

Resourceful Smart Home Energy Automation System For Real World System

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Abstract

The “Resourceful smart home energy automation system” is a IOT based research work whose purpose is to manage and switch between different types of electricity sources according to their availability and to use them as much efficiently as possible. The system is geared to use the renewable sources of energy as much as possible and hence help the users to save in their monthly electricity bills. The system also allows the use of net metering system where the excess renewable energy is sent back to the grid. Net metering is a smart energy metering system where excess energy produced by the solar panels in the homes are sent back to the grid and the appropriate amount is deducted from monthly electricity bills. This allows no wastage of any energy in home. Through this research work the user will be able to get the updates of the energy usage in his home also the notifications if the energy is switched between the sources.

Keywords: IoT, Integrated Technologies, System Architecture, Flow Graph, energy automation system.

1. Introduction

“Resourceful smart Home energy management system” is an electronic system that allows the consumer to control, accomplish and switch among the diverse power options that is available inside the home. This allows the efficient use of renewable and non-renewable energy resources. The system also allows the use of net metering system where the excess renewable energy is sent back to the grid. Net metering is a smart energy metering system where excess energy produced by the solar panels in the homes are sent back to the grid and the appropriate amount is deducted from monthly electricity bills. This allows no wastage of any energy in home. The user will be able to get the updates of the energy usage in his home also the notifications if the energy is switched between the sources.

Today’s world is in an urgent need of solutions to the global warming and climate change. The best way to overcome this is by reducing the use of the non-renewable sources of energy such as coal, petrol, diesel etc

and increase the use of the renewable alternatives such as Solar, wind, Hydro etc. However, renewable energy alternatives are still not a complete replacement for the nonrenewable resources since renewable resources are not available 24 hours of the day . Therefore, they cannot be used on their own for now, and must be used along with the non-renewable energy. So for now there is a need for a system that allows the use of both these energy resources according to the availability. Thereby reducing the impact of global warming and climate change. Recently there has been a very big decrease in the cost of renewable energy systems and therefore there is a need for a system that allows for switching between different energy resources in home. Especially in India where the current government is pushing very hard on renewable energy, there is a need for such systems.

2. Related Work

The “ Resourceful smart home energy management system: An exploration of IoT use cases” desires to take care of the developing issue of pointless energy utilization in a singular's family utilizing the idea of the IoT (web of things). The plan screens and investigates the energy devoured by the power outlets in the family utilizing sensors and microcontrollers. The proposed configuration gives the client different control strategies to control energy utilization(M. B. Soudan et. al 2018).

In our research work we have implemented the idea of monitoring and analyzing the electricity usage of the home. But unlike the referenced article where its major focus is on mains power consumption and usage of power by different sockets. Our projects focus is on the efficient usage of different sources of electricity.

The “Design of an IoT Energy Monitoring System” is a writeup on plan and carry out a minimal expense IoT energy checking framework that can be utilized in numerous applications, for example, power charging framework, energy the executives in shrewd matrix and home computerization (K. Chooruang and K. Meekul (2018)).

In our research work we are using a similar idea of energy monitoring using an ACS712 current sensor, It allows us to measure and monitor the power usage in the home. We also trying to implement the concept of reverse metering/net metering, where excess energy produced through renewable resources is routed to main grid and appropriate amount is reduced from the monthly electricity bills.

In [3], The “Energy monitoring and control using Internet of Things (IoT) system” is a writeup on manually controlling the state of different outlets in the home (W. T. Hartman, et.al. (2018)).

Unlike this referenced work, we are using a fully automated system that switches between different energy resources without the need of manual intervention. The operations can also be overridden manually if the user chooses to but its not recommended.

Savvy Home innovation is the eventual fate of private related innovation which is intended to convey and circulate number of administrations inside and outside the house through organized gadgets wherein every one of the various applications and the knowledge behind them are coordinated and interconnected. These savvy gadgets can possibly impart data to one another given the long-lasting accessibility to get to the broadband web association. (L. Salman et al.,2016)

We take the view that effective reception of IoT in modern conditions ought to be treated as a multidisciplinary issue and ought to be completed in moderately little strides to limit dangers and interruption. (A. Vakaloudis and C. O'Leary, 2019)

Web of Things (IoT) is the arrangement of advancements that can interconnect anything, from day to day existence objects to more modern organized gadgets. The IoT worldview is continually expanding the quantity of gadgets claimed by end-clients. (Y. Benazzouz, C. Munilla, et. al 2014)

The Internet of things (IoT) is quick advancing with a wide scope of innovations being assigned explicitly as IoT arrangements. Studies on such arrangements for the most part reference the particular correspondence medium while refuting the total engineering of the IoT framework. According to a framework point of view, a total IoT arrangement can be isolated into three classes, the information authority, the specialized technique and the cloud stage administration. (J. Fox, A. Donnellan and L. Doumen,2019)

