INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH AND ANALYSIS

ISSN(print): 2643-9840, ISSN(online): 2643-9875

Volume 07 Issue 07 July 2024

DOI: 10.47191/ijmra/v7-i07-01, Impact Factor: 8.22

Page No. 3071-3076

Standardized and Modernized 12 Volts Mobile Electric Battery Charging Machine-An Implementation

Dominic David Ekpo[1], Ekom Enefiok Okpo[2], Imo Edwin Nkan[3]

[1,2,3]Akwa Ibom State University, Ikot Akpaden, Nigeria

ABSTRACT: In this research work, a standard and modernized 12 Volts battery charging machine was constructed and implemented. The materials used were locally sourced. The main objective centred at making the charger to protect the battery from being overcharged and damaged. Related works on the subject were carefully reviewed to arrive at the main objective. The best circuit option for the functionality and reliability of the charge controller was developed. The method adopted, include perforating the Veroboard for soldering and mounting of electronic components on the board. Integration of the required integrated circuit (IC), incorporation of transformer and casing. The circuit was initially tested by checking the output voltage, before testing with battery. The pulse width modulator circuit successfully produced approximately 100 Hz output frequency. The functionality of the charger controller was tested, and was found to be operating optimally, while serving and preventing the battery from breakdown and damage.

KEYWORDS: Transformer, Rectifier, Smoothing capacitor and Regulator

I. INTRODUCTION

In the millennial, battery charger has been widely used. With the advancement of the technology, most electrical appliances have now been adapted to use rechargeable batteries. This has been proved to be more economical and environmentally friendly. The most obvious example is the 12v car batteries (Radin, 2008).

Lead acid batteries were first found in 1748 by Benjamin Franklin where he first defined the term battery to describe an array of charged glass plates. Lead Acid batteries are known to be one of the oldest types of rechargeable battery and are still widely used. The main application of these batteries is in automotive field, robotics, emergency lighting in case of power failure (Krishnamurthy, Rashmi, Sonali & Afrin, (2014). Similarly, Hyapici (2010), describe battery as device, which consist of electrodes and electrolyte for the storage of chemical energy, but brings about a reaction between its electrodes and the electrolyte in a way to cause the flow of electrons through an external circuit (Nkan, et al 2023). A constant potential method of charging is adopted in this project work. It is a phenomenon whereby the alternating voltage from the main is converted to direct voltage through rectification (Olatunbosun, D. et al 2014).

The direct current from the rectifier is passed through the battery that is being charged in the reversed direction in which the battery supplies current to the external circuit Okoro et al 2022). The charger is intended to charge batteries with terminal voltage up to 12volts. It incorporates a sensing technique to monitor when the battery has been charged to its rated terminal voltage so as to automatically cut off supply to the battery (Ekpo, D. D. et al 2012).

The vehicle owners have been facing a lot of challenges with charging of their car battery which often times run down in areas where there are no electricians to recharge their battery (Diji C. J. et al 2013). Therefore, there is a need to look for an alternative of recharging car batteries at any point in time provided there is a source of electricity (Ekpo, D. D. 2012). Hence this research is conducted.

In this study, the aim is to design and construct an inexpensive 12-volt modern electric battery charging machine that will recharge batteries when needed. The designed device consists of a circuit which performs charging, a circuit displaying battery charge level during or resting state of charging (may change according to requirements), a circuit controlling charging time and that displays charging data on battery and LCD. Main charger circuit is voltage controlled (when adjusted charge value equals charge value on battery, charging is terminated) (Ekpo, D. D. 2019). Battery charge level is displayed by leads and cannot be used for inductive loads (Okpo, et al 2021). Another objective of this study is to evaluate the performance of the developed charger (Diji, C. J et al 2013).

II. METHODOLOGY

Design Procedure

This study applied the following procedures in the design stage:

Perforating of vero-board for soldering

Mounting of 10,000µf capacitor were carried out

Installation of diode

Installation of (IC) integrated circuit

Installation of 15volt transformer

Mounting of the circuit to the casing

A. Materials/Component Selections

Choosing the right component is very important to insure not only all requirements are met but also the component is not over specified which may result in a more costly solution than as required in Fig. 1 and 2. The required components are listed below.

