UAV STORAGE DEVICES CIRCUITRY INTEGRATION WITH ELECTRICAL POWER GENERATION SYSTEM

[1]Waleed A. Oraibi, [2]Abadal-Salam T. Hussain, [3]F. Malek,[4]Ahmed K. Abbas

[1,2,3,4] School of Electrical System EngineeringCenter of Excellence for Renewable Energy (CERE),University Malaysia Perlis (UniMAP), Campus UnimapPauh Putra, 02600 Arau, Perlis, MALAYSIA

ABSTRACT

The integration of renewable energy resources with a UAV storage device is an important part for energy challenges that the world is facing now a days. With rapid investigation and development of electric energy storage devices in the world there is a growing interest to integrating both electrical energy storage devices and renewable energy resources into an integrated power system to improve their reliability and economy. This paper describes a hybrid battery charging system also describe the charging process with time for therechargeable battery. The design and implemented in this paper paves way to effectively and efficiently co-ordinate the utilization of renewable energy supply to charge a battery and reduce the charging time for the battery. Here The charging circuit that used to integrate the renewable energy resources with the electrical storage device system is based on the electronic amplifier and this is works based on comparator IC1 (LM741)to monitor the battery voltage level, also it can cut the charging current when the battery is charged full. This is based on comparing the battery voltage with another fixed potential. When the battery voltage is reached to a limit level during the charging process. Therefore, the comparator output is able to pass the currentto the relay and cutoff the charging voltage of the circuit. When the battery voltage become at certain level that is selected by variable resistance, the relay is connected in response to the comparator and charging the battery.

Keywords: Integration Renewable Energy, Storage Devices, Nicad and Nimh Batteries

I. INTRODUCTION

The wind speed is not stable and varies on several time scales due to movement of air masses and numerous meteorological phenomena or solar energy effected by the movement of the clouds. These variations of the wind speed and solar rays effect on the continuously and consistency of generated power which causes power quality concerns when wind energy and solar energy is integrated into the energy storage systems[1]. Residential backup battery systems serve as an alternate power source for the load where storage system plays a vital role. These storage systems need a minimum of two hours of uninterrupted power supply from the utility grid for charging. As this is a rare possibility, renewable energy is used to charge these systems. Existing methods are based on charging systems which use renewable energy supply as a source [2].

This paper describes a hybrid battery charging system. The design implemented in this paper paves way to effectively and efficiently co-ordinate the utilization of renewable energy supply to charge a battery and reduce the charging time for the battery.

II. PREVIOUS WORK

Koutroulis,E. and Kalaitzakis, K. implemented a battery- charging system that is suited for stand-alone solar PV systems [3]. This design works on Maximum Power Point Tracking algorithm and a control algorithm that is based on system operating parameters: battery voltage thresholds and current levels. The charging time, when only solar power is used, is considerably long. HishamMahmood, Dennis Michaelson, and Jin Jiang designed and implemented a hybrid system which uses a bidirectional converter to use a battery as a backup support when power for solar PV is insufficient [4]. It also charges the battery when there is excess power from solar PV. Considering the intermittency in power supply in India, a hybrid design is necessary to facilitate the battery to charge either from the grid supply or solar PV.

III. REVIEW OF STORAGE TECHNOLOGIES

The technologies broad portfolio have been designed with the storage devices systems such as "pumped hydro, compressed air energy storage, a large family of batteries, flywheels, and superconducting magnetic energy storage". The own characteristic and properties of each device drive it to work ideal and suitable with the load application service. This ability of a storage device systems to identify the performance of the grid requirements also it is allow the same storage system to provide several services. This gives storage devices systems a greater degree of ideal operational flexibility and reliability that it cannot be matched by other sources, such as internal combustion turbines or gas diesel generators. The storage system devices is able to meet the some requirements also able to make feasible catching on more than one value, when its investment is possible to justify. While the classification of the early detect stage, and deployed demonstrated some time is not understand and changed over time, Figure (3) some technologies is based on the maturity percentage degree[5].