The accomplishment of the IoT world requires administration arrangement credited with pervasiveness, dependability, elite execution, productivity, and versatility. (A. R. Biswas and R. Giaffreda, 2014)

Progression in IoT based application has turned into the best in class innovation among the specialist because of the accessibility of Internet all over the place. To make the application more easy to use, online and android based advancements have acquired their significance in this state of the art innovation. (S. K. Vishwakarma,et. al 2019)

With each upgrade in Internet as far as speed and data transmission, IOT (Internet Of things) is taking the market on another hub and thumping the entryway with new chances of innovations. (A. K. Gupta and R. Johari, 2019)

The Received Signal Strength Indication (RSSI) worth of Bluetooth can be utilized to assess distance between Internet of Things (IoT) gadgets. IoT gadgets, inside Wireless Body Area Network (WBAN) region, can perceive each other in office climate naturally. (J. Jung, D. Kang and C. Bae, 2014)

3. Proposed Work

“Smart Home energy management system” is an IOT system that allows the user to control, manage and switch between the different power options that are available within the home. This allows the efficient

use of renewable and non-renewable energy resources. The system also allows the use of net metering system where the excess renewable energy is sent back to the grid. This allows no wastage of any energy in home. The user will be able to get the updates of the energy usage in his home also the notifications if the energy is switched between the sources.

Software requirements: Arduino IDE, Any OS that supports Arduino IDE

Table 1. Hardware requirement

Name	No. of components
Arduino MEGA	1
Arduino UNO	1
Voltage Sensors	2
ACS712 Current sensor	1
4 Channel Relay 5V	1
Bread Boards	2
1.5V solar panels	2
16X2 LCD Display	1
LCD Display Breakout	1
Wi-Fi Module	1

The above Table 1 shows the Hardware requirement and number of components required for the proposed system.

3.1 Integrated Technologies

Solar panel: Photovoltaic sunlight based chargers assimilate daylight as a wellspring of energy to create direct flow power. A photovoltaic (PV) module is a bundled, associated get together of photovoltaic sunlight based cells accessible in various voltages and wattages. Photovoltaic modules comprise the photovoltaic cluster of a photovoltaic framework that produces and supplies sun oriented power in business and private applications.

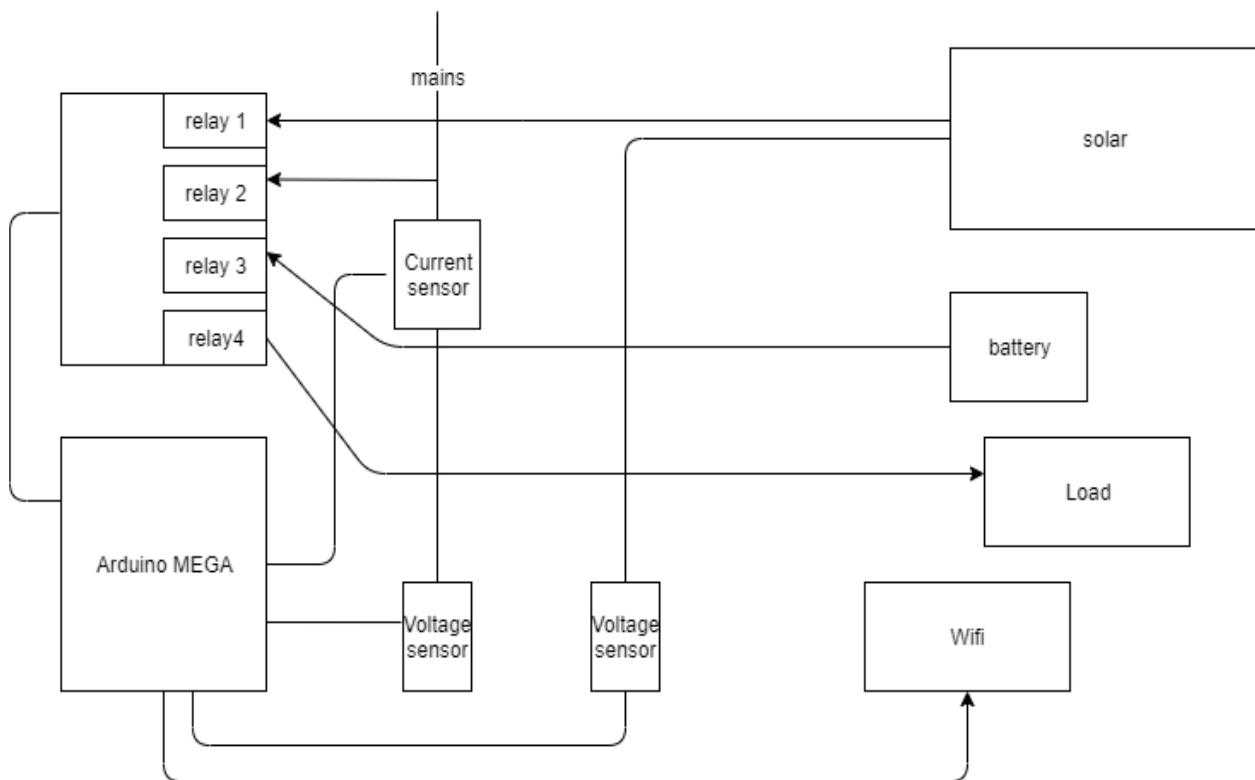
Arduino: Arduino is an open-source equipment and programming organization, task and client local area that plans and fabricates single-board microcontrollers and microcontroller units for building advanced gadgets. Its items are authorized under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL),[1] allowing the assembling of Arduino sheets and programming conveyance by anybody. Arduino sheets are accessible industrially in preassembled structure or as (DIY) units.

