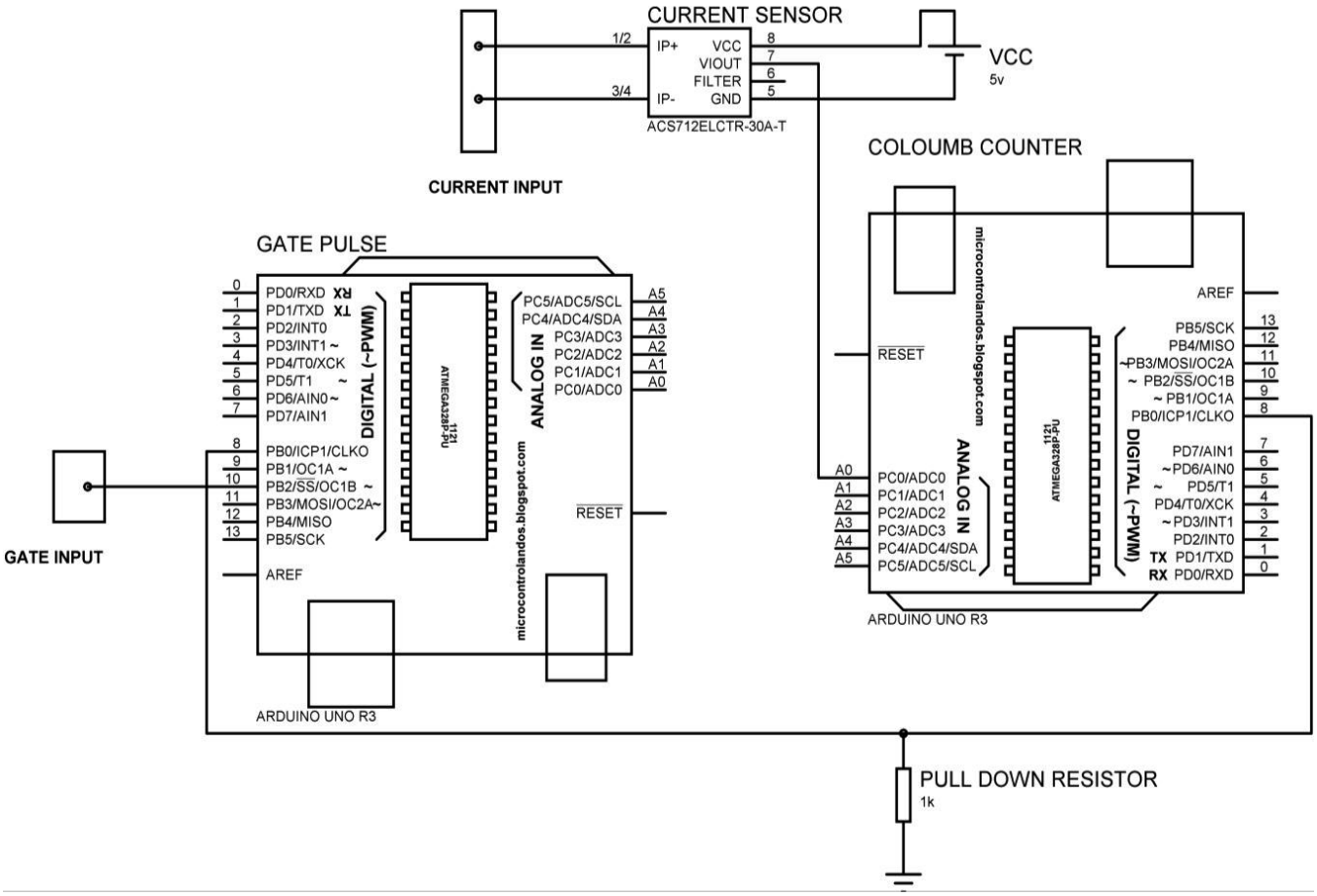

Figure 3: Coulomb Counting Method

6. CHARGING CIRCUIT OF UPS

Now-a-days there is an increasing demand for a continuous and quality power supply. The devices that are used for the continuous power support are playing a crucial role in data storage, communications, and people safety and in business too the circuit can be seen in Figure 4.

