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Solar Panel Measurement System using Arduino with Bluetooth

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ABSTRACT

This project aims to develop a measurement of solar energy using Arduino. In this research, two parameters that been measured are light intensity and the voltage. The light intensity was measured using light dependent resistor (LDR) sensor. The voltage was measured using the voltage divider because the voltage generated by the solar panel are large for the Arduino as receiver. These parameters as the input value for the Arduino and the output was display at the Arduino Bluetooth Controller. The Arduino Bluetooth controller display output of the light intensity and the voltage value. The purpose of using Arduino is to convert the analog input of parameter to the digital output and display via Bluetooth .

Keywords: Light, measurement, voltage

I. INTRODUCTION

Rising fossil gas and burning gas such as coal, international warming and intense weather situations have compelled many countries to search for alternative assets to lessen reliance on fossil based totally fuels. Solar energy is one of the most promising renewable sources that is currently being used worldwide to contribute for meeting rising demands of electric power [1]. Solar power is a conversion of sunlight into electricity, sunlight was collected either directly by using photovoltaics or indirectly using concentrated of solar energy [2]. Photovoltaics was to begin with use as a power supply for a small and medium size program from the calculator powered by means of an unmarried solar mobile to a remote home powered by way of an off-grid rooftop photovoltaics system. In this project, a simple solar panel measurement system using arduino uno with Bluetooth is introduced.

II. LITERATURE REVIEW

A. Solar Cell

The solar panel is a device composed of semiconductor materials can convert sunlight into electricity directly. Often too the term photovoltaic is used.

Figure 1. Solar cell

When sunlight hits the surface of the solar cell, the energy carried by this sunlight will absorbed by electrons in the p-n junction to move from the diode p to n and henceforth flows out through the cable attached to the panel.

B. Arduino Uno

The Arduino Uno is microcontroller board based on the ATmega328 as shown in Figure 2. It has 14 digital input and output pins: 6 pins used PWM outputs and 6 pins is analog input such as the clock speed is 16 MHz, the ceramic resonator, the USB connection, the power jack, the ICSP header and the reset button [3].

Figure 2. Arduiono Uno

Specification for Arduino as used in this project is shown in Table 1.

Table 1. Arduino specification

MICROCONTROLER	Atmega28
Operating voltage	5 V
Input voltage	7 – 12 V
Digital I/O Pins	14
Analog input pins	6
DC current per I/O	40 mA
DC current for 3 – 3v pin	50 mA

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Flash memory	32 kB
Clock speed	16 MHz

C. HC-05 Bluetooth Module

The HC-05 is a very cool module which can add two-way (full-duplex) wireless functionality to projects. One can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a phone or laptop. This device is shown in Figure 3.

Figure 3. HC-05 Bluetooth module

There are several pins on HC-05 modules. Each of this pin functionallity can be seen in Table 2.

Table 2. HC-05 pinout

Pin Number	Pin Name	Description
1	Enable / Key	This pin is used to toggle between Data Mode (set low) and AT command mode (set high). By default, it is in Data mode
2	Vcc	Powers the module. Connect to +5V Supply voltage
3	Ground	Ground pin of module, connect to system ground.
4	TX – Transmitter	Transmits Serial Data. Everything received via Bluetooth will be given out by this pin as serial data.
5	RX – Receiver	Receive Serial Data. Every serial data given to this pin will be broadcasted via Bluetooth
6	State	The state pin is connected to on board LED, it can be used as a feedback to check if Bluetooth is working properly.
7	LED	Indicates the status of Module • Blink once in 2 sec: Module has entered Command Mode • Repeated Blinking: Waiting for connection in Data Mode • Blink twice in 1 sec: Connection successful in Data Mode
8	Button	Used to control the Key/Enable pin to toggle between Data and command Mode

Connection between Arduino and HC-05 used in this project is shown in Figure 4.

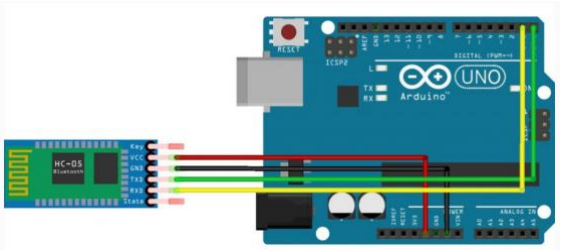

Figure 4. Arduino Uno to HC-05 Bluetooth module

D. Light Sensor

A Light Dependent Resistor (LDR) or photo resistor is device whose resistivity is a function of the incident electromagnetic radiation which means it is light sensitive devices. These components also called a photoconductor, photo conductive cells or simply photocells [4]. The appearance of this device can be seen in Figure 5

Figure 5. LDR sensor

The LDR function on the principle based on photo conductivity which an optical phenomenon. Figure 6 shows the resistance vs illumination graph of LDR.

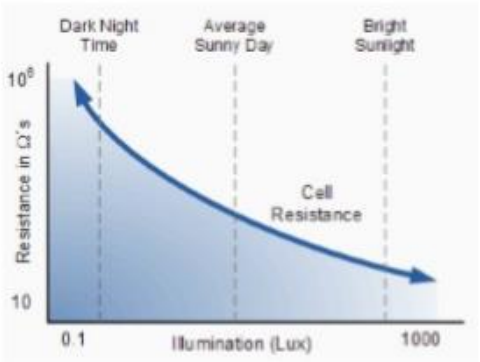

Figure 6. The resistance vs illumination graph of LDR

III. DESIGN IMPLEMENTATION

Figure 7 shows the prototype of solar energy measurement using Arduino Uno.

