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Home Automation Using IOT and Prosumer Based-Energy Sharing and Management (PESM)

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ABSTRACT: Internet of Things (IoT) is introducing the idea of remotely connecting and monitoring real world objects through the Internet. Observing the idea with respect to our house, this concept can aptly help to make it smarter, safer and automated. This IoT project focuses on building a home system which is automated, self-sufficient with regard of energy and demonstrate a basic model of prosumer-based energy sharing and management (PESM) home with internal home automation. Which simply means a home that produces energy by using renewable resources and trade the excess energy to smart grid or been supplied by grid. Home automation part of project is used to collect data and utilize energy in best possible way. The collected data will be stored in a cloud for data analysis purpose and remote controlling. The project also integrate the concept of utilization and management of energy taken from grid level to the level of our domestic consumption in our homes. It is not far from a reality that if a proper utilization of current level of technology happens, we can achieve a very accurate range of useful data and control over all loads. The leverage obtained by preferring this system over the similar kinds of existing systems is that the system can give analysis of energy produced and consumed. This promotes the usage of renewable energy and solar energy. The microcontroller used in the current prototype is the Mega320 Launchpad board. We have used separate Wi-Fi module to send data to cloud. The status of energy consumed, produced and temperature is displayed on LCD.

KEYWORDS :IoT, ARDIUNO, PESM, SMART GRID, REMOTE CONTROLLING, AND ENERGY MANAGEMENT.

I. INTRODUCTION

1.1 Overview: Home automation is a general term that covers a wide range of technological capabilities that can be installed in the home. Home automation will embrace dominant aspects of home remotely through a pc or phone, programming electronic devices to reply mechanically to bound conditions or situations, or centralizing the control of a variety of items in the home into a single control center. One of the applications of home automation is sensing an increase in temperature. An increase in temperature can automatically control the fan by programming according to required conditions. Home automation make our home more efficient and easier to operate both with regard of operation easiness and energy utilization, it can also help us to keep it maintained. Appliances can be connected to devices that monitor their activity and also store the data; so a self-monitoring furnace, for example, can tell when it needs cleaning and replacing, and a refrigerator can report that it needs a new filter. Home Security is also another very useful application. Package thief alarms, fire alarms, automated face recognition, finger locks and surveillance cameras



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are the most common home security devices. The devices within the home security systems package are connected through a central microcontroller or central control board. Beside the already used and mostly discussed applications of home automation, it can also be used to monitor status of energy consumption and production in home and it can be connected to smart grids to use data and provide a chance for owner to trade the energy in very accurate form. All required data and status of home which are essential for organizations providing the energy and home owners both will be sent to their systems. For example the organizations need data and graphs of annual energy consumed in very accurate, data for determining the renewable energy capacity and efficiency, energy utilization and all accounts of energy trading with their clients and possibly many more useful, so if homes are automated the data will help them and will be send to them. Similarly owners can understand their trading status and home security, so it is possible to send them all data simply to their cell phones. [1], [2], [3], [4], [5], [6]

1.2 Advantages and Features of Home Automation using IoT:

I.) Save you time and effort. By applying home automation we are approaching one more step to a completely automated and well managed world where people priorities their works. As many of other automated things in our modern world can save time, reduce risks of malfunctioning, increase accuracy and improve your personal safety.

II.) Adequate energy management. Reducing energy wastage and use it accurately and wisely. By employing sensors we can always make the best of our energy and know exactly which resources we are using.

III.) Step by step approach toward sustainable green energy by use of producing energy homes. If we can build homes with self-monitoring and automated technologies, we can always track the energy input to house, energy production and energy consumption.

IV.) Home energy independence and even trading and earning money. Now homes with this technology can always sale energy to grid if the renewable resources available such as: solar and wind energies are utilized properly. So the idea of Home Automation Using IoT and PESM is exactly to have powerful hand on control, data analysis and monitoring of energy and all home together. It can always be a very clean and profitable trade and investment without any harms to environment.[7], [8]

V.) Usage, analyze and planning of data. All collected data can be used by a higher and collective organization. Higher organization can be governmental or private sectors working in the fields of energy management, control and distribution.