B. Components List

R1 = R2 = 10K	C1 = 1nF	T1=BD140
R3 = 1K	C2 = 220µF / 35V	T2=BC546
R4 = 5.6K	D2=D3=1N4148	D4=green LED
R5 = R6 = 12Ω	D1 = 1N4001	

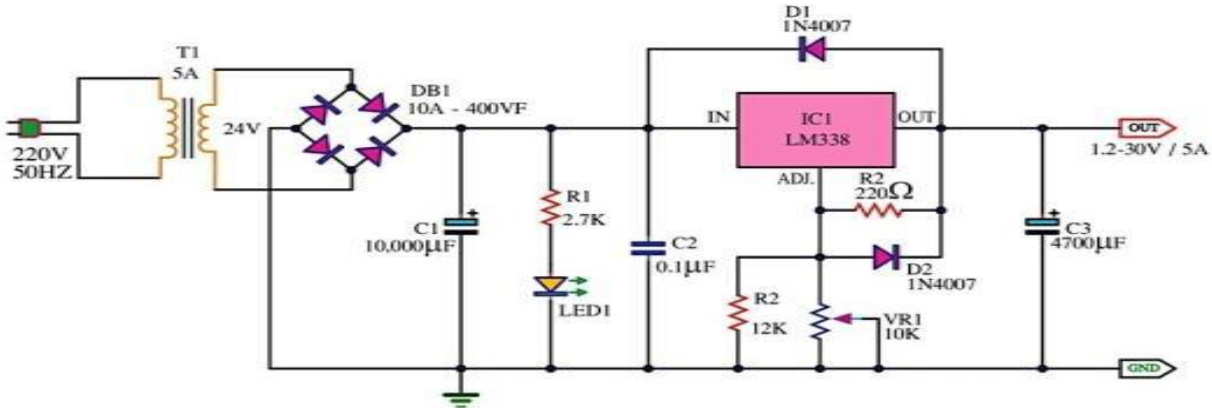

Figure 1: Circuit design

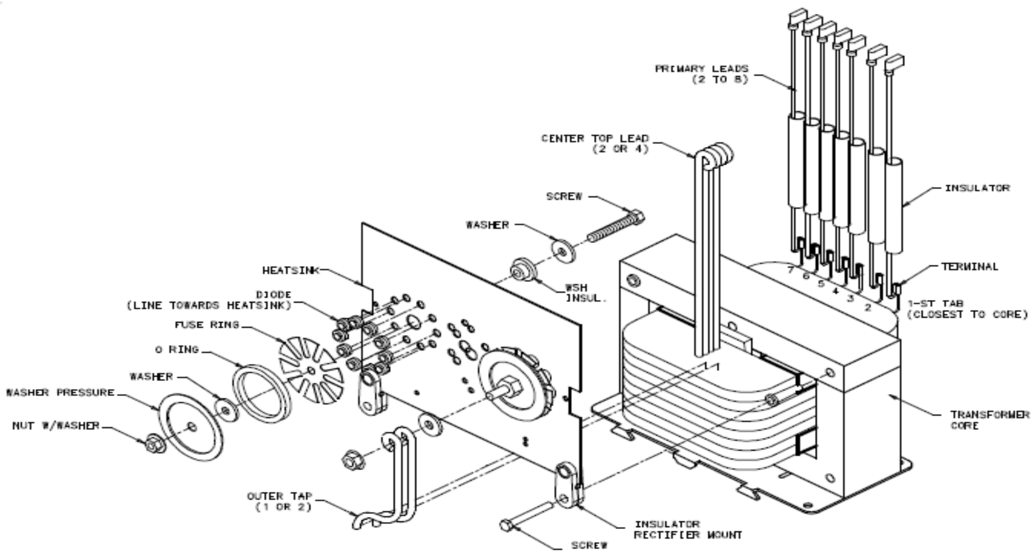

Figure 2: Transformer connected to rectifier assembly in an Associated Equipment charger

Working drawings and battery structure are illustrated in Figure 3, 4. The Figures 5 give a pictorial view of the sides and dimensions of the battery charger. The assembly of diode, heat sink and capacitor on the vero board is illustrated in Fig. 6 and Fig. 7 illustrates the arrangement of cable to the transformer.

