Universal Hybrid Charger

Angelo A. Abrazaldo

***Abstract* - This study aims to enhance and modernize the current power supplies through the development of a device called Universal Hybrid Charger (UHC) that can charge multiple gadgets. As energy continues to become important, the device provides practical and stable schemes for daily electricity consumption.**

UHC is designed to charge multiple secondary batteries independently. Every bank attached to each battery is polarity protected, current limited, and programmable to charge deep cycle, wet cells, starting batteries, and even all types of secondary batteries. This power supply tends to remain efficient even at high load.

The primary function of a power supply is to convert one form of electrical energy to another. However, a common problem is overload usage due to numerous and simultaneous demands of electricity for devices. Hence, the development of charging prototype helps address this problem unlike the use of other power supplies that is commonly limited to one device. Test results indicate that UHC can charge 50pcs. or more different devices simultaneously with a current amount of 0.5mA to 40 Amperes.

Keyword – Charger, Power Supply, Mobile Devices

I. INTRODUCTION

Technology has remarkably improved the quality of life and has brought an undeniable ease in the present way of living. It also has provided a vast number of opportunities for achievements and studies which are beneficial to bolster our quickly growing needs.

With this, ***the researcher has collaboratively come up with a substantial study to help the gadgets and technology users to enhance and modernize the current power supplies to perform multi-tasking and a much suitable device.*** As energy continues to become important, ***this study helps to provide practical schemes which are applicable to everyday life scenarios through the use of the Universal Hybrid Charger (UHC).***

The Universal Hybrid Charger (UHC) is designed to charge multiple batteries independently. Every bank attached to each battery is polarity protected, current limited and programmable to charge deep cycle, wet cells, starting batteries and even all types of secondary batteries. This power supply tends to remain efficient even at high load.

The primary function of a power supply is to convert one form of electrical energy to another. Direct Current (DC) to Alternating Current (AC) or alternating current (AC) to direct current (DC) , and direct current (DC) to direct current (DC) conversions flow of electricity.

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With the use of; step up or step down transformers and even microcontrollers (IC). However, most of the times the common problems of power supply are the overloaded usage due to the numerous demands of electricity for devices at the same time. Hence, this prototype helps address the issue. Unlike, other power supplies which you can use with a limited number of devices. ***The Universal Hybrid Charger (UHC) can hold 50pcs or more different devices with a current amount of 0.5mA to 40 Amperes.***

II. OBJECTIVE OF THE STUDY

The general objective of this study is to develop a Universal Hybrid Charger (UHC) for the Students and Faculty of Bulacan State University Meneses Campus that can be used as charger for different devices such as cellular phones, netbook computer, tablets, Personal Digital Assistant (PDA's) devices and other portable gadgets and it can be a tool as electricity outlet for any kinds of appliances.

III. SPECIFIC OBJECTIVES

The prototype aims specific objectives will be considered as follows;

1. To design and develop significant features such as:
1. Can charge Personal Digital Assistant (PDA's) devices;
   a. 1.5-3.3vdc for 10pcs of AAA/AA Battery at 15 Amperes
   b. 5vdc for 50pcs of Cell phones or any other Personal Digital Assistant (PDA's) devices with input current of 40 Ampere;
   c. 15-25 vdc/vac for 3pcs of net book laptops at 8Amperes;
   d. 6-12vdc for 2pcs of car/motor batteries at 8Amperes;
   e. 9vdc for 3pcs Guitar batteries and Others at 5 amperes;
   f. 220vac for 3pcs of any kinds of Appliances;
   g. 110vac for 3pcs of any kinds of Appliances
2. Maximum speed of charging;
3. To lessen the use of chargers;

2. To determine the level of acceptability of the prototype upon completion of its specific function and features in terms of the following criteria;

- Functionality;
- Reliability;
- Usability;
- Maintainability;
- Workability; and
- Safety;

IV. SIGNIFICANCE OF THE STUDY

End-Users, this prototype helps to provide a universal charger to those places that experiencing a total block out, by means of generator. They can use this prototype to charge or

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supply their appliances or devices to be used in emergency purposes; a vast number of devices at a particular time.

