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A NOVEL CHARGE CONTROLLER FOR OFF GRID SMALL WIND MACHINE USING PWM TECHNIQUE

Ms.Priyanka P. Alawekar, Prof. U.L.Bombale, Prof. N.N.Shinde

Abstract:-. Wind is the most promising renewable source. However its erratic behavior hampers the output especially when the energy generated is to be stored safely and used as per demands. The paper revel the charging battery with maximum power point tracking (MPPT) considering battery safety. The main task of wind power charge controller is to control the flow of charge to and from the battery and protect it from over charging and deep discharging. It regulates flow of charge by monitoring the battery voltage and wind variations continuously. The charge controller developed takes care of ,weak winds while battery charging and improves the efficiency. Upon fully charging the charge controller disconnects the battery from wind panel to avoid excess charging thus the battery life is increased. Further the performance of the wind charge controller is evaluated

Key words - Battery safety, charge controller, Maximum power tracking, Off-grid small Wind mill.

1 INTRODUCTION:-

A charge controller is an essential part of nearly all power systems that charge batteries. Its purpose is to keep the battery properly fed and safe for long time. Charge controller is a circuit that connects the battery load to the input supply whenever the battery backup is discharged and it disconnects the battery from turbine as soon as battery gets fully charged.

The existing charge controllers are based on analog electronic components like operational amplifiers to amplify the input electrical signal, transistors which are used as switch, silicon controlled rectifiers which passes high current through them and MOSFETs which acts as electronic switch at high current..However the input available power is not tracked and the conversion efficiencies are low. They do not contain intelligent IC's on board. If charge controller circuitry get designed around microcontrollers then many facilities like LCD displays can be added to display the current status of charge held by the battery. The charge conversion efficiency also can be increased .The effort is made to develop such charge controller using MPPT /PWM techniques.

2 SYSTEM ARCHITECTURE

The basic blocks of the wind power charge controller system analyzed here are shown in Fig.1. Since the wind mill power fluctuates with wind velocity, the generator output voltage varies continuously. The dc voltage is then regulated to obtain constant voltage by controlling the duty cycle ratio of a DC to DC converter.

The suitable battery bank of 12V/24V/48V is to be connected at charge controller output. The proposed system will switch off the supply from wind station on complete charging of battery and again switch ON the supply on discharging below certain minimum voltage level to avoid battery from over charging and deep charging respectively.

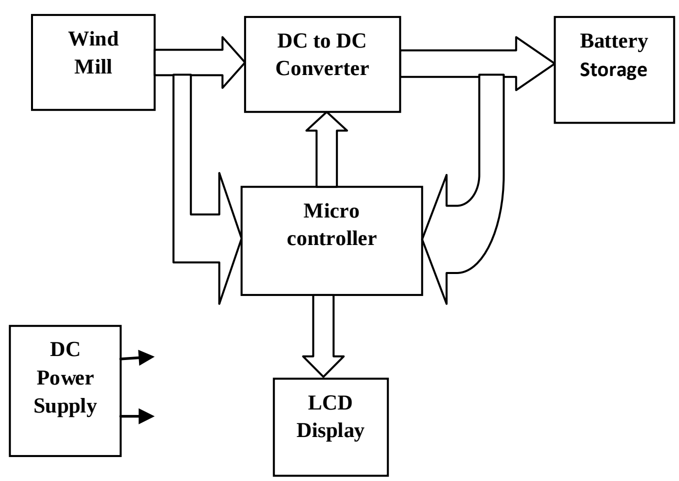

Figure 1: Block diagram of wind power charge controller

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The system is microcontroller based which shall provide accurate results depending upon input variation; it will be user friendly system with LCD display on board.

3 SYSTEM DESIGN

3.1 DC to DC converter

Circuit diagram of DC to DC converter is shown in Fig.2. The main components in a DC to DC converter are switching power MOSFET Q1, flywheel diodes D and filter capacitor C. As per the control signal provided by microcontroller, duty cycle of MOSFET Q1 is controlled. This allows the constant voltage which is given to battery for charging purpose.