IV. RE-CHARGER CONTROLLER CIRCUITRY

The common (9) rechargeablebatteries (NiCad and NiMh batteries) charging time control, here the timer has been taken longer time because it can be charged with lower current rate 0f 0.1C, where(C) is the Capacity of the battery, or 1/10C (mAhr = charging time) oftheir mA capacity. The values is seldom between 30mA to 100mA and this variation is depended on the 9V capacity in mAh of the battery. this situation of the batteries stay great to put up with considering that non rechargeable 9V battery cost leg and arm .here this is done to meet avery low charging current to save the batteries lifetime , same the batteries portable phone pack this is docked in its base Station. The mostCommon abbreviations – symbols – prefixes nickel-metal hydride (cell) – NiMHand nickel-cadmium battery (cells) – NiCad. All of these batteries have 9V.

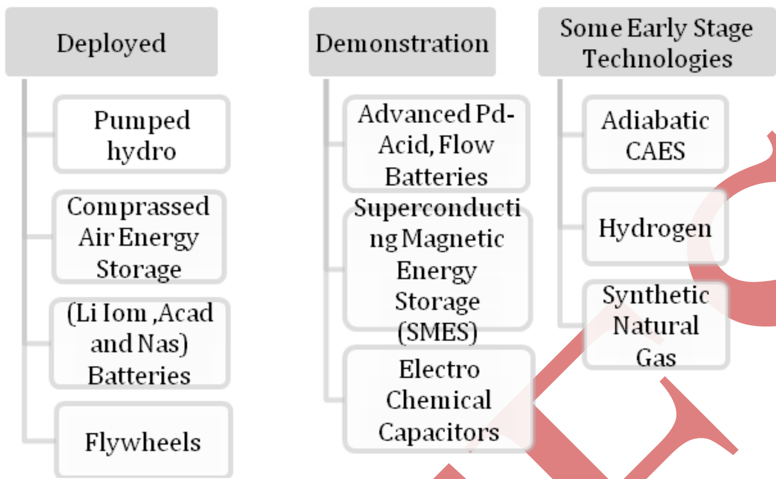


Figure (3) Maturity of Electricity Storage Technologies

Lead-Acid is similar the NiCad batteries and this batteries is ideal same like (LA,) batteries [6].All these batteries consist of (nickel hydroxide) is a positive electrode and (metallic cadmium) is a negativeelectrode. Each electrode is separated by divider (nylon) and electrolyte (aqueouspotassium hydroxide,). If the Nickel ox hydroxide reacting with water during the discharge process, a hydroxide ion and nickel hydroxide is produced from this process. And the cadmium hydroxide has been produced at the negativeelectrode. When the battery still on charging the battery process is reflected .All the NiCad batteries can be operation in higher temperature range compare with the lead-Acid (LA). When the NiCad batteries discharge have small depth during the operation, therefore more cycles are able to achieve [7].the charging circuit that used for charging the battery is show in figure (2) the circuit here is based on the Amplifier that used to compare the battery voltage with the another fixed potential and this voltage is not effected by the source voltage and battery voltage but it’s selected by Ziner Diode.

For calculating manually the time process for the charging time in hours is:

(Charging time process) equals to 12 x Ahr = hrs

or12/1000 x mAh= X hrs

(12/1000 x mAh = hours of charging timeprocess).

So the formula basic of the charging time process is:

Battery charging time = battery capacity/ charger output charging current [8].