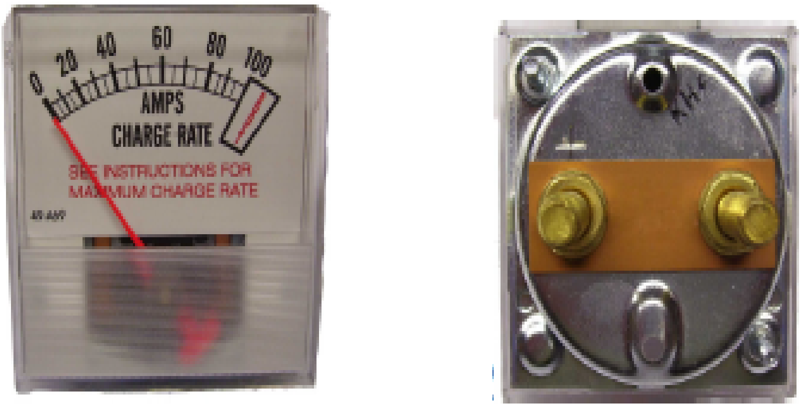

Figure 3: Amp meters

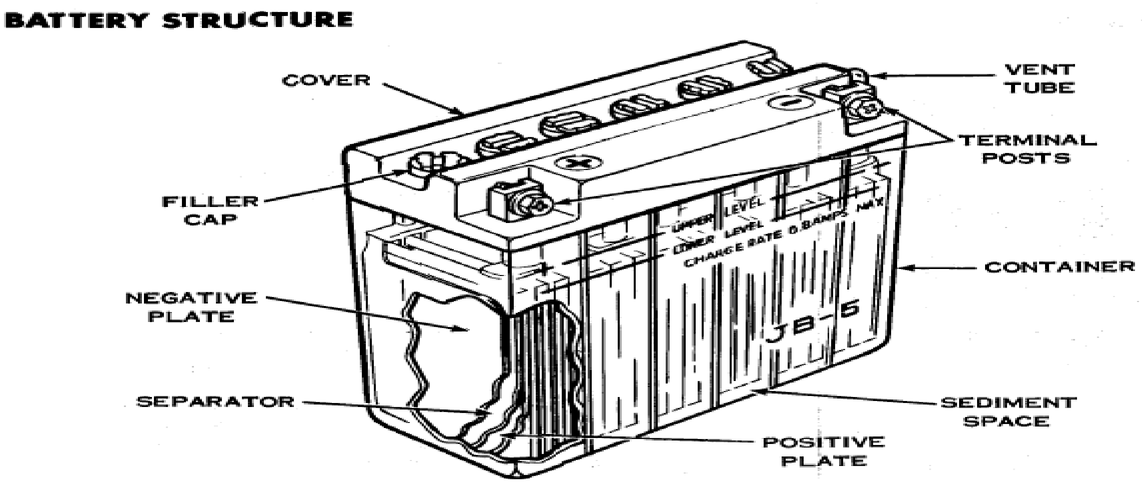

Figure 4: Seal lead acid battery

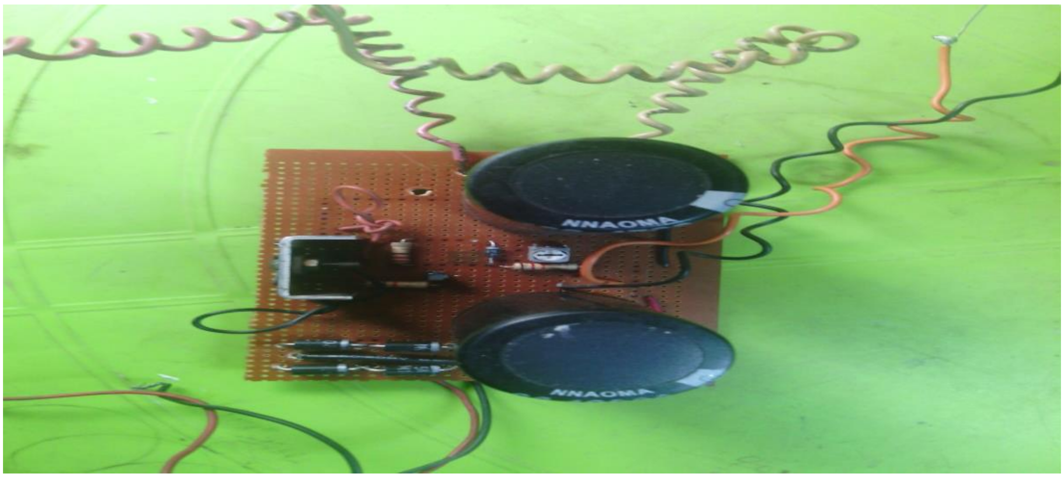

Figure 5: Side and dimensions of the battery charger

Figure 6: Diode, Heat sink and Capacitor to a vera board

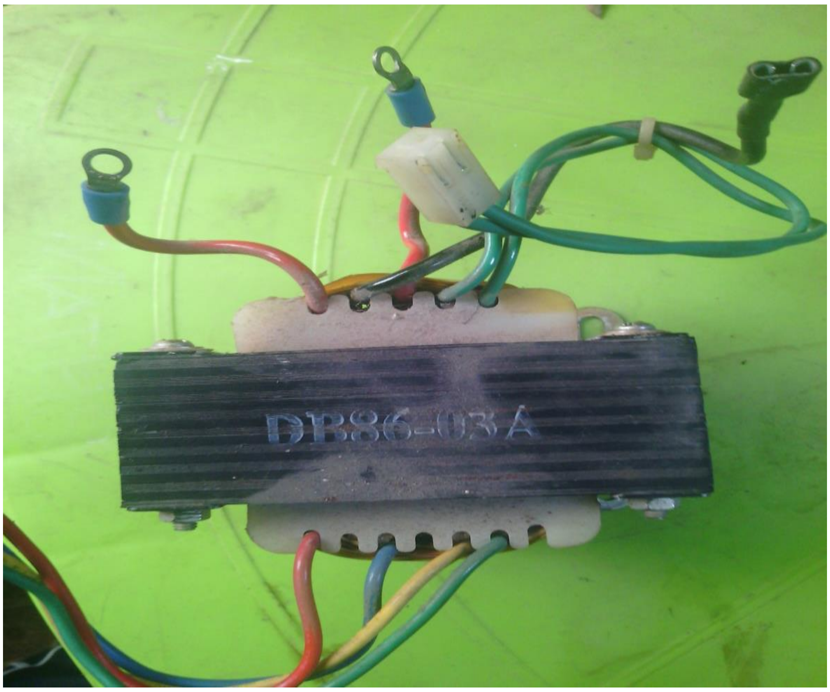

Figure 7: Cable and capacitor connection to transformer

III. CONCLUSIONS

Table 1: Presentation of Results

S/NO	COMPONENT	CAPACITY
1	Capacitor	10,000µf
2	Transformer	15 volts.
3	Vera board	1 piece
4	Bridge rectifier	DBI 10A-400vf
5	Integrated circuit IC	LM 338

6	C3	4700µf
7	Light emitting diode	1
8	Variable resistor	10K
9	Resistor 2	220Ω

The purpose of this study has been achieved hence the construction has been done successfully and it is hoped that, this will address such challenges hence vehicle owners/user who have this standard modern 12 volts electric charging machine in Figure 8 can carry it in their vehicles and used it whenever it runs out