School, this prototype helps to decrease the immerse number of fire problems because of the overloaded usage of electricity. It can also help the school administrators to introduce new ideas in developing a new technology.

Students, this prototype surely helps the students for learning and communications. Now a day's computers, laptops, and cell phones are one of the commonly used gadgets in our society, therefore this prototype can be used to charge different types of PDA devices at the same time.

Faculty, this prototype can help teachers to charge their PDA's devices and they don't need to bring any outlet-extension or use multiple chargers because it can charge up to 50 or more different devices without overloading.

Establishments, The prototype can help the company to introduce new ideas in developing a new technology.

Future Researcher, The study will benefit future researcher and programmers who would like to conduct further investigation and analysis regarding this study. In case of the programmers, they can employ and analyse the study for their own system's benefit. This can provide pertinent facts and ideas that are conducive to the development of their own research study.

V. Scope Of The Study

In order to lessen the usage of energy consumption or the output power, by actual observation it is commonly wasted by overcharging or letting the outlet still plug-in. ***With this new and latest kind of technology, you can monitor or maintain the usage of your current flowing into your power supply because it is digital.*** The researcher uses an LCD Display for monitoring the voltages of the different chargers. It has Automatic Voltage Regulator with analog display for 220vac and 110vac, It has Gizduino micro-controller to read the output voltage and for the timer countdown. It has a USB hub outlet for cell phone and other personal digital assistant (PDA's) device connectors; it has circuit breaker for unexpected circuit breakdown, and high powered and constant power supply to supply the whole circuit.

Furthermore, ***The Universal Hybrid Charger is faster and safer to use as it will automatically stop or cut the flow of electricity once the device is fully charged.*** It also has 1-12 vdc, 15-25 vdc/vac and 110-220 vac at fast charged, with the speed of electricity or the amount of current that possibly burst at charging time, ***possible current output from 0.5 mA minimum to 40 amperes maximum speed of current burst.***

VI. Limitation Of The Study

1. The system cannot be used without electricity;
2. The system cannot support the supply of power in the device in case of an emergency blackout;
3. The device can only charge (50pcs.) Personal Data Assistant (PDA's),(10pcs.) AAA/AA Batteries, (3pcs.) net-book laptops; (2pcs.) car motor batteries; (3pcs.) 9V batteries and devices; (3pcs.) 220vac appliances; and (3pcs.) 110vac appliances;

VII. Theoretical Framework

Relevant Theories

According to Aristotle, the response that a circuit has before settling into its steady-state response is known as the transient response. Using Euler's formula, complex numbers, phasors and the s-plane, a homogeneous solution technique is developed that captures the transient response by assuming the final state has no energy. In addition, a particular solution technique is developed that finds the final energy state. Added together, they predict the circuit response.

According to Coulombs, it is important to understand that this concept of "charge" is associated with static electricity. Charge, as a concept, has a physical boundary that is related to counting a group of electrons. "Flowing" electricity is an entirely different situation. "Charge" and electrons separate. Charge moves at the speed of light while electrons move at the speed of 1 meter/hour. Thus in most circuit analysis, "charge" is an abstract concept unrelated to energy or an electron and more related to the flow of information.

Thevenin's Theorem Independent current sources can be turned into independent voltage sources, and vice-versa, by methods called "Source Transformations." These transformations are useful for solving circuits.

Norton's Theorem

The output voltage, v, of a Thevenin equivalent circuit can be expressed as

$$v = v_s + iR_s$$

When rearrange for the output current, i:

$$i = -\frac{v_s}{R_s} + \frac{v}{R_s}$$

Fig.1: This is a KCL description of the following circuit. The constant term v_s/R_s the source current, i_s.

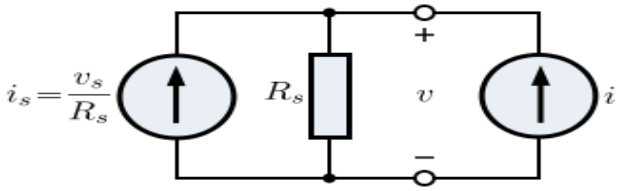

Fig.1: Kirchhoff Voltage Law

The equivalent current source and the equivalent resistance can be found with an independent source as before.

