



Green Building - Energy Conservation using IoT

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Energy resources are the main generator of electricity and works based on its natural condition and circumstances, namely - renewable, fossils and nuclear energy. Wind, wave, tidal and solar are examples of renewable energy resource and coal, oil and natural gas are instances of fossil energy resource. Energy conservation plays a significant role to reduce demand, develop and use renewable energy sources, protect and replenish supplies and reduce climate changes. In a study done by the Japan International Cooperation Agency in 2013, a masterplan for energy conservation in the power sector was created for the Sultanate of Oman. The masterplan aims at bringing power efficiency on the demand side and conserving electric power by the year 2023 and thereby institutionalize and promote an Energy Efficiency & Conservation policy (EE & C). The EE & C policy have led to the rise of 'green' building projects in Oman which works to reduce and prevent negative impacts on natural environment and conserve energy. Advertently the Oman Green Building Council (OGBC) was established in 2012 which aims at promoting green building concepts and ensure sustainable development. Sustainable energy is meeting requirements of the present generation without wastage and the ability of future generations to meet their own requirements. This project chooses an office room in the college as a sample and attempts to make it 'green'. We use renewable energy like solar, pollution and waste reduction measures, and enabling recycling and re-use of materials that are non-toxic, ethical and sustainable and adapts to a changing environment. The project will use IoT devices like sensors and boards with microcontrollers (Raspberry PI) to achieve sustainability and 'green'. An app will show real time use of electrical components like light, air conditioner and fan and controls the usage of these components to maximize the percentage of sustainability and energy efficiency. The results of the app like real time measurement of energy consumptions accruing to a days' usage are useful in further data analysis. This project will help to implement the system in the entire organization and adding an impetus to the global energy efficiency and conservation struggle.

Introduction

One of the major consumption of energy is buildings. The Energy Efficiency and Conservation policy of Oman demands studying and developing means to conserve energy in buildings with the help of modern technologies like IoT. The need is therefore high in dealing with dynamic and diverse requirements of buildings like occupancy tracking and optimizing the use of energy (Wayes T, Nipun W, Wen-Tai L, Chau Y, Vincent H, Tapan K. S, Kristin L. 2018). IoT has opened wide knowledge in innovations using internet to bring any object to the part of the internet network. The smart property of IoT devices allows it to be networked and communicate among them. Internet of Things helps in developing smart environment so that the people can reap its benefit and can lead an easier and simpler life. Today IoT is promoted in constructing smart cities, smart public services, smart health services and also smart home or office. Green building is a concept that involves the use of appliances that utilizes natural energy sources in its functioning (Manic M., Wijayasekara D., Amarasinghe K., Rodriguez J.J., 2016). In addition, when the Green building is

smart implies automatic monitoring, making the building more efficient and energy consumption is minimized. The project discussed in this paper is about smart devices and applications that help in converting an office room to the concepts of green building. Sensors play an important role in the making of this project. Sensors help in reducing energy wastage and make the office room energy efficient. Sensor data offers a way to control the use of energy in the office room thereby reducing energy consumption and the room can now referred to as Green building.