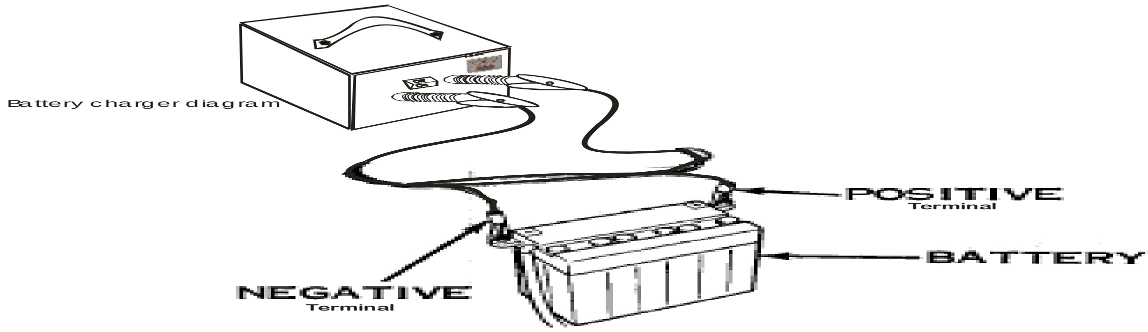

Fig. 8: Diagram showing battery charger, charging the 12volt battery

IV. CONCLUSION

Based on the result presented above, it is apparent that the design and construction of the automatic battery charger with controller were successful. Using locally available components, the best circuit option for the functionality and reliability of the charge controller was developed. The pulse width modulator circuit successfully produced approximately 100 Hz output frequency with 10% duty cycle for charging and 90% duty cycle for trickle charging. The functionality of the charger controller was tested, and was found to be operating normally and is ready for use.

REFERENCES

1) Krishnamurthy, V., Rashmi V., Sonali T. & Afrin, S. (2014) Automatic Battery Charger. International Journal of Advanced Research in Computer and Communication Engineering Vol. 3.
2) Hyapici (2010) Automatic Battery Charger. Battery Information. Retrieved March 6, 2019..com/battery.html Sannella,
3) Diji, CJ, Ekpo, DD and Adadu CA (2013) Exergoenvironmental evaluation of a cement manufacturing process in Nigeria International journal of engineering re-search and development 7, pp25-32
4) Intelligent NiCd/NiMH Battery Charger - Construction Project. Retrieved February 19, 2007
5) from http://www.angelfire.com/electronic/hayles/charge1.html.
6) Radin (2008) Battery charger with Alarm application. Faculty of Electrical & Electronics Engineering University Malaysia Pahang www.ibll56.batteryservice.com
7) Ekpo, D. D. (2019) Electricity Generation Potential from Municipal Solid Waste in Uyo Metropolis, Nigeria
8) Jmaes W. Nilsson Susan A. Riedel (2005) Electric Circuits, International Edition.
9) Altinbasak Orhan (2005) PIC Programlama, Altas, Istanbul.
10) http://www.teknomerkez.net/makale.asp?k=213
11) Olatunbosun, D., Uguru-Okorie, B. E, & Ekpo D. C. (2014) A Comparison of Medical Waste Generated in Selected Private and Public Hospitals in Abeokuta Metropolis, Nigeria. International Journal of Scientific & Engineering Research pp 1441-1449
12) Diji, CJ, Ekpo, DD and Adadu, CA (2013) Design of a Biomass Power Plant for a Major Commercial Cluster in Ibadan-Nigeria the International Journal of Engineering and Science pp 23-29
13) Ekpo, D. D. (2012) Challenges of Municipal, Solid Waste Disposal A Case Study of Uyo Township. Education & Science Journal of Policy Review & Curriculum Development, Vol. 1 no 2, pp 110-116

14) Nkan, I. E., Okpo, E. E., & Okpura, N. I. (2023). Optimum Location of Shunt FACTS Devices for Enhancement of Power System Loadability Using Continuation Power Flow. International Multilingual Journal of Science and Technology (IMJST), 8(9).
15) Okoro, O. I., Abunike, C. E., Akuru, U. B., Awah, C. C., Okpo, E. E., Nkan, I. E., Udenze, P. I., Innocent, U. O., & Mbunwe, M. J. (2022). A Review on the State-of-the-Art Optimization Strategies and Future Trends of Wound-Field Flux Switching Motors. IEEE PES/IAS PowerAfrica, (pp. 1-5). Kigali, Rwanda.
16) Okpo, E. E., Nkan, I. E., Okoro, O. I., & Akuru, U. B. (2021). Winding Reconfiguration of 5.5 kW Three-Phase Induction Motor for Improved Performance. IEEE PES/IAS PowerAfrica, (pp. 1-4). Nairobi, Kenya.
17) Ekpo, DD, Diji, C and Offiong, A (2012) Environmental degradation and municipal solid waste management in Eket-Nigeria Pan African Book Company, ISSN: 2276-6138, pp 164-172.

There is an Open Access article, distributed under the term of the Creative Commons Attribution – Non Commercial 4.0 International (CC BY-NC 4.0) (https://creativecommons.org/licenses/by-nc/4.0/), which permits remixing, adapting and building upon the work for non-commercial use, provided the original work is properly cited.