Energy Monitoring for Small Smart Farm Using Internet of Things

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Abstract. The primary aim of this study is to monitor energy utilization. Real time energy monitoring to avoid over energy surcharges in residential buildings. We apply a low cost, advanced embedded hardware with Arduino NODEMCU ESP8266 and smartphone with cloud computing technologies are used to develop a prototype model. It will provide optimal solutions for real time monitoring of energy for regulation. Our system is based on Internet of Things (IoT) and mobile phone.

Introduction

Real time monitoring can help people for optimized energy usage. The system based on IoT and smart phone for real time monitoring and responsive control on energy utilization. This will save the energy surcharge. The data acquisition module and utility meters are connected to the Internet through a suitable gateway, to send data of interest to local web server or mobile applications. The system can be controlled by the user. The collected energy data is stored locally and also in the cloud.

The stored data is for the user for decision making. This information can be applied to decrease energy consumption. Arduino based controller is an efficient tiny device to sense and process the real time data and also provides better response with system integration.

![Arduino NODEMCU ESP8266 Prototype Model](image)

Figure 1. Gives an overview of Arduino NODEMCU ESP8266 based prototype model.

Thus during load shedding, low end consumer will be affected more than high end consumers. This prototype model provides the fairness in terms of a common load sharing strategy among all types of consumers for their basic necessity during peak hours. The difficulty of real time energy monitoring and dynamic schedule based energy regulation is minimized with IoT.

In proposed Multi Agent System [MAS] to autonomously manage the energy beyond individual capability of a single agent. MAS enhanced the operational efficiency of energy management and consumer demand in autonomous energy management system. The agents are more responsive in task accomplishment. The growing demand for energy in different countries like India and China is emphasised. Enforcement of energy management in real time case is for the benefit of the consumer
considering the demand, change in energy price in real time and the time of energy use. Energy consumption during peak hours can be reduced with the focus on Heating Ventilation and Air Conditioning (HVAC) 3. The access of physical data from remote locations and its transmission to the base station is made easy with Wireless Sensor Network (WSN) 4. It also supports remote monitoring of energy meter data with high reliability. The role of WSN has further heightened with the evolution of the internet and advancement in the internet services to form an inseparable part of IoT 5. However, it has its own restrictions in terms of extraction of information from the data, based on the application. At the same time, real time processing of the data and data security are the major concerns on integrating with IoT. With the advancements in the field of tiny controllers and devices, a vast range of hardware’s are available for integration with IoT for real time network monitoring solutions 6. With the help of IoT integrated controllers, RTEMMS can be realized at ease for monitoring and control. The current method of energy regulation by load shedding can be mitigated by load sharing with a proper demand supply based scheduling. An IP based 7 connectivity with WSN approach for IoT has been discussed where challenges and advantages of IPv4/IPv6 interconnectivity for the particular application has been analyzed. Residential and commercial buildings consume one third of the global energy generation. The energy providers, as well as consumers have realized the importance of energy management during peak hours to avoid the burden of load shedding, energy surcharges and dependence on secondary energy sources like generators and inverters. Increasing energy usage will also affect the environment with the presence of elevated level of greenhouse gas leading to climatic changes.

**Proposed Model**

Embedded hardware is developed for real time monitoring of the energy usages for customers and self-regulation.

Arduino NODEMCU ESP8266 is used to collect the data from energy sensor. In this work a voltage regulator is chosen for simulated voltage rating for the energy consumption data. From the collected data, data of interest (energy data in Kilo Watt Hour (KWH) format) is sent to a local web server with the use of local network as well as an open source mobile application using internet via cloud based services. The data can be viewed in a KWH format in real time by logging into the local web server and also through smartphone application. The consumer can control the energy usage in order to avoid additional surcharges

**System Implementation and Results**

Energy consumption is monitored in real time using IoT to bring about energy awareness to the consumer.

![Layout of working module.](image)
Our system can help the user to control the energy consumption. The real time data monitoring will be very useful to predict the energy demand from time to time. The energy data are sent to the web server via internet the energy data are stored in the database server and can be retrieved by any authorized client. By using the web server, remote monitoring of energy data is done efficiently.

**Experimental Results**

Our system is based on Arduino and the codes are developed in the Arduino IDE and tested. Initially, the output is monitored at the terminal. The data can be viewed at the web server and mobile application.

![Figure 3. The data can be viewed.](image)

Our mobile application is an open source entity that can be integrated with Arduino. Through this application can display real time data. The data provides the energy consumption in real time through a smartphone.

**Conclusion and Future Scope of Work**

The energy management system will get transformed to smart system with IoT. The energy data can be collected in real time for monitoring and control through web server as well as mobile application. The user can control energy usage. The system can be enhanced in future by applying Artificial Intelligence for automatic regulation. The automated system will be switching from conventional source of energy to non-conventional source when the consumer reaches the scheduled energy usage limit.

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**References**