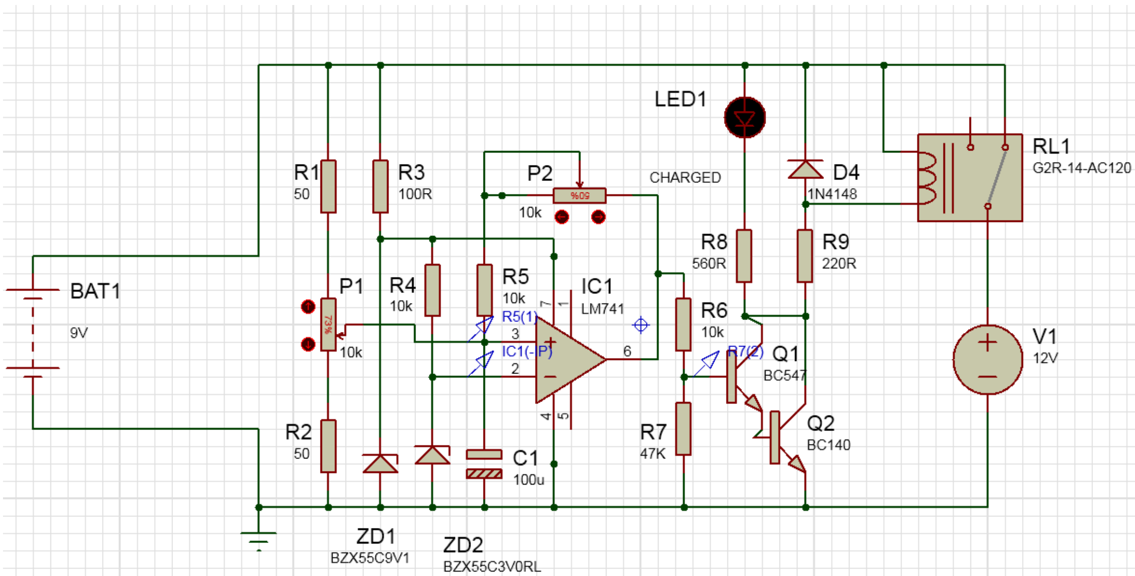


Figure (2) Simulation Circuit

V. APPLICTION AND RESULT

The circuit idea based onan electronic component worksis added on monitoring the battery situation also it can be cut the charging current when the battery charging is completed. This component is called Amplifier and its type is IC1 (LM741) that is connected in the circuit as comparator. Which is compare the battery potential that connected to the circuit with another fixed potential. When the battery potential is reached to limit level during the charging process. Therefore, the comparator output is able to connect the relay RL and cutoff the charging current of the circuit. When the battery voltage become at certain level that is selected by variable resistance, the comparator will be connected the relay and pass the charging current to the battery.

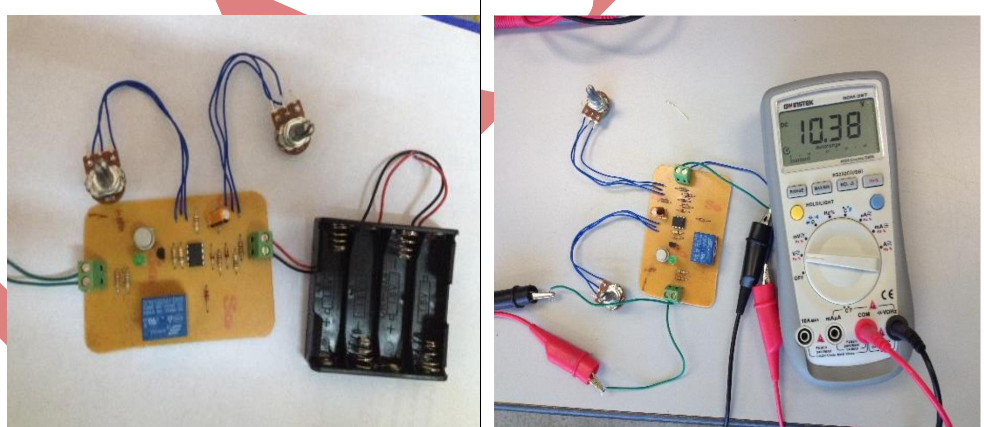
The comparator is supplied by fixed potential by R3 and ZD (9.1V), so it's not affected by any changes in the potential source. The voltage reactionary is connected to the reflect part of the comparator by R4, ZD (3.0V) and this potential is comparable with the battery potential that is needed to charge.