When the above circuit (the Norton Equivalent Circuit, after Bell Labs engineer E.L. Norton) is disconnected from the external load, the current from the source all flows through the resistor, producing the requisite voltage across the terminals. Also, two terminals of the circuit were to be shorted, the current would all flow through the wire, and none of it would flow through the resistor (current divider rule). In this way, the circuit would produce the short-circuit current i_{sc} (which is exactly the same as the source current i_s).

VIII. Project Methodology

Development of the Project

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This study focused on the design and development of a "Universal Hybrid Charger (UHC)".

To design the said project, the researcher uses Rapid Prototyping Model as a guide in the analysis, design and implementation of the project.

Planning Stage. The planning stage is the most crucial step in development and maintenance of the project. During this phase, the researcher should review the budget and revise with any new information and expand it to include more details. This stage requires study and analysis, when you are generating ideas and forming a question that may lead to system development activities.

The researcher describes the coverage of the project, dissertation process, creating a work plan, setting goals, and work productively during the many stages of the dissertation. As your project evolves, assess and renegotiate your work plan as necessary.

Analysis Stage. Defines the requirements of the system to establish an understanding of the application domain and to capture, formalize, analyse, and validate the user requirements of the system to be built.

The requirement document may be expressed in a formal language based on the mathematical logic. The requirement document does not specify the architectural or implementation details, but specifies the information and higher level of description.

Design Stage. The objective of this phase is to design a solution system. This phase need to decide what you are doing, and why you are doing it. Whether you are writing a proposal or an introduction it should start with a rationale and defined clearly in goals. The researcher collected the information and analyse the design to accomplish the project. And after gathering the data needed, the design will come out.

Development Activities in the Design Stage

The researcher gathered all the information to create an idea on how to design the Universal Hybrid Charger (UHC). After collecting and reviewing all the gathered data, the researcher started to design the proposed project. The researcher chose the Rapid Prototyping Model as the project methodology. At this stage the researcher designed the system, estimates the cost of the project and chose the hardware and software that already used on building stage.

System Function

The Universal Hybrid Charger (UHC) is a device used to put energy into a secondary cell or rechargeable battery by forcing an electric current through it. The researcher' aims to develop the Universal Hybrid Charger (UHC) that can be used for different devices like cell phones, laptops, tablets, PSPs, and other portable gadgets like Personal Data Assistant (PDA's), appliances and car/motor batteries. ***The Universal Hybrid Charger (UHC) have different voltages for each devices, it also have timer for the users to limit the charging time of their Devices. The LCD will also play as voltage monitoring. This device has a USB hub outlet port for PDA's devices and it can minimize the consumption of electricity. It has three security features; 1.) A plenty number of fuses installed individually for each current burst, 2.) It has high powered circuit breaker and lastly the program of this device has the capability to automatically cut the electricity flowing thru it with designed timer.***