Relay: A hand-off is an electrically worked switch. It comprises of a bunch of info terminals for a solitary or various control signals, and a bunch of working contact terminals. The switch might have quite a few contacts in various contact structures, for example, make contacts, break contacts, or blends thereof.

3.2 System Architecture

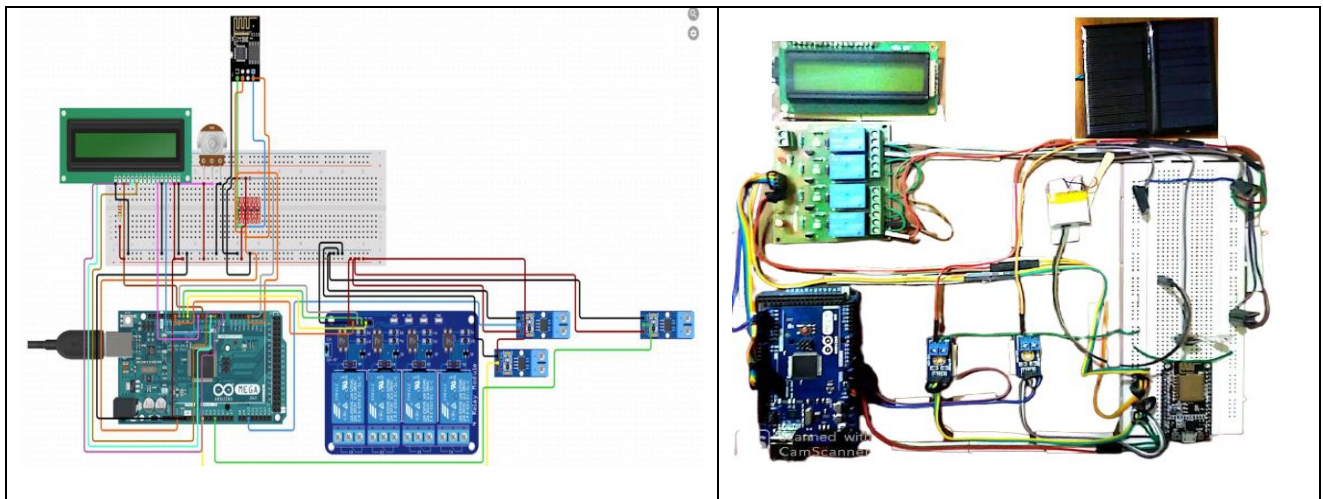
The figure 1 shows the block diagram of the “Smart Home Energy Management System”. Can see the connectivity of relay, current sensor, battery, load, wifi, voltage sensors, solar, mains and Arduino MEGA.

Figure 1. Block diagram of Smart Home Energy Management System



The figure 2 shows circuit connections between the different components Arduino MEGA, Arduino UNO , Voltage Sensors , ACS712 Current sensor , 4 Channel Relay 5V , Bread Boards , 1.5V solar panels , 16X2 LCD Display , LCD Display Breakout , Wi-Fi Module of the system.