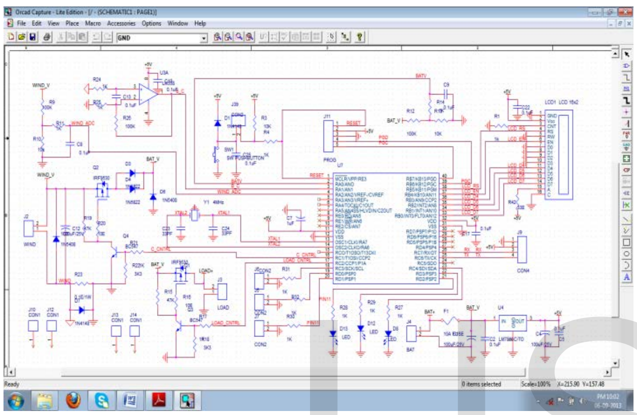

Figure 2: System Schematic Diagram

3.2 Microcontroller

Here PIC microcontroller is used which has in built ADC. Programming is done in Embedded C & MicroC compiler is used. Below Fig.3 shows Interfacing circuit Diagram of charging current, wind mill dc voltage and battery voltage detectors & LCD with PIC microcontroller.

Wind mill DC output and battery DC output is applied to microcontroller. It compares these voltage signals and generates a controlling signal, which is providing to DC to DC converter. Then variable input voltage converted into fixed DC and provides it for charging purpose of battery, as per control signal provided by micro controller. The purpose is to feed constant voltage supply to battery. Then display the charging current and voltages of battery and wind mill.

In the section of DC-DC converter, charge flow to ward battery is controlled by switching MOSFET. Input to MOSFET is taken from wind mill that is in DC form and output is given to battery for charging purpose. This switching signal is provided by PIC microcontroller in the form of PWM signal. So that depending upon duty cycle MOSFET switch is on or off for that duration only.

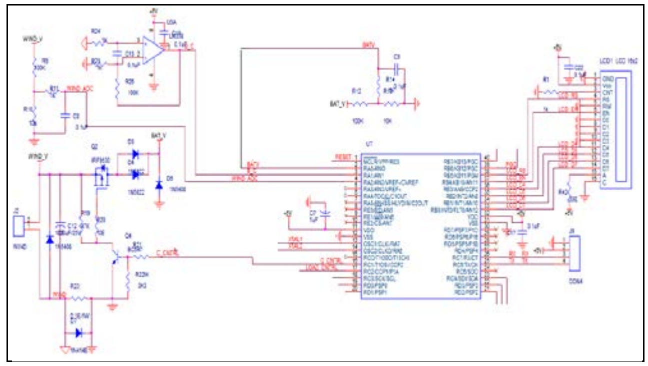

Figure 3: Interfacing circuit Diagram

3.3 Charging current detection of circuitry-

In this section of charge controller circuitry charging current detection of battery takes place. When current flowing through current detector resistor, voltage drop is developed across it. That voltage is given to input of op-amp LM358 as shown in fig.3. Here, it works as I to V converter. Then it provides respective voltage signal to PIC microcontroller. This signal is then used for further operation.

3.4 Voltage detection of wind mill and battery circuitry

The use of voltage divider network is must. Here we use simple resistive voltage divider network. Its output is given to microcontroller for wind mill voltage detection and for battery voltage detection. These voltages are then used for further operation.

3.5 LCD Display

Recently, number of projects uses intelligent L.C.D. modules. Their ability to display not just numbers, but also letter, words & all manner of symbols makes them a good deal more versatile than the familiar 7-segment light emitting diode (L.E.D) displays.

Character based LCD's are still used extensively in Commercial and industrial equipment. There is wide variety of shape & size available. Line lengths of 8, 16, 20, 24, 32 & 40 characters are all standard, in 1, 2 & 4-line versions.

3.6 DC power supply:-

Microcontroller & other I/O peripherals require 5V dc. Here battery output is used to give DC supply to IC7805 voltage regulator for output voltage is 5V dc. It has voltage drop about 1.5V between input & output pin, because this project is designed for off-grid. Its output is given to microcontroller as well as to other IC's like LM358 Operational Amplifiers, LCD etc.

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4 EXECUTION PROCESS

A typical execution of the program is illustrated in flow chart given in figure 4.

