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Solar Energy Measurement and Monitoring System

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Abstract: *The aim of this project is to measure solar cell parameters through multiple sensor data acquisition. In this project a solar panel is used which keeps monitoring the sunlight. Heredifferent parameters of the solar panel like the light intensity, voltage and the temperature are monitored.The light intensity is monitored using an LDR sensor, voltage by voltage divider principle, current by current sensor and temperature by temperature sensor. All these data aredisplayed on a 16X2 LCD interfaced to Arduino microcontroller.The power supply consists of a step down transformer 230/12V, which steps down the voltage to 12V AC. This is converted to DC using a bridge rectifier. The ripples are removed using a capacitive filter and it is then regulated to +5V using a voltage regulator 7805 which is required for the operation of arduino microcontroller and other circuits.*
Keywords: *Low cost, ATMEGA328, LM35, LDR, SOLAR PANEL.*

I. INTRODUCTION

The use of solar power system as alternative source of power supply has continued to be advocated and all over the world because of its ease of deployment and low or no maintenance. However the high installation cost is still scaring a lot of people who would have their facilities powered by solar. In most developing countries like nigeria the story is becoming a sour experience because most of the installations don't perform as itended. Key factors that have been identified for supply unit, the control unit and the sensor units of the entire project by using solid state ectronic components, integrated circuits and microcontroller. The software design involves the development of a program using 'C' programming language to enable the arduino microcontroller to function and perform as desired. The basic inputs to thye system are the sensor units. They sense the required variable that is to be measured and the measured values are then displayed. The results obtained from the display unit are then compared with the manufacturer's values that are found on the solar panel. It is observed that there are slight differences between the measured and the manufacturer's values, but still within a tolerable range(less than 5%).

Non-performances of the solar installation include wrong sizing, poor workmanship and lack of appropriate maintenance culture. Also, there have been growing concerns on the challenges of unsatisfactory performance of solar powered equipment in nigeria which has been linked to importation of sub-standards solar panels to the market. Most of these solar panels are not rated properly.

Some manufacturers label the solar panels with arbitrary ratings in other to sell and make profit as seen in . This work is therefore necessary so as to assist both those who install solar system as well as consumers to confirm the manufacturer's specification claim on the imported solar panels in nigeria. The solar energy measurement system is a system designed to measure the rating of the solar panel by monitoring the solar panel parameters- voltage, current, temperature and light intensity.

II. PROPOSED SYSTEM

The light intensity is monitored using an LDR sensor, voltage voltage divider principle, current by current sensor and temperature by temperature sensor. All these data gets displayed on 16X2LCD interfaced to Arduino. Also Arduino convert analog to digital and used to measure value. The power supply consists of step down Transformer 230V/12V , which is a step deags to the voltage so 12V AC. It is converted to DC using bridge rectifier.

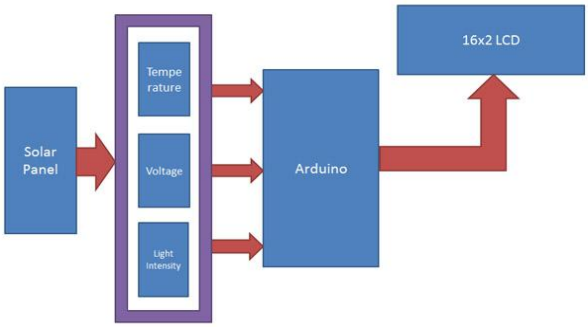


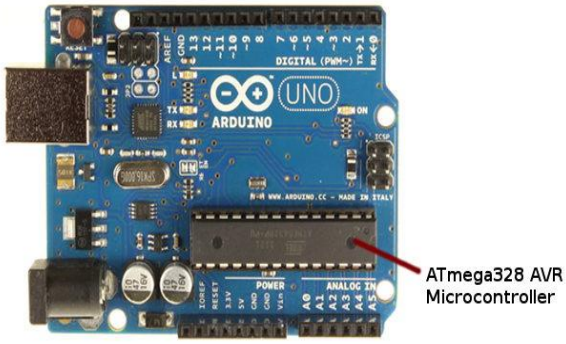
Fig.1 Block diagram of solar energy measurement system

A. HARDWARE

Arduino uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs), a 16 MHz resonator, a USB connection, a power jack, an in-circuit system programming (ICSP) header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

An Arduino based solar power parameter measuring system has been designed and constructed using the optimized simulated parameter from proteus ISIS. This device was then to acquire solar, voltage, power, temperature, and light intensity.