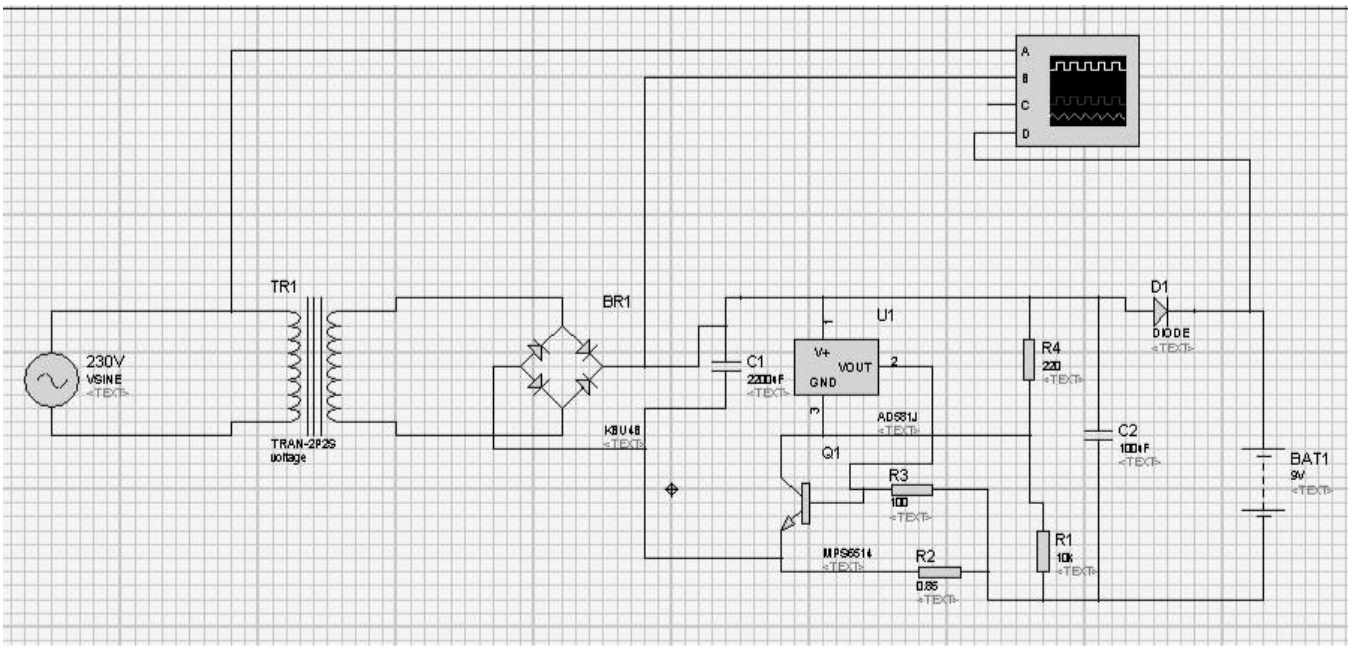

Figure 4: Charging Circuit of UPS

7. RESULTS

The results which are done with simulation in the proteus software and which is also fabricated with the real time data collected. The circuit which is simulated and fabricated are shown in Figure [5-8].

