Energy Conservation Using IoT

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Abstract - *Energy conservation is gaining popularity day by day because of large usage of electrical appliances and due to improper use of methodology to conserve it. So, to achieve this, home appliances and electrical devices can be connected to internet. This enables automation of devices like fans, lights etc. Which helps in conservation of power. In this paper an IOT based energy conservation system is proposed whose goal is to develop a system that can be used to save the extra unused energy. This system can be remotely accessed through the internet. It is based on multimodal application that can be operated through a web based application.*

Key Words: *Energy Conservation, Automation, Relay, Internet of Things (IoT), Raspberry Pi4, Node MCU.*

1. INTRODUCTION

Energy is a precious resource especially now and moving forward when most of our energy sources are mostly fossil fuels are depletable or nature dependent. We often come across situations where excess energy is used up or rather wasted when no one is utilizing it. This brings us the need to conserve the energy and make efficient use of it. The project is aimed at monitoring the energy usage and usage patterns to then automate the appliances to function in apt conditions where they are actively being used. The advantage of using IoT is that the whole system can be brought online and its flexibility can be increased further. Not to mention the fact that the system would be able to make switching decisions based on the environmental data gathered by the sensors. The system can also be controlled remotely. The system also aims to learn the usage Pattern and distribute the energy required accordingly.

IoT can be employed for improving energy efficiency, increasing the share of renewable energy, and reducing environmental impacts of the energy use. This paper reviews the existing literature on the application of IoT in in energy systems, in general, and in the context of smart grids particularly. Energy conservation is the effort made to reduce the consumption of Energy by using less of an energy service. This can be achieved either by using energy more efficiently (using less energy for a constant service) or by reducing the amount of service used (for example, by driving less). Energy conservation is a part of the concept of Eco-sufficiency. Energy conservation measures (ECMs) in buildings reduce the need for energy services and can result increased environmental quality, national security, *personal financial security* and higher savings.[1] It is at the top of the sustainable energy hierarchy.[2] It also lowers energy costs by preventing future resource depletion.[3]

Energy can be conserved by reducing wastage and losses, improving efficiency through technological upgrades and improved operation and maintenance. On a global level energy use can also be reduced by the stabilization of population growth.

Energy can only be transformed from one form to other, such as heat energy to motive power in cars, or kinetic energy of water flow to electricity in hydroelectric power plants. However, machines are required to transform energy from one form to other. The wear and friction of the components of these machines while running cause losses of very high amounts of energy and very high related costs. It is possible to minimize these losses by adopting green engineering practices to improve life cycle of the component.

2. LITERATURE REVIEW

In one of the researches reported, IoT Based Automated Temperature and Humidity Monitoring and system developed using raspberry pi. Pi receives the temperature also as humidity values sensed and therefore the same sent to the web. This project however has resulted in prototype development of automated temperature and humidity control with good feasibility. Research also been administered towards Smart Home Control and Monitor System using IoT where a User-Friendly GUI been developed which may be accessed globally from any device that has internet connectivity. In addition to the abovementioned research, Smart Home Monitoring prototype developed by employing Android mobile handset and Wireless Sensor systems. This system monitors the usage characteristics of electrical power at the socket outlet in real time. This system measures the Voltage Current and temperature of socket outlet periodically from each room and monitored data sent to the system towards computing the edge violation for action by the user before circuit breaker gets tripped or fire breakout happens. Also research work carried out in developing an Automatic Lighting and Control System for the efficient use of energy. They have also provided mobility and remote command execution to system using Android mobile App via Bluetooth to regulate lighting based on voice command. Energy Management System for Smart Home has been developed to manage energy at the extent of appliances. So, towards this

Home Energy Management System Architecture been developed. In this system, Sensors control the energy consumption of home appliances. In addition, solar power is employed an alternate source where consent in change within the weather, resources are often switched. Energy data from numerous home servers are aggregated by the PC server and accordingly compare them for producing statistical analysis information.

In none of the earlier projects, system been developed towards controlling the electrical appliances usage based on environmental conditions which could ultimately reduce the energy consumption of appliances.

So we are using hall and light intensities sensor to give temperature, humidity and light intensity of environment which will help us to control the different appliances according to the required conditions.

Components

• Node MCU
Node MCU is an open-source firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espresso Systems, and hardware which is based on the ESP-12 module.

• Raspberry Pi4
The Raspberry Pi 4 Model B is that the newest version of the low-cost Raspberry Pi computer. The Pi is different from your typical device; in its cheapest form it doesn't have a case, and is simply a credit-card sized electronic board.

• Relay
Relays are electric switches that use electromagnetism to convert small electrical stimuli into larger currents. These conversions occur when electrical inputs activate electromagnets to either form or break existing circuits.