Block Diagram

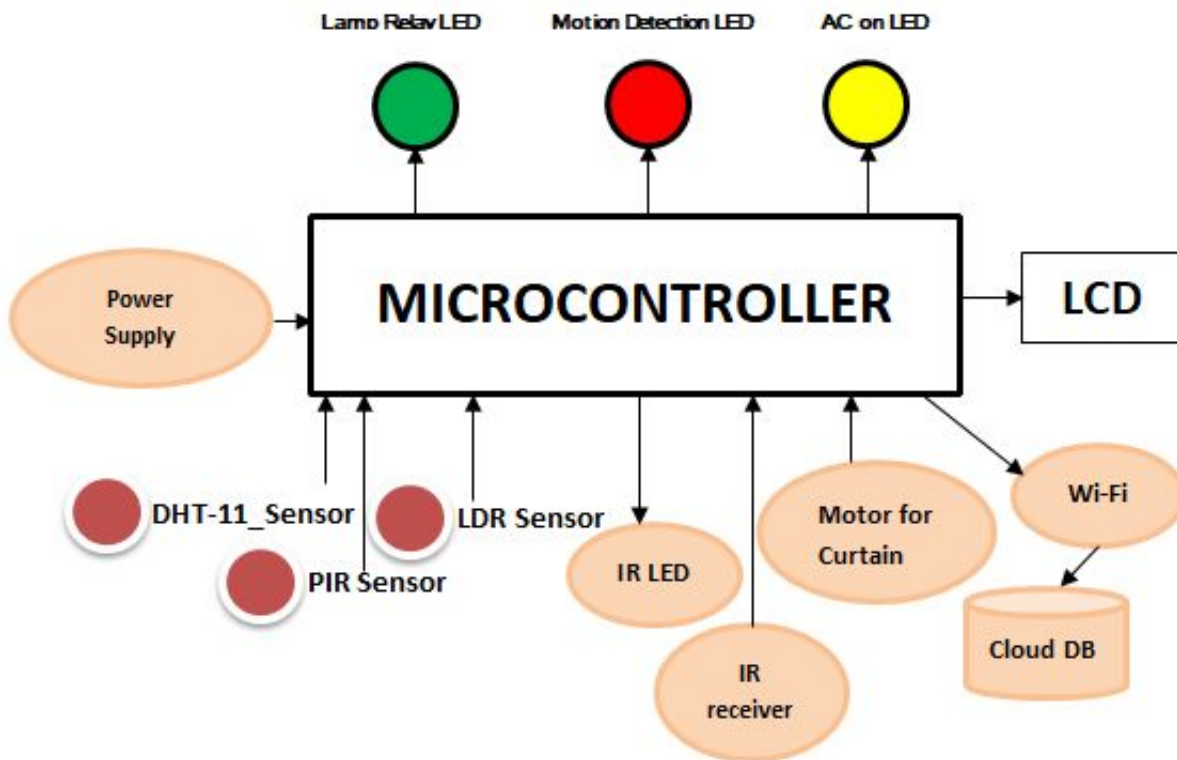


Figure 1. Block diagram of Green Building - Energy Conservation using IoT

Working

The system designed in this project uses Raspberry Pi which is a single board computer which acts as the microcontroller (Figure 1). When the system is turned ON, the software program undergoes a self-test and initializes the sensor readings. The DHT-11 sensor is used to collect temperature and humidity data. The LDR sensor measures the intensity of light (Pandharipande A., Caicedo D. 2015). The motion sensor (PIR) tracks people in the office room. The infrared receiver monitors the temperature of the air conditioner. Sensors are controlled with the help of stored program that decides the operation of different electrical appliances and that of window curtains in the office room. During day time and for a high value of LDR the window curtain automatically retracts allowing day light to enter the room. The value of LDR is used to control the use of electrical light (Cheng Z, Zhao Q, Wang F, Jiang Y, Xia L, Ding J 2016). The room temperature is optimised to remain at 24 degree Celcius. However the DHT-11 and LDR readings are controlled to be used on a positive count of value from the PIR sensor. In other words the light, air- conditioner and window curtains are smartly operated based on the number of person in the room. Therefore these electrical appliances will not operate during night unless people remain in the room after office hours. The glow of differently coloured LED's provided on the system indicates the use of these electrical appliances. The readings of the sensors are displayed in the LCD unit. The data from the sensors and the operation of electrical appliances are stored in database which can later be used to



analyse energy consumption (Javed A, Larijani H, Ahmadinia A, Gibson D 2017).

Results

In most of the buildings all energy consuming appliances are controlled manually and managing these appliances with human resource is laborious and not cost effective. The project discussed in this paper overrides the manual approach by automating the electrical appliances using IoT. The monitoring of these appliances is accurate and tends to behave smartly (Singh S, Majumdar A 2017). This system can also be used for home and small energy consumers.

The proposed kit discussed in this paper behaves in a smart way and eliminates human interventions in the operation of energy consuming devices. In addition to the LCD in the system, different user interfaces adaptable to desktop computers and smart phones helps remote monitoring (Singh S, Majumdar A 2017).

Conclusion and Future Work

The design of a green building solution with IoT discussed in this paper is intended to be used at The College of Applied Sciences, Sohar. The control of electrical appliances with the help of a software program using the IoT sensor data has made the office room smart. The designed kit can be replicated to all office rooms of the building and an analysis of the cumulative consumption of energy of the whole building can be obtained. Therefore the system helps to promote the Energy, Efficiency and Conservation Policy of the government of Oman. We will pursue this system in tracking and identifying the people of each room using the OpenCV algorithm for image detection, preventive and operational maintenance of electrical appliances intending to increase the degree of smartness (Tyndall A, Cardell-Oliver R, Keating A 2016).

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