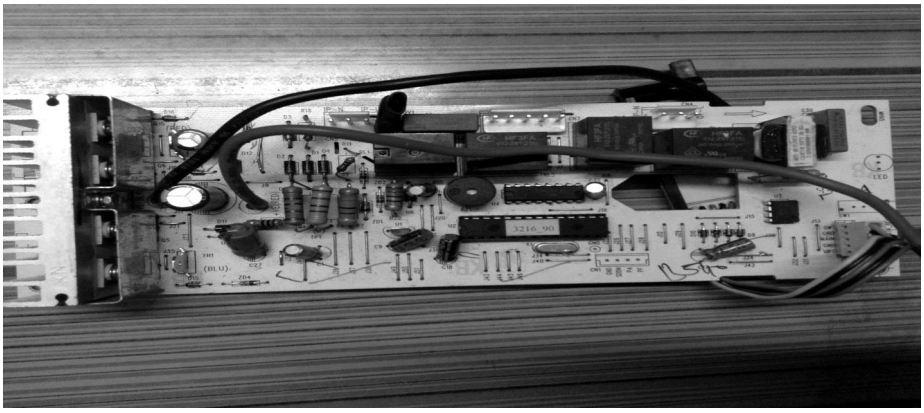

Figure 5: Charging circuit of UPS

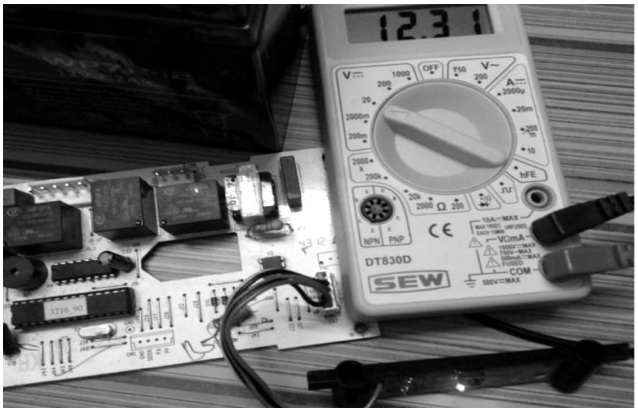

Figure 6: Battery Voltage when it is discharging

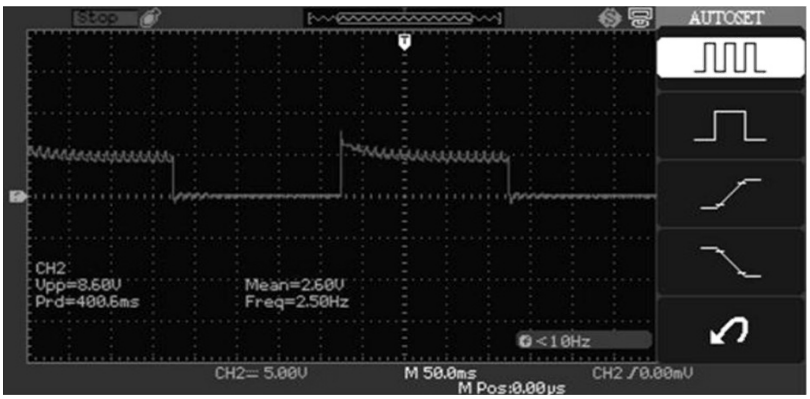

Figure 6: Result of Pulse charging circuit

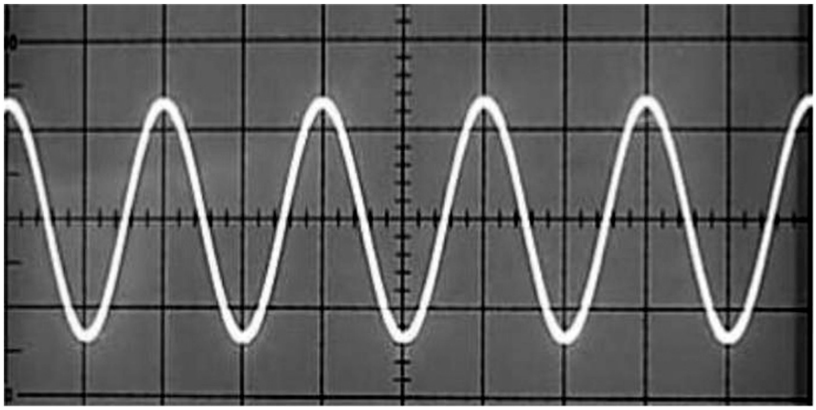

Figure 7: ac mains supply (charging circuit ups result)

