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Intelligent Energy Monitoring and Control System.

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Abstract

This project is all about live monitoring of energy consumption. It monitors the voltage and current of a load. It calculates the amount of energy consumed by individual appliances frequently. This is an application oriented project which allows monitoring of household appliances. This application is coded with pre-defined timings where the energy consumption needs to be zero. If there is any energy consumption at those timings the application notifies the user about the energy consumption. Thus, continuously indicating the user to turn off particular devices using the application. If the user fails to turn off, the application keeps on notifying him unless he does it. The application interface indicates Current, Voltage, energy consumed and also the status of the appliances are displayed. The application receives the information from Arduino and Esp32. Arduino is coded with the predefined timings about the energy consumption and status of the appliances. As the project prevents the over consumption of energy, it reduces the electricity bill. Hence, it is helpful in reduction of energy being wasted

Keywords: Energy, Mobile App, Monitoring system.

1. Introduction

Energy is a primary factor for development, as it helps in the improvement in companies, job production and the business exchanges. To ensure benefit for the environment, and also the conservation of non-renewable resources energy saving is important. Electrical energy is the most important factor in our daily lives. We live in a digitalized and industrialized worldwhere it is not possible to live without electricity, since we rely on it to do a large part of our regular activities for a better quality of life. Nowadays, everything is obtained in just a click like getting pictures, sounds, heat or cold , lighting, butwe never think about where it comes from Electricity generated in power plants is liable of obtaining energy from primary sources. These primary energies can be renewable; such as water, solar radiation and wind, or non-renewable; such as oil, natural gas and coal. Many countries are now shifting towards clean energies, but most of the consumption is still heading towards nonrenewable energies. Additionally, saving the energy helps in improving domestic and the national economy, exceptionally in nations that mostly rely onforeign oil. Hence, by decreasing consumption, it helps to lessen the dependence of energy.

Energy is a key element for development. Without which, people live with shortage in the most required services like education and health, and it also becomes a limiting factor for businesses, hence for investors, leading to state of being poor and unemployment. Aiming for this purpose, saving the energy, we have come up with this idea. By this project, an individual will be able to monitor the

amount of energy he is using and also he can monitor his household appliances by the application that we have developed from.

2. Integrated Design of system

The current sensor (ACS712) present here senses the amount of current, and the power of the appliances are calculated. These values are sent to the cloud (Thingspeak) and then are displayed in the mobile application which is developed by using MIT app inventor. The user can also do the switching operations (ON/OFF) of the appliances using this application (by using relay module). Both the Current Sensor and the Relay Module are powered from the ESP32 Module. The analog value from the current sensor is read by the ESP32 module and the instructions to the relay module are also fetched from the ESP32 Module. (When a User logs into his respective screen, the values of current and power are continuously fetched from the cloud and keeps updating on their respective labels. The control buttons when pressed, gets updated about the light status in the cloud. Based on the current value on the cloud, the system status is shown in the app.)

3. Design of the hardware

A Current Sensor and a Relay module are connected in series between supply and the load. Current Sensor is used to sense the analog value of current flowing the circuit whereas Relay Module is used to control the load i.e. to switch on/off the load. Both the Current Sensor and the Relay Module are powered from the ESP32 Module. The analog value from the current sensor is read by the ESP32 module and the instructions to the relay module are also fetched from the ESP32 Module. ESP module is a wi-fi Enabled module. It has Internet connective capability. The nearby wi-fi details are written as part of code that is being dumped into the ESP Module. So that ESP Module connects to that wi-fi and sends information to the cloud.

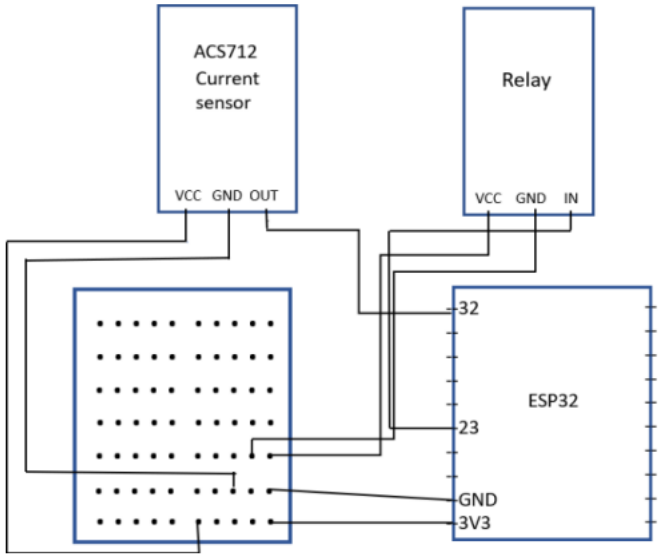

Fig. 1.Block diagram of the hardware model.

