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ELECTRICAL ENERGY MONITORING SYSTEM FROM SOLAR PANEL

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ABSTRACT

Renewable energy development as an alternative source of power supply has now been discovered and widely used. In fact, most users have begun to install one of the renewable energy known as solar photovoltaic (PV). Solar PV is installed in residential and industrial sectors as the government are considering every possible solution to increase the effectiveness of renewable energy. Solar PV has the feature that the energy stored from the solar energy into the battery will decrease at any time. Therefore, a monitoring system needs to be developed to measure power consumption based on the type of power supply currently being used, whether it be a primary power supply or a solar power supply. In this project, a system to monitor the percentage of energy supplied by solar PV as well as to inform the state of the solar panel via Interface. Information and data collected is obtained by monitoring the current and voltage through sensors installed and stored on a personal computer as well as using the Matlab application. Matlab is used to display data through graphical user interface (GUI) development. User friendly software in terms of organizing and controlling the system is created through the Interface. At the end of this project, this monitoring system will be used and applied mainly in residential and industrial sectors to enable measurement of solar energy performance.

Introduction

One of the most popular types of renewable and sustainable energy is solar energy that is now attracting researchers from around the world due to its minimal environmental impact. Solar energy is growing to be more involved than generating electricity around the world, so an early study of solar energy is crucial for us to get benefit from it [1-2]. Monitoring quality performance quality should be an essential component of any solar energy system, but it will be sacrificed in the name of cost savings. Smart monitoring and control includes analysis, and tracking energy generation to analyze system performance. The solar surveillance and control system can tell if the system is not in line or if it is not working as expected [3]. Data retrieval systems require large amounts of measured data that need to be recorded regularly to eliminate the

possibility of human error and save time. This project describes the development and work of software systems for solar panel monitoring [4-5].

Literature Review

By conducting this research, various innovations can be discovered and can be produce better and innovative systems. In addition, the main purpose of this system is to replace the current system. The system will be developed using Arduino IDE software and MATLAB software to create an interface display. Arduino is an open-source single-board micro device [5-6]. Built on a platform, designed to facilitate electronic use in various fields. Arduino has an Atmel AVR processor and uses its own computer programming language. At present, Arduino is very popular around the world. Many users who are learning about robotics and electronics love to use Arduino because they are easy to learn [7-8].

Arduino

Arduino is a tool that allows the computer to track and control more than the physical world over your computer. It is an open source in physical computing based on micro controlling board and project development environment for writing software on Arduino board. Arduino can be used to develop an interactive project, gain input from variety of switch or sensor and control many light, motor and other physical output. Arduino projects are standalone or they can communicate with the software used on the computer. Arduino boards can be installed on their own or purchased directly at the electronics store. IDE Arduino is open source and downloadable for free [9].

Remote Monitoring

Remote Monitoring Remote monitoring is a convenient specified monitoring activity using a remote device known as a monitor or probe. Remote monitoring helps network administrators with control and efficient network infrastructure management. Remote monitoring was initially developed to handle or monitoring issues using the Local Area Network. Next, remote monitoring [9].

Voltage sensor

A voltage sensor is a sensor is used to calculate and monitor the amount of voltage in an object. Voltage sensors can determine both the AC voltage or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, an audible signal Sensors are basically a device which can sense or identify and react to certain types of electrical or some optical signals. Implementation of voltage sensor and current sensor techniques have become an excellent choice to the conventional current and voltage measurement methods [9-10].

Solar panel

Photovoltaic solar panels absorb sunlight as a source of energy to generate direct current electricity. A photovoltaic (PV) module is a packaged, connected assembly of photovoltaic solar cells available in different voltages and wattages. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications [11].

Charge Controller

A charge controller, limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan and may pose a safety risk. It may also prevent completely draining a battery, or perform controlled discharges, depending on the battery technology, to protect battery life [11].

Battery

A battery storage power plant is a type of energy storage power plant that uses a group of batteries to store electrical energy. The maximum power of battery storage power plants is an order of magnitude less than pumped storage power plants, the most common form of grid energy storage. This battery function to store

electricity energy from solar panel. Battery storage power plants are used for short-term peak power and ancillary services, such as providing a frequency-response reserve to minimize the chance of power outages [11].

Circuit Diagram

Figure below show the drawing in this system all hardware needs to be properly connected to get the right readings. Each appliance has its own functionality.