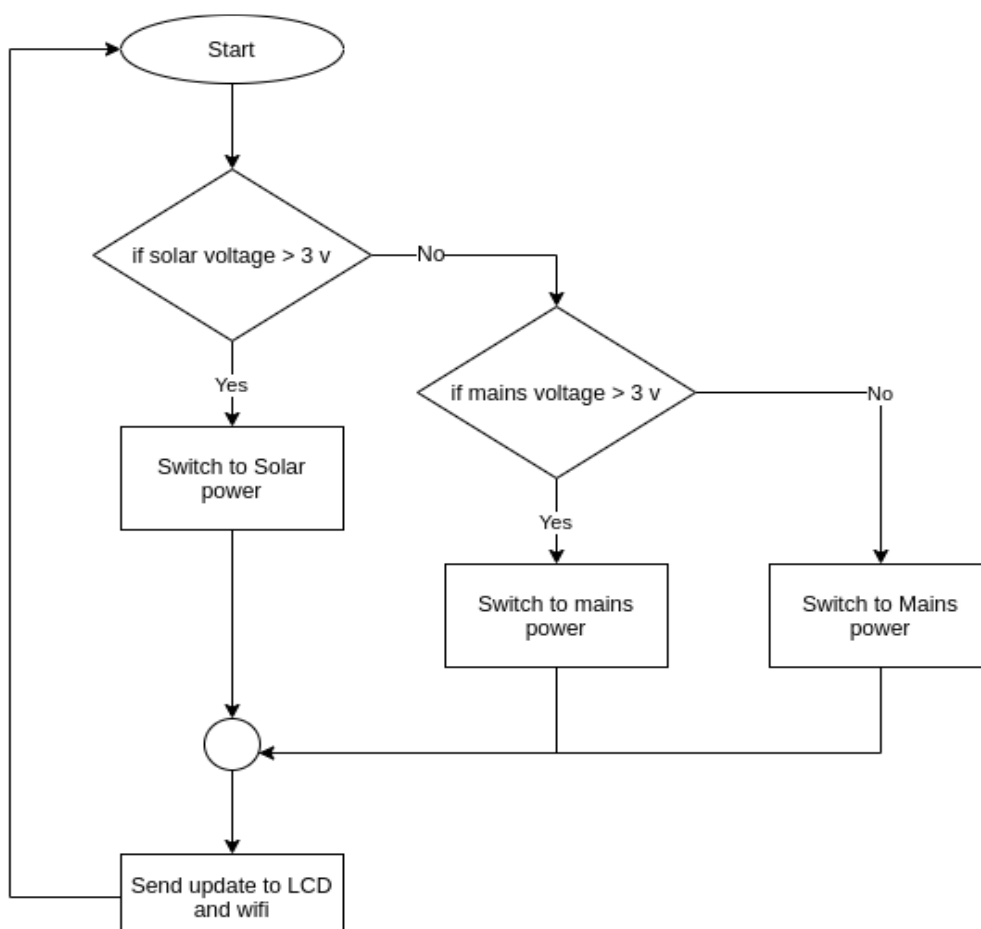
Figure 2. circuit connections between the different components of the system



3.3 Flow Graph

The Figure 3 shows the flow of activities and relationships between the different activities in the project. If solar voltage is greater than 3v then move to switch to solar power and send s upadte to LCD and wifi again repeat the same otherwise move to else condition if mains voltage greater than 3v then switch to mains power and sends update to LCD and wifi.

Figure 3. Flow Graph



4. Result Discussion

By using Arduino Mega, we have found a solution to manage and switch between different types of electricity resources available in the home i.e., the renewable resources like solar and wind energy are underutilized and are not used to their full potential due to less availability, here, we are implementing a smart technique that will switch between different electricity resources automatically according to their availability. The main Motto here is to use renewable resources of power as much as possible. The results show that the system was able to switch between the different modes, i.e. switch between the different sources of electricity automatically accordingly when the specific constraints and triggers are activated. To switch between the different sources of electricity we make use of a 4 channel relay.

Some of these constraints/triggers are:

- If the solar voltage is more than 3 volts, then switch to solar mode.
- If the main voltage is more than 3 volts and the solar voltage is less than 3 volts, then switch to mains mode.
- If the main voltage is less than 3 volts and the solar voltage is less than 3 volts, then switch to battery mode.

Since Arduino does not support parallel programming. The main switching and the monitoring/Wi-Fi services couldn't be achieved within one Arduino itself. So we decided on using another dedicated Arduino for monitoring the statistics and usage of the different power resources and the updates and notifications are sent into the think-speak cloud server through Wi-Fi internet. The think-speak cloud server allows the user to monitor, record and visualize activities such as current usage, modes, history etc. through their visualization tools.

5. Conclusion

Smart Home energy management system is an electronic system that allows the consumer to control, accomplish and switch among the diverse power options that is available inside the home. This allows the efficient use of renewable and non-renewable energy resources. The system also allows the use of net metering system where the excess renewable energy is sent back to the grid. In our research work we have implemented the idea of monitoring and analyzing the electricity usage of the home. But unlike the referenced article where its major focus is on mains power consumption and usage of power by different sockets. Our projects focus is on the efficient usage of different sources of electricity. Unlike this referenced work, we are using a fully automated system that switches between different energy resources without the need of manual intervention. The operations can also be overridden manually if the user chooses to but its

not recommended. Through this research work the user will be able to get the updates of the energy usage in his home also the notifications if the energy is switched between the sources.

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