• PIR sensor
A PIR sensor measures infrared that's reflected off moving objects that emit heat. They are commonly won't to detect movement of individual and animals to trigger alarms and security lighting.

• Resistor
A resistor could be a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses.

• Diode
A diode could also be a semiconductor device that essentially acts as a one-way switch for current. It allows current to flow easily in one direction, but severely restricts current from flowing within the opposite way.

• Capacitor
A capacitor (originally mentioned as a condenser) could also be a passive two-terminal electrical component want to store energy electrostatically in an electrical field. The type of practical capacitors varies widely, but all contain a minimum of two electrical conductors (plates) separated by a dielectric (i.e., insulator).

• Connecting Wire
A wire could also be versatile strand of metal, usually cylindrical. Wires are used for establishing electrical conductivity between two devices of a circuit. They possess negligible resistance to the passage of current.

• Light Bulb
A wire could also be versatile strand of metal, usually cylindrical. Wires are used for establishing electrical conductivity between two devices of a circuit. They possess negligible resistance to the passage of current.

• Light Sensor
The light sensor could also be a passive device that convert this "light energy" whether visible or within the infra-red parts of the spectrum into an electrical signal output. Light sensors are more commonly referred to as "Photoelectric Devices" or "Photo Sensors" because the convert light energy (photons) into electricity (electrons).

• AC Motor
An AC motor is an electrical motor driven by an AC (AC). The AC motor commonly consists of two basic parts, an outside stator having coils provided with AC to provide a rotating magnetic flux, and an inside rotor attached to the output shaft producing a second rotating magnetic flux.

• SD Card
Secure Digital, officially abbreviated as SD, could also be a proprietary non-volatile memory card format developed by the SD Association (SDA) to be utilized in portable devices.

• AC Wall Adapter
An AC adapter, AC/DC adapter, or AC/DC converter could also be kind of external power supply, often enclosed during a case almost like an AC plug. ... AC adapters are used with electrical devices that require power but don't contain internal components to derive the required voltage and power from mains power

3. METHODOLOGY

The system consists of 3 main components:
Sensor Node, Hub, Switch Node.
The Sensor Node works to gather the data from the environment, in this case the sensed factors being temperature, humidity, light intensity, electrical power, and presence of people. This environmental data is then sent to the hub through the controller connected to the sensors. The Hub is the brains of the operations; it not only houses the rule engine which dictates the operation rules but also provides an interface for interacting with the system. Many sensor and switch nodes can be connected to the hub. The switch node is the part which controls the actual switching of appliances. The switching is done when commands are given to this node by the controller. The switch node has a controller for data processing and transfer and relays for opening or closing the actual circuits. In all the hub provides the instructions to switches based on the environmental data collected by the sensors and the rules set for operations programmed by the users.
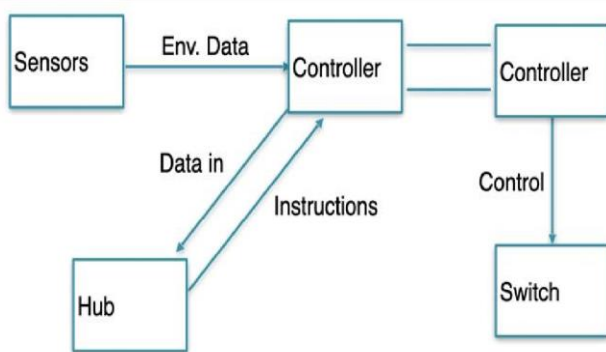

Figure 1. Block Diagram of Energy Conservation

4. CONCLUSION

Smart Home and Energy Management is current trend with of IoT. Lot of labor been reported with regards to controlling the appliances of home and also on monitoring the electrical parameters towards hazard. Also work reporting in controlling the appliance for energy consumption. So, with all these works reported, we here have developed a better IoT system for Energy Management which takes the Humidity, Temperature and light intensity into consideration and accordingly interfaced with Arduino Microcontrollers for controlling the usage of appliance like speed of fan, can develop power instead of just turn on or off. Also, the prototype system computes the current drawn from each appliance based on appliance usage and send to Raspberry Pi3 where total power consumed of appliances computed against time. This information is computed during the day and same uploaded in cloud server too. This ultimately achieves in energy consumption of each household leading to Energy Management using IoT. More amount of power is often saved supported the lesser usage of the appliances. There is also a manual control over the appliances. We have implemented algorithm that learns the change in the weather based on season and detect changes in season based on the temperature, humidity and brightness. The system so developed is not fully complete. In future, we propose to extend the system for controlling appliances based on the presence of humans.

5. REFERENCES

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