B. THE POWER SUPPLY UNIT

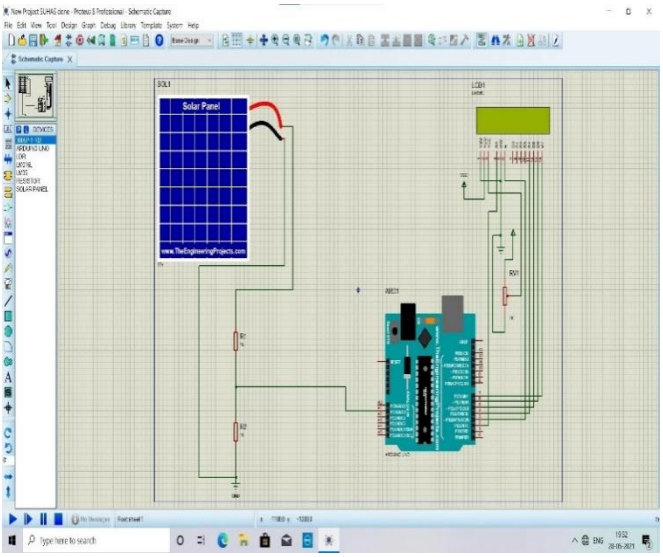
This unit is made up of the following components: the 240/12 step–down transformer, bridge rectifier, 1000-Mf capacitor, voltage regulator (LM7805). These components were used to produce a DC voltage from AC mains. The transformer changes the mains voltage to a lower level suited to our requirements; and the rectifier removes the negative part of the alternating signal giving an output which only has positive voltages which is filtered by the capacitor and regulated.

C. VOLTAGE MEASUREMENT:

Voltage Measurement of the Solar Panel is very easy which is up to 5 volts. But if we want to measure more than 5 volts then we have to use some additional circuitry like Voltage Divider. This circuitry changes according to Voltage, which means How Much Voltage we have to Measure. Let us suppose if we want to measure 5 volts, then there is no need for any Additional Circuitry. Just connect the solar panel Output Voltage to Analog pin of Arduino and convert that in Digital and Display result on LCD or Computer. And suppose if you want to measure up to 10 volts then you have to use the given circuitry

For measuring Voltage we have to follow the given Formula

Voltage= (Analog value / resistor factor) * reference Voltage



D. LIGHT INTENSITY MEASUREMENT

Light Intensity is also easy to execute in the project like the Voltage Measurement. For Light Intensity first we have to use Voltage divider and then measure the Voltage. Later through some calculation we will get the Light Intensity Result.

Here we are going to show you how to do this:

For this we have to use LDR, (Light Dependent Register) which is very common and easily available in the market.

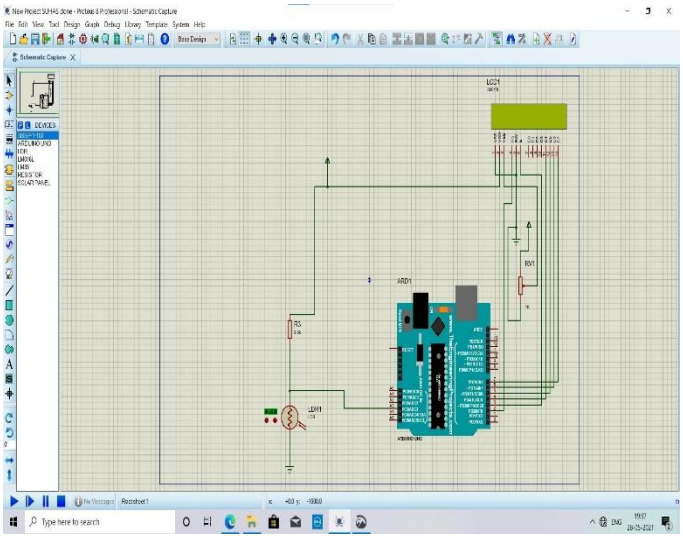
Now you can see the Circuit Diagram for Light Intensity Measurement partHere we are using a 3.3K ohm resistor and a LDR connected with each other and middle points is used as output. As light falls on LDR, resistance of LDR decreases, due to which Analog Voltage is generated, later apply this Voltage to Arduino.

