Smart Hybrid Charger Based on PIC Microcontroller

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Abstract:- This paper discusses a charge regulator with a PIC microcontroller integrating a solar panel with a low speed wind turbine that can be used as an alternate source of electrical energy that may be provided for domestic use. This hybrid system can increase the potency of the total system as compared to their stand alone operation. The projected hybrid system utilizes a microcontroller to affirm the best usage of assets and thus increment the overall potency, as contrasted with their standalone method of generation. The charge controller for this mixture framework system is presented here.

Keywords:- *Charge controller, PIC Controller, Solar, wind, pulse width modulation, Hybrid.*

I. INTRODUCTION

Global increase in energy requirement and reduction in non renewable energy has put up conditions for exploring newer, cleaner energy resources. In parallel to creating development; interest for more energy makes us to look for newer energy sources. The most vital application field of this inquiry is sustainable power source assets. Wind and sun based sources have being prominent ones due to their simplicity, accessibility and convertibility. This work covers study of a cross breed sustainable power source framework for a residential use, that keeps running on a microcontroller to use the solar insolation or wind control. Batteries in the framework are charged by either wind control by means of a little generator or sunlight based power by means of a solar Module.

II. PROPOSED SYSTEM

In this hybrid system the solar and wind voltages are constantly measured by a PIC controller and compared with a set voltage value. If the solar voltage is sufficient the controller turns ON relay1 and if wind voltage is higher the controller turns ON relay2. Based on which voltage is accessible, it's transformed into steady DC by a buck-boost converter. Fig. 1 shows the block diagram of the proposed hybrid system with battery. In this scheme, a solar panel of 2 Watts, 6 Volts rating is connected. Vertical pivot wind turbine blades are fixed with the turning shaft through a circle shaped plate and is coupled to generator. The DC generator creates a varying voltage in the range of 2 - 10 volts with a turning of 10 - 150 rpm of generator shaft. The battery voltage feedback is taken in order to prevent any battery overcharging.

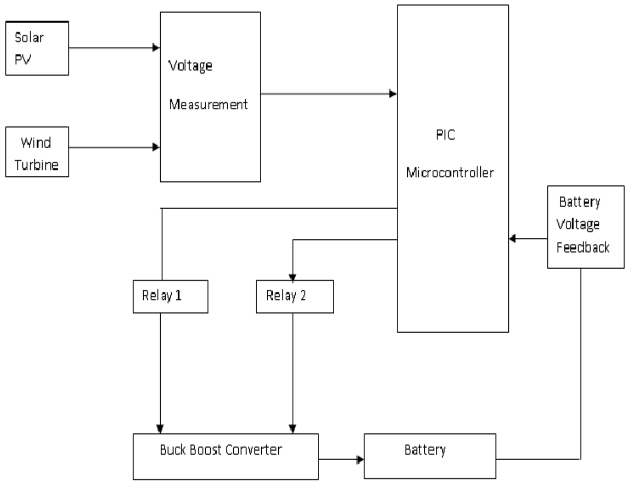

Fig 1:- Block Diagram for Proposed System

III. BATTERY CHARGE CONTROLLER

The essential capacity of charge controller is to restrain overcharging which generally will deteriorate battery performance or diminish its life expectancy. This can create a safeness hazard. It likewise shields battery life by avoiding deep discharging. The charge controller is placed admist the hybrid sources and the storage battery. It screens the battery voltage and if the battery voltage has achieved predetermined set value, it shows that the battery is packed and the controller forestalls surplus flow of charge into the battery. Apart from aforesaid functions today's charge controller can also perform in various capacities like - stopping reverse charge flow, disconnection during low voltages, displaying and energy measurements.

IV. HYBRID CHARGER CIRCUIT

The build-up of circuit for charge controller is interpreted below.

- Voltage Measurement to quantify the voltage across hybrid sources and battery, a voltage divider circuit is constructed. Fig. 2 depicts voltage divider circuit employed for measuring the voltage. The circuit for voltage divider is constructed in such a way that the max yield output voltage ought to be under 5V since analog input pins of PIC are confined to 5V. To detect the max voltage from the wind turbine, solar panel and battery, voltage should be decreased down to comparable voltage level lower than 5V so that it can be easily interfaced with the PIC controller.

Calculation of the output voltage according to the following voltage divider formula:

$$VOut= (V_{IN} \times R_2) / (R_1 + R_2)$$

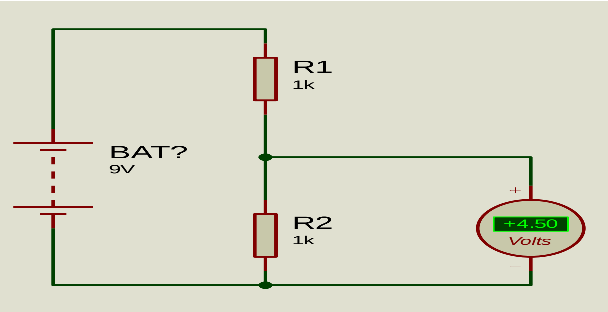

Fig 2:- Voltage divider for Proposed System

V_{IN} = input voltage, R1 = resistance of the first resistor, R2 = resistance of the second resistor, V_{out} is the output voltage. Here if we take input voltage from solar on a bright sunny day as 9Volts, then R1=1Kohm, R2=1kohm will give output voltage equal to 4.5V, well below the voltage rating of the PIC analog pins.