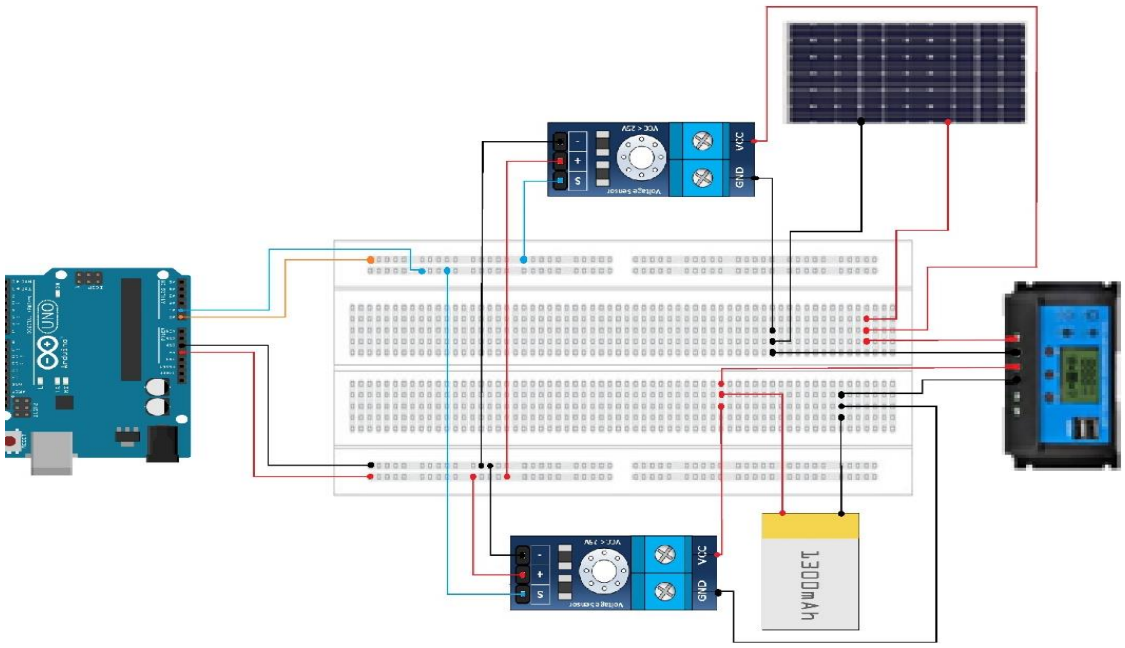

Fig. 1: The Arduino Circuit Drawing used in the Application

The general structure of the purposed system is shown in Fig. 2. The system consists of Arduino Uno, Ethernet Shield, Computer, voltage sensor, solar panel, battery, and the application build using Matlab software and Xampp software [12-13].

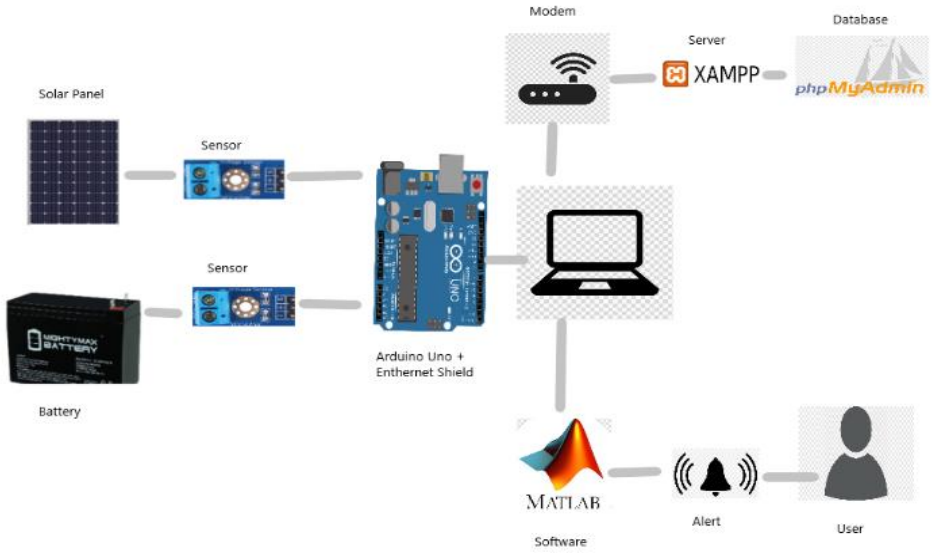

Fig. 2: The General Structure of the Proposed System

System Architecture

The Prototype Model has been selected for use to develop this system. The prototyping model is a systems development method in which a prototype is built, tested and then reworked as necessary until an acceptable outcome is achieved from which the complete system or product can be developed. This model works best in scenarios where not all of the project requirements are known in detail ahead of time. It is an iterative, trial-and-error process that takes place between the developers and the users [8].