Figure 2: Discussed the flow of electricity within the prototype

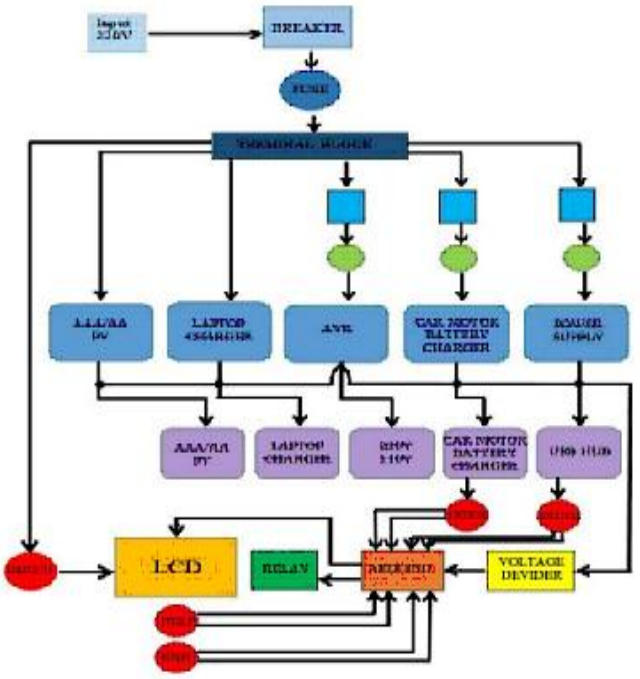

Fig.2: Block Diagram

Fig.3: Shows the pictorial view and it indicates the capability of the prototype to charge multiple devices

Fig.3: Pictorial View

Fig. 4: Conceptual Framework of the study. It uses (IPO Method) Input Process Output Method

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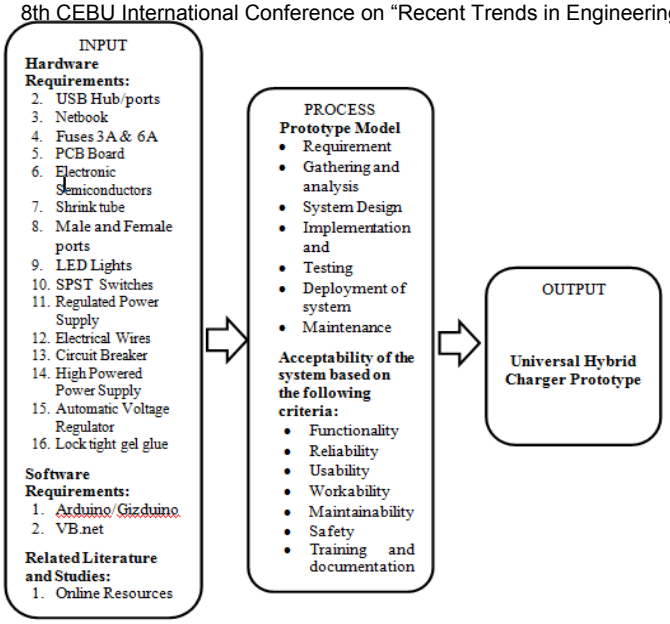

Fig. 4 Conceptual Framework

Presentation of Findings

The researcher used Likert Scale to determine the level of acceptability of the developed project through the weighted arithmetic means. According to Rensis Likert, scaling method is measuring either positive or negative response to a statement. It is the most widely used approach to scaling responses in survey research, when responding to a Likert questionnaire item; respondents specify their level of agreement or disagreements statements.

The weighted arithmetic mean was used to determine the average response for each criterion of 5 option for each item in questionnaire, *(5) Acceptable (4) Slightly Acceptable (3) Neutral (2) Slightly Unacceptable and (1) Unacceptable*

To compute the mean, the responses to the individual questions were tabulated. The data were summarized in the form of frequency and percentage distribution.

Forty (40) students from Bulacan State University-Meneses Campus and Ten (10) IT experts, IT Programmers, Doctor of Science, Doctor of Engineering and Electrical Engineer were also asked to evaluate the developed prototype. Responses from the proposed clients were also considered by asking them to evaluate the system.

Table 1: Surveyed Individual from Bulacan State University Meneses Campus Students and other Professionals.

TABLE 1: SURVEYED INDIVIDUALS AND PROFESSIONALS

Items	Frequency (N)	Percentage (%)
Students of BSU Meneses Campus	40	80
IT experts, IT Programmers, Doctor of Science, Doctor of Engineering and Electrical Engineer	10	20
Total Percentage	50	100%

TABLE II: TOTAL SUMMARY OF EVALUATION FOR THE OVERALL ACCEPTABILITY OF THE PROTOTYPE

Criteria	Mean	Verbal Description and Written Survey
Functionality	4.42	Slightly Acceptable
Reliability	4.15	Slightly Acceptable
Usability	4.3	Slightly Acceptable
Maintainability	4.25	Slightly Acceptable
Portability	4.13	Slightly Acceptable
Workability	4.28	Slightly Acceptable
Safety	4.08	Slightly Acceptable
Training and Documentation	4.33	Slightly Acceptable
Grand Mean	4.24	Slightly Acceptable