- *Selection of MOSFET*: Mosfets are needed for proper flow of power from the hybrid sources to the battery. There are certain important parameters vital in choosing the suitable MOSFET viz. P or N channel, Threshold voltage, drain current (I_d), drain-to-source voltage (V_{ds}) and losses during switching. Here N-Channel MOSFET (IRF540) is employed for power flow between the hybrid source and the storage battery.
- *PWM Signal Generation*: By regulating the duty ratio of MOSFET the output voltage could be regulated using PWM control of pulse generation. The PWM pulses are sent from the microcontroller according to the charging requirements.

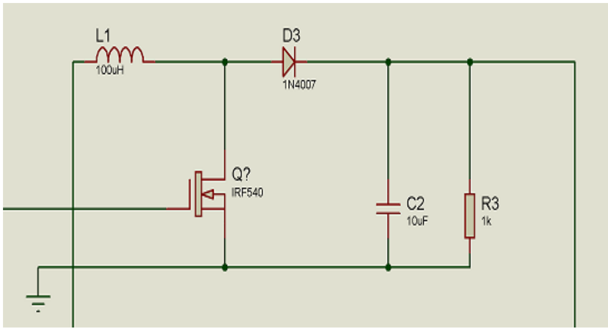

Fig 3:- PWM signal from PIC

- LCD Display to observe voltages of hybrid source and storage battery, a LCD with 16x2 characters is utilised.

Fig 4:- LCD display depicting solar voltage and PWM

V. WORKING OF HYBRID CHARGER

The microcontroller checks for the minimum set voltage for both the solar panel and the wind generator. This is accomplished by the voltage divider circuit Depending on which is present with the sufficient required quantity the respective relay gets energised thus enabling the power flow from switching of the MOSFET to the battery. The charge controller compares the solar or wind system voltage with battery voltage, if solar or wind system voltage is higher than the battery voltage, the controller will initiate dispatching the required gate pulses to the MOSFET so as to charge the battery .When the solar or wind system voltage is lesser than the battery voltage, there would be no issue of gate pulses for the MOSFET and hence no charging of battery. Based on the levels set for the battery voltage the battery would be charged either in booster mode where the PWM signals with high duty cycle is employed or in saturation mode by altering the duty cycle from high to lower value. The saturation mode will ensure that the battery remains charged in full.

FLOW CHART

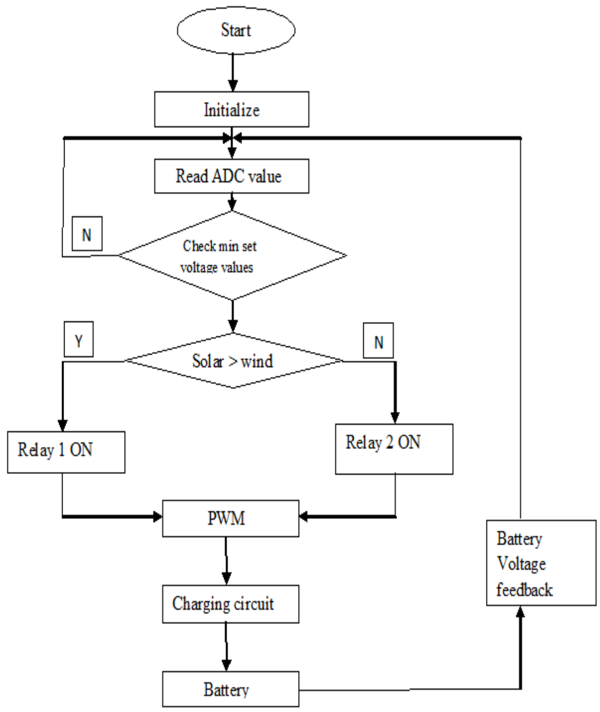

Fig 5:- Flow Chart of Proposed System

V. RESULTS

Fig 6:- Designed Hybrid Charger

Experimental observation shows that combining both sources and with PWM control, we can improve the total efficiency of the system as compared with their stand alone operation.

VI. CONCLUSION

The proposed hybrid charge controller with slow speed wind turbine and solar panel utilising PIC16F877 microcontroller has provided sufficing output and these types of systems could be utilised in domestic purposes as a viable alternate source of electricity in limited scale. Low conversion efficiency of solar panels can be overcome by using a hybrid system.

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