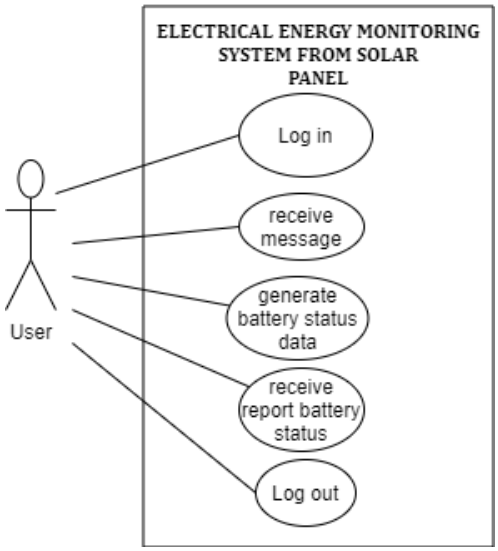

Fig. 3: Use Case Diagram

This system has been designed through the Unified Modelling Language (UML), as depicted in Fig. 3. This system comprises of one main user, namely, the worker. He or she needs to log in to the system using their username and password. The Use Case illustrate how a worker interacts with the application that is to be created. All this can do is log in, receive message, generate battery status data, receive report battery status, log out.

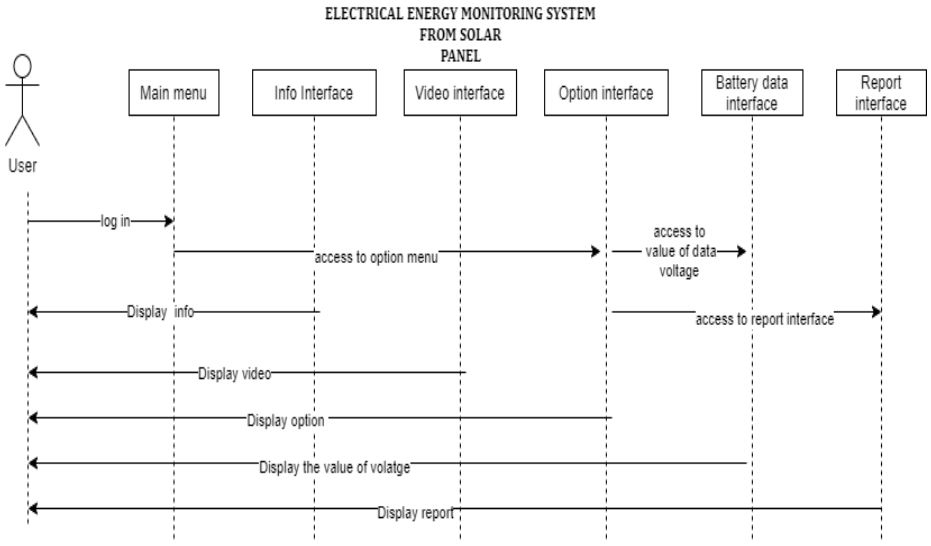

Fig. 4: Sequence Diagram

In sequence diagram, the interaction diagram shows how the object operate with each other and in what order. It shows the interaction of objects arranged in sequence.

System Development

This Electrical Energy Monitoring System from Solar Panel has been developed through the Matlab while the Matlab guide package was used to develop the interface of the system. The algorithm for the process of determining the value of voltage automatically. For the process of determining the battery, the voltage sensor detects the voltage in percentage. If the voltage is above 80%, the maximum message will be displayed. However, if the voltage level is detected at 20% or below, a minimum message will be displayed. If the voltage level is between 80% and 20% then the charging message will be displayed [11].

System Implementation

System implementation will be showed through the system interface below.

Fig. 5: Display Current info from Solar Panel

In this interface, user will always get a flashing message on the box in red or green colour based on the current supply from the solar panel. if the current from the solar panel is at its maximum the green colour on the box will be displayed at the top box, if the current supply from the solar panel at its minimum the red colour on the box will be displayed at the middle box. The bottom box will always display the value of the voltage from the solar panel. Red colour on the box will be displayed at the middle box. The bottom box will always display the value of the voltage from the solar panel [8].