Table 2: Interpretation of data using Likert scale *Acceptable (4.60 – 5.00); Slightly Acceptable (3.60 – 4.59); Neutral (2.60 – 3.59); Slightly Unacceptable (1.60 – 2.59); Unacceptable (1.0 – 1.59)*

Table 3: Total cost for each charger when individually sold on the market

TABLE III: INDIVIDUAL COSTING

ITEMS	QUANTITY	AMOUNT/PC.	TOTAL
LAPTOP CHARGER	3	1500	4500
CELL PHONE CHARGER	50	300	15000
CARD READER	1	50	50
USB HUB	4	80	320
ELECTRIC GUITAR ADAPTOR	3	1000	3000
MOTOR AND CAR CHARGER	3	1500	4500
AA/AAA BATTERY CHARGER	1	2500	2500
TOTAL			**PHP. 29,870**

Table 4: Electricity Consumption of the Whole Device when powered ON

TABLE IV: ELECTRICITY CONSUMPTION

	Day	Month	Year
1 Hr.	Php 4	Php 115	Php 1,401
8 Hrs.	Day	Month	Year
	Php 31	Php 922	Php 11,213
16 Hrs.	Day	Month	Year
	Php 61.44	Php 1,843.2	Php 22,4256
24 Hrs.	Day	Month	Year
	Php 92.2	Php 2,764	Php 33, 638
1 Month	Week	Month	Year
	Php 645.12	Php 19,353.6	Php 235, 469
1 year		Month	Year
		Php 85,708.8	Php 104,279

IX. CONCLUSIONS

1. This project used Gizduino Microcontroller and a program/software as a controller that reads the input and output voltages of the Universal Hybrid Charger (UHC).
2. Users of gadgets can greatly benefit from using the project.
3. The developed project has functionalities like; can charge a plenty number of different devices and it can supply 110 vac and 220 vac for appliances, can use without overloading. Since this project used fuses, that will be the first one to be busted when an unexpected circuit problem

comes, the users won't have to worry about their devices or appliances because it's safe and secured.

4. The project was evaluated by IT experts, IT Programmers, Doctor of Science, Doctor of Engineering and Electrical Engineer, Bulacan State University Faculty Members and Students, which have the overall means of 4.24, which is Slightly Acceptable for the respondents.
5. A high powered IC, advance micro controller and transformer are suitable in making the Universal Hybrid Charger (UHC)

X. RECOMMENDATIONS

1. Training for the administrative staff and faculty should follow in order for them to be familiar and accustomed to the hardware.
2. To the Future Researcher, they are advised to change the switch's (Pushbutton/Rotary Switch) to a microcontrollers/ IC that has a capacity to store program and data.
3. Use a mechanical system for the cable of each charger
4. Installed a high powered power bank

XI. OPERATING PROCEDURE

1. Check the voltage output of the prototype.
   - If the output voltage is of the same value as the desired output, proceed to the next step.
   - If the output voltage is not yet set ,set the voltage output to the desired output
2. Check the voltage source (AC source or DC source).
3. Plug the prototype to the electricity outlet.
4. Choose or pick the correct size of the connection plug that fits the device.
5. Charge the device.
6. Wait for the device to be fully charged.

XII. MAINTENANCE

1. The Hybrid Charger for Multiple E-Gadgets should be stored in a secure place. It should not be kept near an AC or Room heater. Too much hotness and coldness can reduce the functionality of the charger.
2. The charger should be continuously used until the device becomes fully charged. The charger should be removed from the device and electric board.

XIII. SAFETY AND CONTROL MEASURE

1. A charger should never be used near a stove, oven or open flame.
2. When plugging a charger in or removing it from the outlet, a user should firmly greet the charger's plug.
3. Never remove a charger's plug by yanking on it while holding the cord because the plug's blades can be damaged and broken entirely.
4. The Hybrid Charger for Multiple E-Gadgets is highly vulnerable to water, so it should never be used in a sink or tub.

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