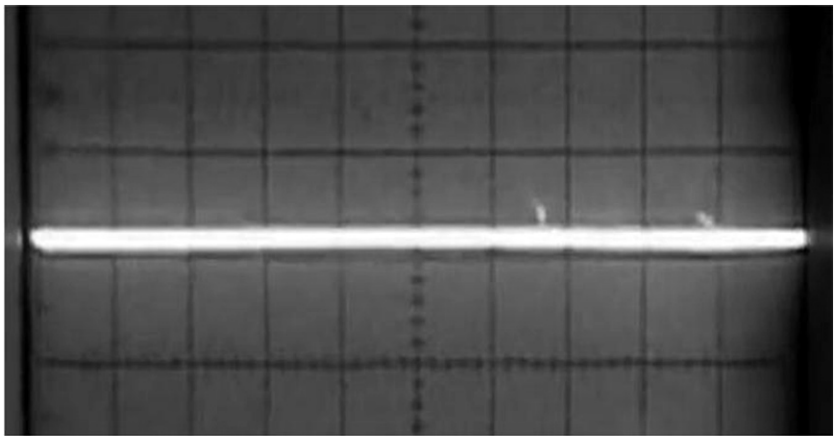

Figure 8: dc voltage of the battery

8. COST ANALYSIS

S.No	*Components*	*Specifications*	*Quantity*	*Cost*
1	CSC-B1 Class B (Black) Transformer	O/P: 120V AC; 50/60Hz 10.9A; 1200W(Max)	1	Rs. 1870
2	HF3FA (Black) Relay	250V AC, 6A, SPDT Dielectric strength: 2.5 KV	1	Rs. 105
3	833H-1C-C Black relay	SPDT; 7A, 30V DC; 7A, 250V AC; 19 * 15.5 * 15 mm	1	Rs. 42

S.No	*Components*	*Specifications*	*Quantity*	*Cost*
4	ULN2003 IC Darlington transistor *r*	Collector current = 500 mA, R = 207 K Ohm	1	Rs. 26
5	LM358N Operational Amplifier	CMRR: 65dB Input current = 1.2 mA Input offset voltage = 7 mV Gain bandwidth = 0.7 MHz	1	Rs. 135
6	BZ1 zener diode		1	Rs. 90
7	Resistor 4.7 K ohm Tolerance +/–5%	4.7 K ohms, 1 ohm, 12000 M, 41 K	4	Rs. 15
8	Capacitor	1 micro, 10 micro, 20 micro, 220 micro, 47 micro, 470 pico	5	Rs. 15

TOTAL = Rs. 2298/-

Cost of Charging circuit components

S.No	*Components*	*Description*	*Quantity*	*Cost*
1	Power mosfet irf 640	18a, 200V	1	70
2	GATE DRIVER TLP 250	O/P CURRENT 1.5A Voltage isolation 2500 Vrms Current dc forward 20 mA	1	50
3	BridgeRectiferBR1010	10A single phase silicon bridge	1	30
4	Transformer	O/P: 120V AC 50/60Hz	1	325
5	ARDUINO module	UNO	1	130
6	Resistors	1 K,1.5 OHMS	3	10
7	Capacitors	4700 micro (4),100 micro, 100 nano	6	20

TOTAL = Rs. 725

9. CONCLUSION

The paper discusses about the one of the charging technique, pulse charging technique. When the battery is charged fully and in discharged mode if it reaches to 60%. If we connect the charger this designed charger will not allow to get the battery charge. But when it is compared with the real time charging circuit of UPS. Then in the view of cost analysis the circuit which is implemented with this technique is more efficient and in the reason of sulfation problem also the charging circuit is more efficient for the battery. The pulse charge technique with CC method is more efficient and the most advantage technique for lead acid battery in future also.

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