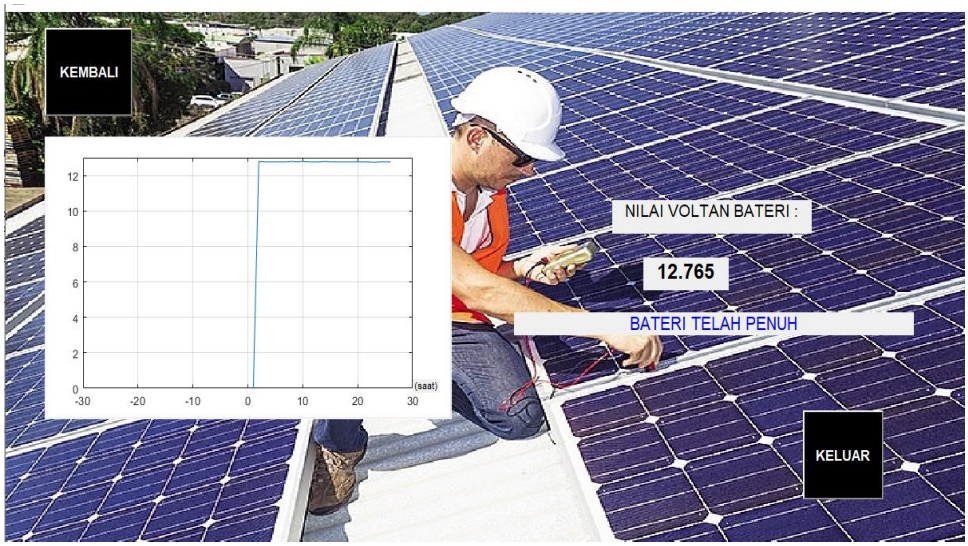

Fig. 6: Display Voltage info from Power Supply

Displays the voltage value info from power supply interface. This interface gives an overview of the percentage of voltage levels in the form of graphs. This voltage level display is the current reading detected by the sensor. The percentage of voltage in the tank is also visible to the user in the column below the graph. if the voltage in the battery is at its maximum, the TEXT BOX will display the message '*bateri telah penuh'* in blue. When the volatge level is below the minimum, the TEXT BOX will display a red '*bateri di paras minimum*' message in red.

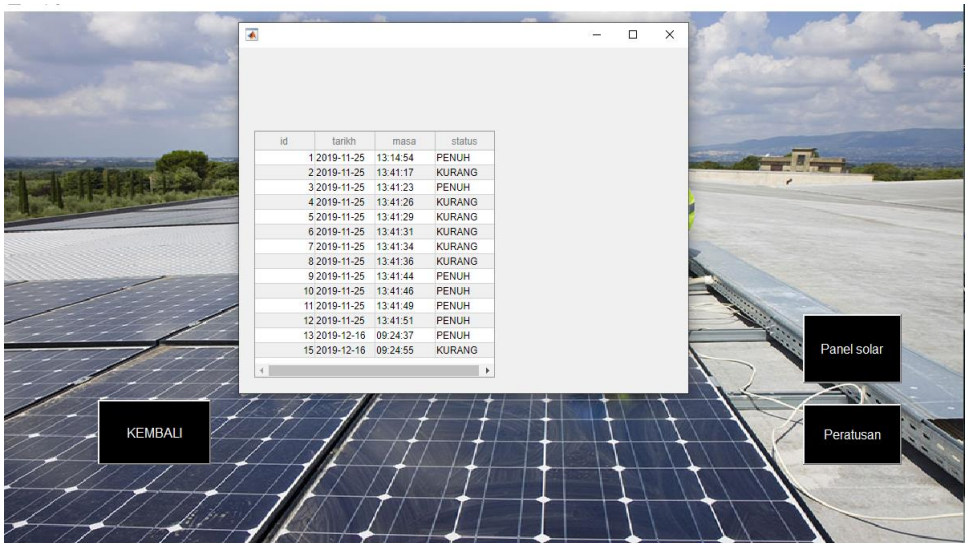

Fig. 7: Display Battery Status Data for Report

Fig. 7 shows the Battery Status Data interface. This interface provides users with full battery or low reports. Arduino always keeps battery status data in the database every 10 minutes or whenever based user set up. The application extracts data from the database and displays the data in a table format.

Conclusion

In conclusion, the Electrical Energy Monitoring System from Solar Panel enables the employees of Solace Skywater to monitor their power supply as well as find alternative energy to power the AWG engine. As such, the discussion and conclusions section provided some information about the obstacles encountered while developing this application. However, some improvements should be done to upgrade this system. The application also has its own advantages in helping Solace Skywater company monitor AWG machine and get alternative energy.

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