To protect the battery from the conducting current again when the potential is decreased to selected level. This voltage drop is resulted from the leakage current and not affected on the battery. This process is covered by connect apart from the Amplifier(not reflected part)to resistance and another variable resistance as reflected voltage from the voltage source as show in the results below .

Battery Voltage	Not Reflected Comparator Voltage	Reflected Comparator Voltage	Transistor Gate Voltage	Battery Statues
9V	3.06247V	2.94704V	1.50884V	Full battery
8.9V	3.02699V	2.94655V	1.50690V	Full battery
8.8V	2.99096V	2.94605V	1.50488V	Full battery
8.7V	2.95013V	2.94554V	1.50237V	Full battery
8.6V	2.18451V	2.94542V	0.81138V	Not full*
8.5V	2.16053V	2.94490V	0.81116V	Not full*

(*) It is means the battery still in active charging.

The implementation of the circuit that mention above in the figure (2) is done as show in figure (3) below. During the test the capacity and battery charging time have been recorded. The battery voltage level is selected the time required to charge the battery fully or 90% of the battery voltage according to the variable resistance that explain its work above. So the results showed the charging time is depended on the battery internal impedance and also on the type of the batteries.



a) Circuit Implementation | b) Circuit in Operation

Figure (2) Implementation of the Charging Circuit

VI. ACKNOWLEDGEMENT

I would like to express my gratitude to my research supervisor, Dr. ABADAL-SALAM T. HUSSAIN, for giving me the opportunity to do research and providing.I would like to express my gratitude for Prof. F. MALEK, dean, School of electrical system Engineering, university Malaysia Perlis (UniMAP)

VII. CONCLUSION

The renewable energy resources and energy storage devices have been integrated with the reliability and the process battery charging time of the system are evaluated in this paper. Proposed reliability and battery charging time have been applied to evaluate the electric energy storage and renewable energy resource integration and the discharge of the batteries that is resulted from the leakage current. The result of case studies explain the benefits of the operation strategies and produce insights explain how electric energy storage capacity of the battery, limited power capacity impact on the reliability and battery charging time.

REFERENCES

[1] "Ackermann T., Garner K. and Gardiner A".,"***(1999) Embedded wind generation in weak grids - economic optimization and power quality simulation,"****.Renewable Energy 18*, 205-221.

[2] "E.Lorenzo,L.Narvarte,K.Preiser,R.Zilles,,"***Afield experience with automotive batteries in shs's,.***", "*Proceeding of the 2nd World Conference and Exhibition on Photovoltaic Solar Energy Conversion, Vienna, pp. 3266-3268, 1998".*

[3] Koutroulis, E. and Kalaitzakis, K.. ,"***Novel battery charging regulation system for photovoltaic applications,***" "*Electric Power Applications, TEE Proceedings -, voU5 1, no.2, pp .191, 19 7, Mar 2004".*

[4] "HishamMahmood, Dennis Michaelson and Jin Jiang,," "***Control Strategy for a Standalone PV/Battery Hybrid System***", *38th Annual Conference of the IEEE Industrial Electronics Society (IECON 2012), Montreal, PQ, 25-28 October 2012,.*

[5] Vogstad K.-O.,"***(1997) Energy resource planning - A systems engineering approach. Master Thesis",***."*Norwegian University of Science and Technology, Trondheim, Norway.energy.gov"*

[6] Ervin Spahic, GerdBalzer, Britta Hellmich and Wolfram Münch,*"**WindEnergyStorages – Possibilities**", 2007.*

[7] Adolfo Gonzalez,, Brian Ó Gallachóir, EamonMcKeogh, "***Study ofelectricity storage technologies and their potential to address wind energyintermittency in Ireland***",,, *2004.*

[8] "A Study by the DOE Energy Storage Systems Program., Sandia report"*"**Characteristics and Technologies for Long vs. Short-Term Energy Storage.**", 2001,.*