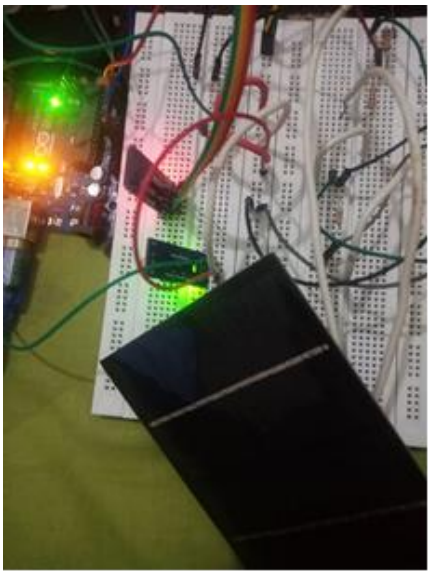

Figure 7. The prototype

IV. Result and Analysis

This section discusses the results based on the simulation results and the measurement result.

A. *Simulation Result*

Figure 8 shows the results of the reading voltage and light intensity. It varies depend on the sunlight during the simulation.

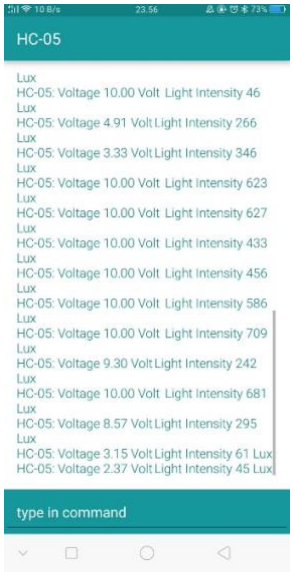

Figure 8. The reading of HC-05 Bluetooth module

Table 3 shows the simulation result of light intensity and the output voltage. From the simulation results shown that the circuit are function is very well and can be continue to the hardware development.

Table 3. LDR simulation result

Output Voltage (V)	LDR Intensity
4.91	266
8.57	242
9.30	295
10.00	456
10.00	586
10.00	709

B. *Measurement Result*

The light intensity had been recorded in the two days with the solar panel, the sunrise role as proven in Figure 9. Based on the result, the highest light intensity changed into 980 Lux at 2.00 p.m., at the same time as the lowest mild intensity become 700 Lux at 5.00 p.m.

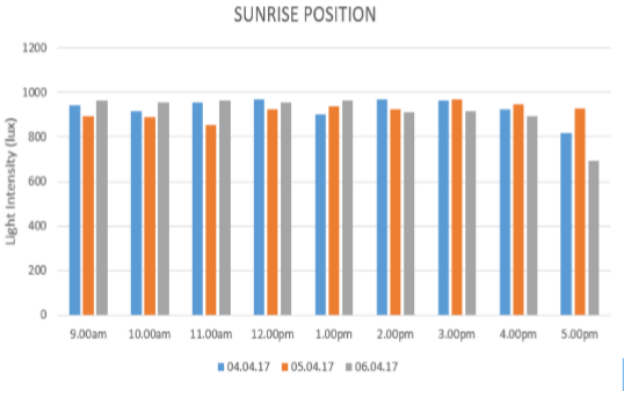

Figure 9. Result of light intensity for sunrise position

The light intensity had been recorded in two days with the solar panel inside the sunrise role as the proven in Figure 9. Based on result, the highest upward intensity turned into 970 Lux at 11.00 a.m., whilst the lowest upward became 350 Lux at 5.00 p.m.

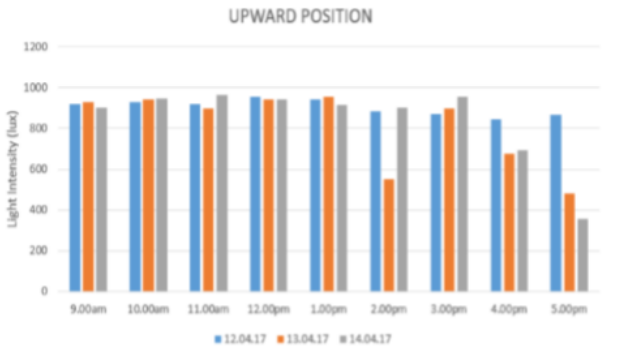

Figure 10. Result of light intensity for upward position

Table 4 shown the maximum and the minimum of the light intensity that have been recorded according to their solar panel position.

Table 4. Maximum and minimum light intensity

Position	Sunrise	Upward
Maximum (Lux)	900 Lux at 2.00 p.m.	970 Lux at 11.00 a.m.
Minimum (Lux)	700 Lux at 5.00 p.m.	350 Lux at 5.00 p.m.

V. CONCLUSION

In the conclusion, the implementation of solar panel measurement using Bluetooth that can be used to monitor the voltage of solar panel, also to track the intensity of the light in the area. Moreover the system also can send the measurement data to mobile phone through Bluetooth communication. For the light intensity parameter was by using the LDR sensor, for the voltage parameter was by using the voltage divider method in order to reduce the maximum value of the solar panel to the voltage value suitable for the Arduino of power supply and lastly the current parameter was by using the current sensor module.

For future work reset, reseacher have some suggestion based on the research, in terms of communication Bluetooth can be changed to ESP 8266 module. so the range will be longer and create a more steady communication to the smartphone and add some sensors to improve the system.

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