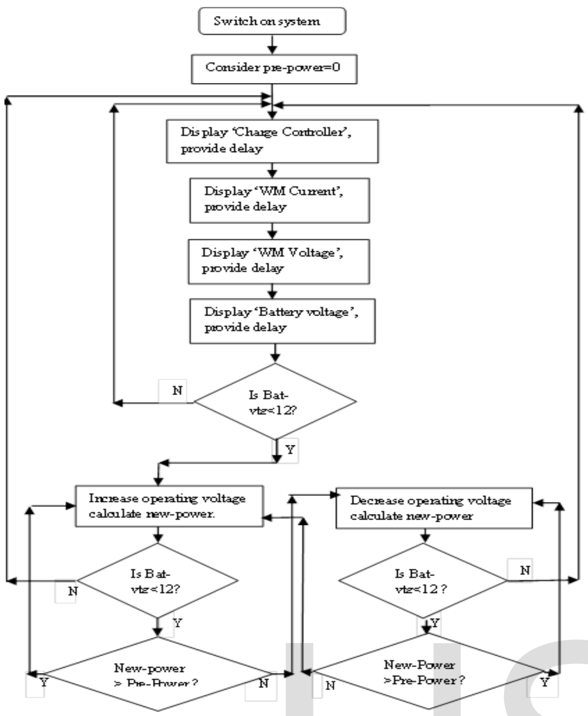

Figure 4: General flow chart.

5 HARDWARE LABORATORY SET-UP:-

A laboratory set up with variable speed drive is used for varying input conditions equivalent to real life small wind machines for testing of MPPT based charge controller .Fig 5 explains the test set up .The performance of the device is evaluated based on actual measurements of input /output conditions

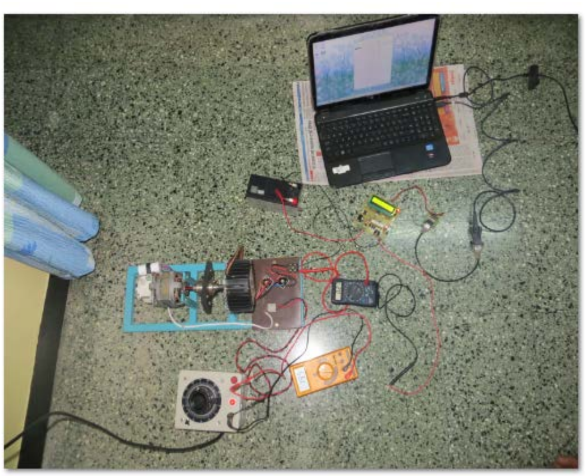

Figure 5: Laboratory testing setup

6 OBSERVATIONS AND RESULTS

A] OBSERVATION TABLE

RPM	A-Vdc	A-Idc	i/p-P	B-Vdc	B-Idc	o/p-P	H
1050	12.93	0.18	2.32	12.04	0.14	1.68	69
1053	12.93	0.19	2.45	12.09	0.13	1.57	63
1058	12.93	0.18	2.32	12.09	0.18	2.17	91
1059	12.99	0.19	2.46	12.15	0.18	2.18	87
1066	12.99	0.2	2.59	12.15	0.22	2.67	100
1069	12.88	0.22	2.83	12.2	0.21	2.56	89
1073	13.1	0.24	3.14	12.2	0.24	2.92	93
1078	13.15	0.26	3.41	12.25	0.25	3.06	88
1082	13.15	0.28	3.68	12.25	0.29	3.55	97
1084	13.21	0.3	3.96	12.31	0.3	3.69	92
1087	13.27	0.33	4.37	12.31	0.33	4.06	93
1091	13.27	0.35	4.64	12.36	0.35	4.32	100
1094	13.27	0.38	5.04	12.36	0.38	4.69	92
1095	13.1	0.4	5.24	12.41	0.41	5.08	96
1096	13.1	0.4	5.24	12.41	0.41	5.08	96
1097	13.1	0.42	5.50	12.41	0.44	5.46	98
Average							**91.6%**

B] GRAPHICAL REPRESENTATION OF RESULTS

1. RPM Vs Efficiency.

Shown in fig.6 ,RPM Vs Efficiency Graph, When Alternator speed is increases the alternator current is also increases means input power is increase respectively, with the help of charge control circuitry the efficiency of system is increase and maintain constant ,this is observed in graph.