A. ESP 32 Module

ESP32 is a series of low-cost, low-power system on a chip microcontrollers with integrated Wi-Fi and dual-mode Bluetooth. The ESP32 series employs either a Tensilica Xtensa LX6 microprocessor in both dual-core and single-core variations, Xtensa LX7 dual-core microprocessor or a single-core RISC-V microprocessor and includes built-in antenna switches, RF balun, power amplifier, low-noise receive amplifier, filters, and power-management modules. ESP32 is created and developed by Espressif Systems, a Shanghai-based Chinese company, and is manufactured by TSMC using their 40 nm process. It is a successor to the ESP8266 microcontroller.

B. Current Sensor ACS712

The ACS712 is a fully integrated, hall effect-based linear current sensor with 2.1kVRMS voltage isolation and a integrated low-resistance current conductor. Technical terms aside, it's simply put forth as a current sensor that uses its conductor to calculate and measure the amount of current applied.

C. Relay module (1 Channel)

The transmission module is the electric transfer utilized by the electromagnetic field. The 6 pins at the left side of the transmission module connect high voltage, and the proper pins join the low-voltage factor — the Arduino pins. The excessive voltage aspect has 2

connectors, every with 3 bases: general (COM), generally closed (NC), and typically open (NO).

- COM: ordinary PIN
- NC (usually closed): Closed suspension is used in case you need to download to automatically shut down, meaning that the current flows without sending a signal from Arduino to the transmission module to open the circuit and avoid the current date.
- NO (usually switch on): The open configuration works differently: the relay is usually open, so the circuit is interrupted unless you send a signal from Arduino to close the circuit.
- The right hand set combines VCC and GND to allow the module, then enter 1 (IN1) and then enter 2 (IN2) to control the lower and upper relays, respectively.
- The second set of anchors contains the GND, VCC, and JD-VCC anchors. JD-VCC PIN allows for relay magnetic title.

4. Tests and results

This idea helps in reduction of power loss and also gives live monitoring of energy and also automated appliances control through the application. The application interface indicates Current, Voltage, energy consumed and also the status of the appliances are displayed.

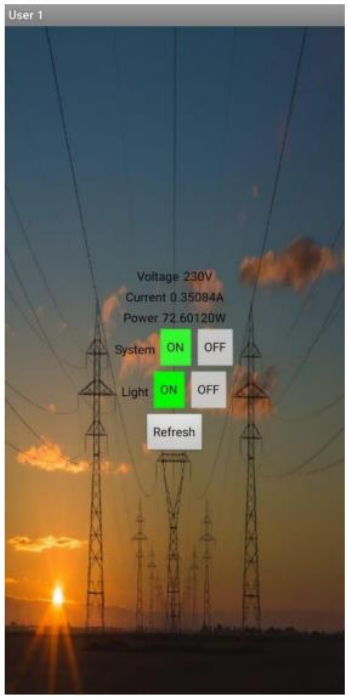

Figure1: Mobile application Interface for User

Table 1 : Resultant Energy parameters monitored for a period of time

Time stamp	User1				User2			
	Load Status	Voltage	Current	Power	Load Status	Voltage	Current	Power
10:16:23	ON	230	0.29	66.70	ON	230	0.42	96.60
10:32:07	ON	230	0.25	57.5	ON	230	0.402	92.46
10:50:34	ON	230	0.301	69.23	OFF	230	0	0
11:15:08	OFF	230	0	0	ON	230	0.451	103.73
11:42:52	ON	230	0.269	61.870	ON	230	0.408	93.84
12:09:42	ON	230	0.35	72.601	ON	230	0.449	103.27
12:29:45	OFF	230	0	0	OFF	230	0	0
12:52:22	ON	230	0.312	71.76	ON	230	0.460	105.8
01:12:55	ON	230	0.309	71.07	ON	230	0.409	94.07

5. Conclusion

Enlarging the awareness of energy consumption in people is a pompous step to help the individuals manage their energy consumption. We have brought up this project to ensure that the users now observe not only the overall house hold consumption but also each device's consumption. Hence, users are now able to look up the energy profile of every device and can recognize the devices that consume most power at home. Taking into consideration the increasing cost of electricity and the Global Warming campaigns to reduce general consumption of electricity, there is an increasing interest in analyzing power consumption in households. By analyzing the electricity usage of each individual appliance separately, more accurate conclusions can be drawn on their efficiency and need for replacement. This helps in reducing cost and consumption of energy.

The main agenda of our project "Intelligent energy monitoring and control system" is to develop a system that is capable of keeping a live track of each and every electrical machine in the home and the user will be able to attain all appliance energy consumption parameters, and it is been achieved. Along with this, the energy consumption parameters of each individual appliance will also be able to monitor by the user, where an intelligent algorithm is run to manage all the appliances as per the requirements of the user. The user will be ableto monitor the energy parameters of each individual load using an android smartphone and also the switching of the appliances is done through the application itself. By automatically turning off loads when not in use, the system helps in saving energy in homes.

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