II. SYSTEM ANALYSIS

2.1 Problem Definition: There has always been research and discussion about two concepts always in very separate contexts and never seemed in a perspective that the two might be integrated with each other; Home Automation using different data transferring and monitoring techniques such as IoT, and Prosumer-Based Energy Sharing and Management. So this project gives the basics of idea that we can collect a very analytic data from home not only for home owners but for organization analysis. And this to happen the best way is to use a cloud that stores data can easily be accessible.

2.2 Project Statement: Our project is Home Automation using IoT and prosumer based energy sharing and management (PESM). In this project as its name suggests we are trying to make use of existing technologies in a pattern that different ideas such as home automation, IoT, remote controlling and energy management come together to achieve smart homes, smart cities and smart electrical power grids.

III. PROPOSED SYSTEM DESIGN AND IMPLEMENTATION

3.1 Proposed System Block Diagram: The block diagram in figure-1 shows the proposed system. As it is shown we use Arduino as brain or microcontroller of our system connected to three different sensors for the basic demonstration purpose, rain sensor, temperature sensor and light sensor. The sensors will mainly help the system with automation and decision making conditions from environment. The Arduino is programmed for specific conditions received from sensors. For example: Turn ON the fan for temperatures above 35 Celsius.

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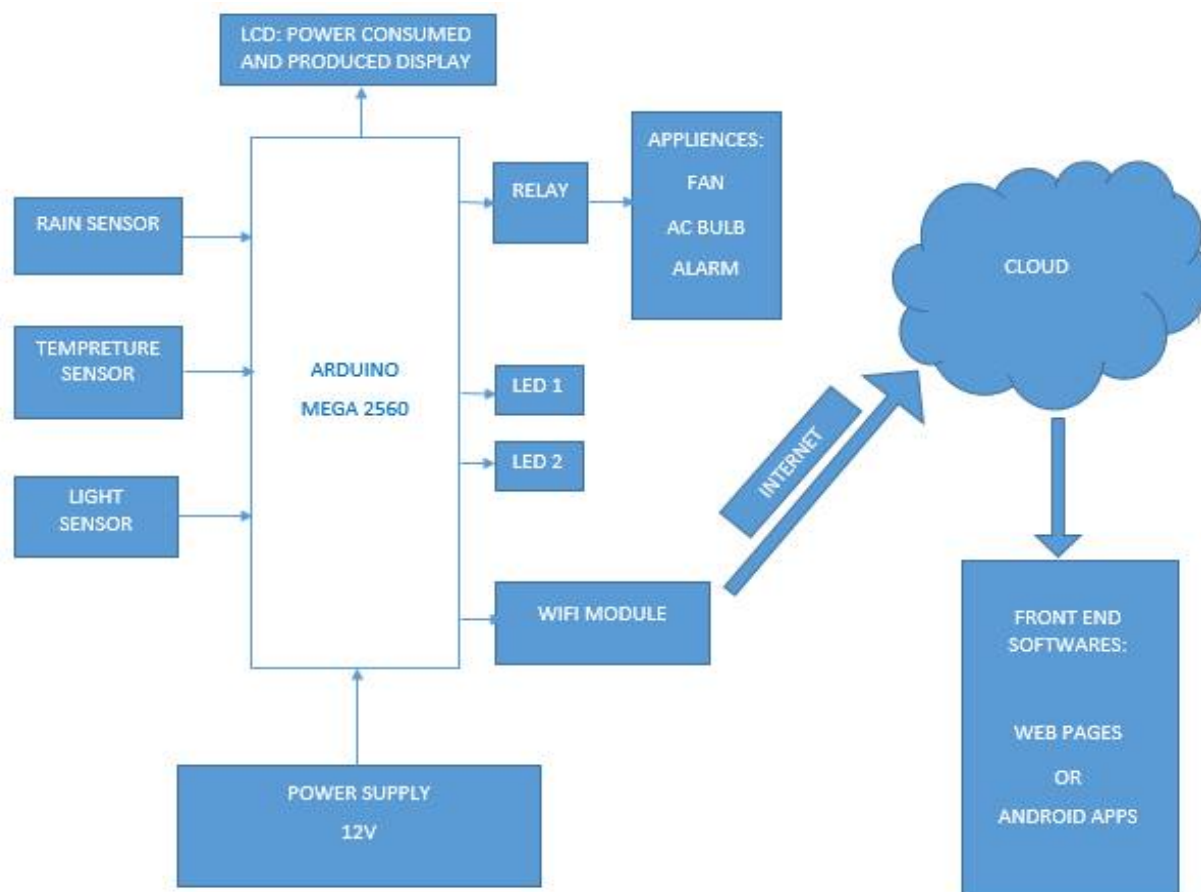