Relation between RL (LDR) and Light Intensity (Lux) is given below: RL=500/Lux

Output Voltage of this circuit can be calculated by using given formula Vout= 5 * RL / (RL+3.3)

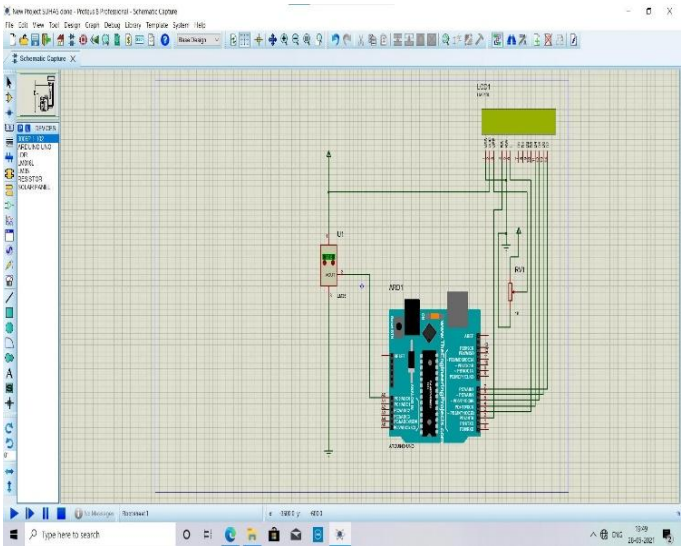
Where RL is Load Resistance (LDR Resistance varies according to light intensity).

Now by using given formula we can calculate Light intensity in lux (where lux in unit of light intensity) Lux= (2500 / Vout – 500) / 3.3



E. TEMPERATURE MEASUREMENT :

For Measuring Temperature here we have used lm 35 that is gives 10 mV for every 1 degree Celsius. Circuitry is simple for this. By using given formula we can calculate Temperature in Degree Celsius:
Temperature=Analog value*(5.0/1023.0)*100 Where 5 is reference voltage

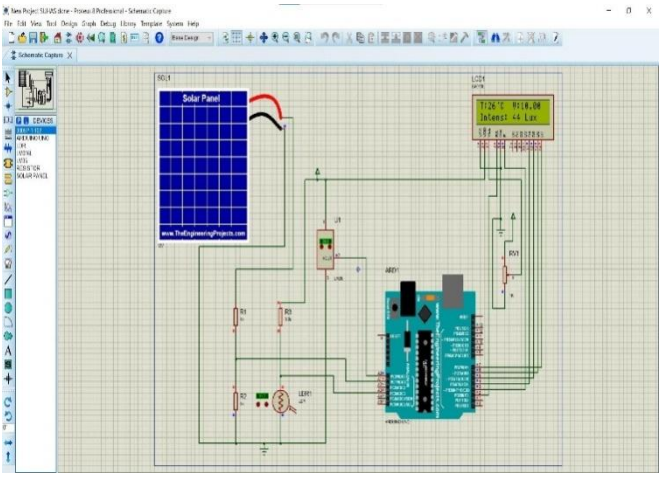


III. SOFTWARE

Software Design stage involved the programming of the microcontroller which is The Arduino Uno R3. The programming language used for the microcontroller is C Programming Language.The software used to program the Arduino is called the Integrated Development Environment (IDE). The IDE is a Java application that runs on many different platforms, Including PCs, Macs, and Linux systems

IV. IMPLEMENTATION

Microcontroller Coding and testing- The theArduino Uno R3 microcontroller was programmed to carry out its functions as outlined in previous sections. C programming language was employed in the coding of the Microcontroller. The compiler used for debugging was the Arduino compiler. The microcontroller code was tested using a software simulation package - proteus 8 professional. The code was loaded on the Arduino Uno R3 with the use of the Arduino Compiler and simulated the activities of the pins, ran some tests and monitored its activities as shown in the proteus simulation,



V. CONCLUSION / FUTURESCOPE

We have presented work on design and development of solar panel parameterreading using arduino for enviornmental monitoring, the node is enough to provide information aboutenviornment parameters such as temperature,voltage,light intensity.

In the upcoming years, technology improvements will ensure that solar becomes even cheaper.It could well have become the most important source of energy for electricity production in a large part of the world.Solar energy have a positive impact on the environment and climate change.India plans to generate 100 Giga Watts of power using solar panels by 2022.According to the Council On Energy, Environment and Water and The Natural Resources Defense Council of India , this growth will create an estimated 3,30,000 jobs in the field of solar.The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country and it receives solar radiation almost throughout the year,which amounts to 3,000 hours of sunshine.

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