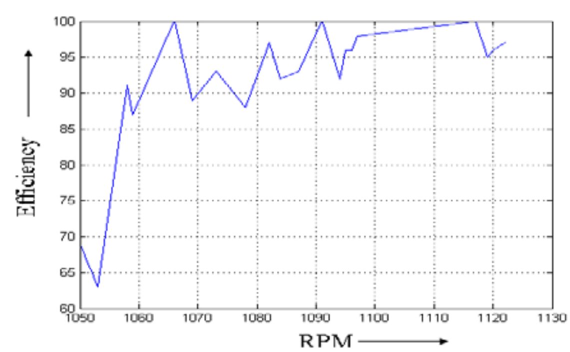

Figure 6: RPM Vs Efficiency Plot

2. Current Vs Efficiency:

Shown in below figure ,Plot of current Vs efficiency, when alternator current is increases means input power is increase to maintain efficiency at more than 90 % required increase output power proposal with input ,this is achived in this system ,so this effect observed in observation table as will as figure 7 and 8.

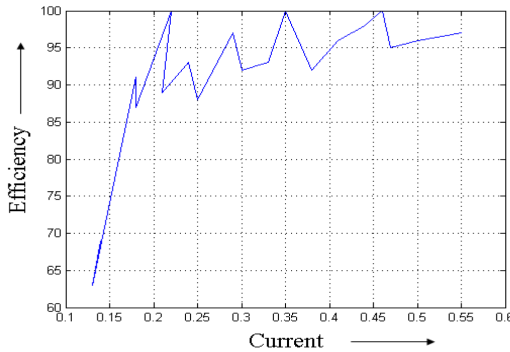

Figure 7: Current Vs Efficiency

3. Voltage Vs Current:

In the charging process of battery, when input current of battery is increases the potential of battery is also increases respectively, this effect I observed in below figure. is constant

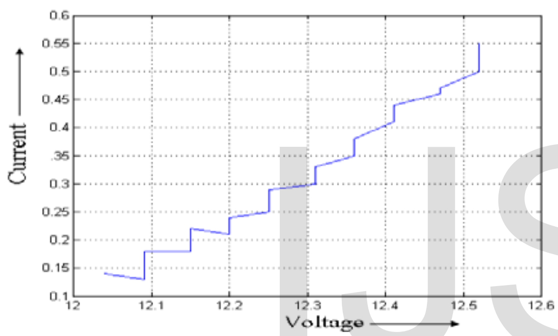

Figure 8 : Voltage Vs Current Plot

7 CONCLUSION:-

The PWM charge control technique presented in this project shows the assurance for charging the battery with the maximum power. Though the voltage of wind mill and the voltage of battery are different, the maximum power can be attained during battery charging from the wind mill through this technique. The voltages of the wind mill are different in different time and days. This depends on the wind speed. When the wind speed is maximum, alternators speed is high and wind speed is low, the speed of alternator is low .In that case, by increasing the pulse width, the battery is charged with maximum power. For this reason, the battery is charged quickly and efficiently.

Pulse charging has been successfully exploited in increasing the battery life while the dummy loads ensure the safety of the system and the longer the battery life. With an appropriate wind turbine, the system can meet the power requirements of any remote rural locations at a much cheaper rate than other grid powered solutions without compromising on service quality. With the help of PWM technique the efficiency of this system is increase upto 92 %.So this efficiency is increase 30-40 % as compared to conventional battery charger technique.

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AUTHORS

	**Ms.Priyanka P.Alawekar** His received B.E in Electronics in 2008 from D.Y.Patil, Kolhapur. And Pursuing M.Tech (Electronics) from the DOT, SU Kolhapur, under the guidance of Prof. Dr.U.L.Bombale .Currently she is working as a Asst Prof . In Sanjay Ghodawat Polytechnique, Atigre, Kolhapur (India). **Email-Priyualawekar@gmail.com** **Ph.No-+919975719973**
	**Prof.Dr.U.LBombale** Has received M.E in Electronics & Telecommunication in 1994 from COE, Pune, And PhD from the Dhirubhai Ambani Institute of Information & Communication Technology,(DA-IICT) Gandhinagar,Gujarat,India, under the guidance of Dr.S.B.Sharma. Currently he is working as a Prof. In Dept.of Technology, Shivaji university, Kolhapur (India). **Email-uttam_bombale@rediffmail.com** **Ph.No-+919049274380**
	**Prof.N.N.Shinde** Currently he is working as a Head & Prof. In Department of Energy Technology, Shivaji university, Kolhapur (India). **Email-energyunishivaji@gmail.com** **Ph.+919823587183,** **0231-2609225**