Figure 1 PROPOSED SYSTEM BLOCK DIAGRAM

The decisions taken by microcontroller/Arduino is applied to different appliances which are aimed to be controlled by relays connected from Arduino output to them. Meanwhile the data has to be transferred to cloud for storage and analysis, the task is achieved by Wi-Fi module connected to internet. The data in cloud is mainly used for data analysis. This data can be used by higher and collective organizations. But our basic demonstrative project we have an open platform used by researchers called ThingSpeak to store this data and analyze by basic mathematical calculations. Front end softwares are used to give commands. We use android app to achieve this task. LCD display is used to directly monitor the temperature, energy consumed by system and energy produced by solar panels installed in home roof tops – example of renewable resource which we have been discussing about.

3.2 Proposed System Functions: The proposed home automation system has the following capabilities and functions:

- To detect, sense and monitor light, temperature and rain.
- To control the appliances: Fan ON/OFF, Light ON/OFF, Alarm ON/OFF, LEDs ON/OFF
- To display power status using LCD
- To store and monitor the data of different sensors and appliances in ThingSpeak cloud.

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3.3 Cloud Storage and Data Analysis for Smart Grid:

The figure-2 shows clearly the block diagram and main idea behind cloud storage and its links to Prosumer or Automated Homes and Control Centers. By simultaneously updating the cloud from all Automated Homes or Prosumer Owners, the Control Centers get access to a very vast amount of useful and very accurate data. Control Centers are mainly analysis, control and monitoring centers which are designed for regional or country level functionality. Even this project is a very basic configuration of huge idea but it shows the possibility of complete usage of renewable energy and its beneficial trading. This whole completes the model of a smart and clean grid.

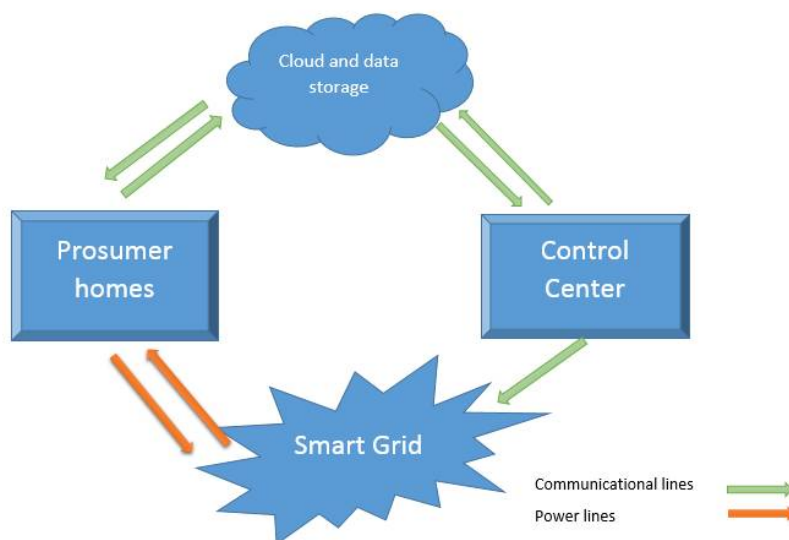


Figure 2 Block diagram of cloud storage

IV. RESULTS

The proposed system is very helpful in monitoring, controlling and management of energy in smart home environment. Proposed system also improves security. User can monitor every activity in home and can control windows and doors. This system also ensures better utilization of energy and resources through smart lighting, smart appliances and smart air-conditioning system. Mainly beside the technical part and engineering of the proposed system, the economics of the project is also observed. For future large scale implementation of the project can be achieved very easily. The cost of hardware equipment is affordable and widely available. According to studies there also a huge scope of implementing this project in market. So we got to know that applying this project both technically and economically is very achievable

This section also gives the complete details about the results of the proposed approach. The operational description with pictorial representation is shown in this section. It is having a Wi-Fi module, fire and temperature, rain and light sensors for power enhancement, and the load. The figure-3 shows the android app used for controlling our project. As it is clear from figure-3 we have separated buttons for different controllable appliances in the circuit. This is a very basic configuration of the possibilities of using more advanced and detailed android apps. By clicking on button 1&2 the LEDs will turn on.

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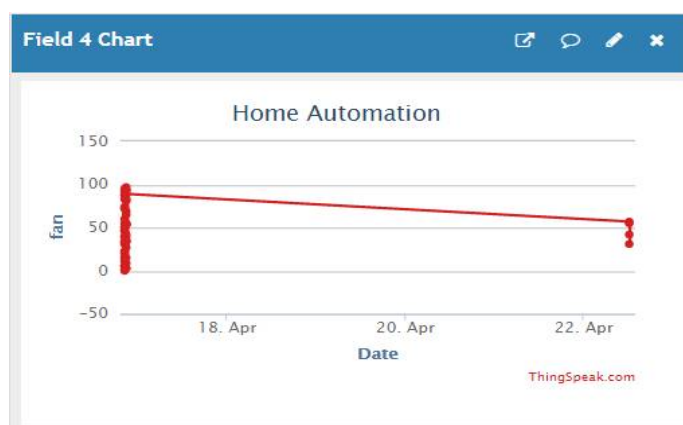
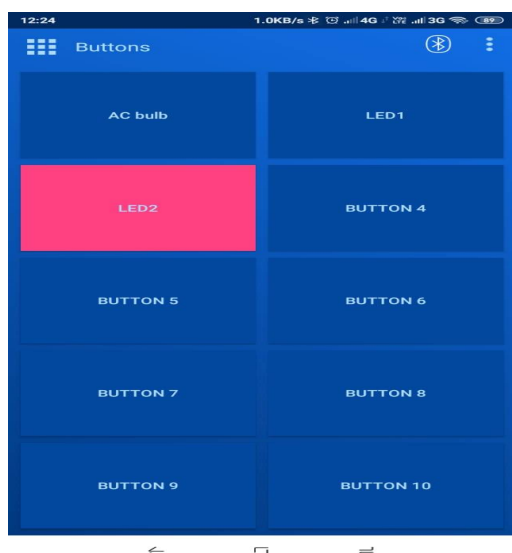


Figure 3 Android app for controlling the appliances

Figure 3 Data stored and monitored in ThingSpeak cloud

The graph shown in figure-4 show the cloud data monitoring and saving. As discussed in pervious parts the main object of project using IoT is to store and monitor data in a cloud. The objective is achieved by monitoring the samples of data according to time for different sensors and appliances. When a sensor get data or an appliance is turned ON the data will be send through Wi-Fi module to cloud. The cloud which we are using in our academic propose is the public domain called ThingSpeak. All data will be saved in cloud forever and can be used for data analysis.

V. CONCLUSION

The proposed IoT based smart home system can be implemented in future smart cities in India and all around the world. Currently the proposed system performs various functions as described in above sections. In future, the proposed system can be extended to perform other functions such as water and waste management. As if now for our project we worked with adding the concept of PESM to Home Automation and Internet of Things, probably other researchers find it more interesting to work and find the connections of Artificial Intelligence AI and Machine Learning with existing technologies for smart homes and Energy Management. The idea of Home automation and Internet of Things is having a very vast range of application. By some modification of inputs and outputs it can be used in any part of industry also. Briefly it can be used for Minimum use of nonrenewable energy, Smart Homes, Sufficient Energy Management and Smart Grids.

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