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Smart Campus System using IoT

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ABSTRACT

Internet is a revolutionary invention, it has always been transforming itself into some or other new kind of hardware and software which makes it irresistible for anyone. IOT can be termed as a universal global neural network in the cloud which connects various things. IoT promises a machine-machine type of communication. The IoT is a system comprising various devices or systems which are intelligently connected which interacts and communicates with other machines, environments, objects and infrastructures. With the areas like business, transportation, medicine, energy, agriculture and others, the Internet of Things also finds a major implication in education. A university campus can be considered as the ideal place for the creation of a smart environment. The aim of the hereby paper is to describe a new concept called Smart University by providing a comprehensive overview of the IoT scenario and reviews its enabling technologies and the sensor networks.

Keywords : Internet of Things, Smart campus, Super sensors, Wireless sensor node

I. INTRODUCTION

The IEEE IoT Initiative provides two definitions based on the complexities of an IoT system. The definition for low complexity systems is as follows: "An IoT is a network that connects uniquely identifiable "things" to the Internet. The "things" have sensing/actuation and potential programmability capabilities. Through the exploitation of unique identification and sensing, information about the "thing" can be collected and the state of the 'thing' can be changed from anywhere, anytime, by anything."[4]

For large complexity systems, the definition given by the IEEE IoT Initiative is the following: "Internet of Things envisions a self-configuring, adaptive, complex network that interconnects 'things' to the Internet through the use of standard communication protocols. The interconnected things have physical or virtual representation in the digital world, sensing/actuation capability, a programmability feature and are uniquely identifiable. The representation contains information including the things identity, status, location or any other business, social or privately relevant information. The things offer services, with or without human intervention, through the exploitation of unique identification, data capture and communication, and actuation capability. The service is exploited through the use of intelligent interfaces and is made available anywhere, anytime, and for anything taking security into consideration."[4]

In this digital era, the life of human beings is getting simpler as almost everything is being automatic, replacing the old manual systems. Nowadays internet have become an integral part of humans everyday life without which they are helpless. Internet of things (IoT) provides a platform where devices can be connected, sensed and controlled remotely across a network infrastructure. The IoT devices controls and monitors the electronic,

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electrical and the mechanical systems. Single admin controls the various devices connected to the cloud server and also facilitates a number of sensors and control nodes. The admin can access and control all the nodes connected to each user but a single user can control only the nodes to which are connected to that particular user. The whole system uses IoT hence the devices connected to internet like mobile or computers can remotely control all the functions and features of the appliances from anywhere. The system designed is economical and scalable as it can be expanded by connecting and controlling of a number of different devices.

Generally, all universities are connected to internet, and in each there are many similar objects that can be converted into smart objects within meaning of Internet of Things. The university campus may consist of simple common objects like doors, windows, printers, projectors, books, poles, benches etc. or complex objects like buildings, classrooms, laboratories and parking etc. All these objects can be converted into smart objects by attaching sensors, QR tags (texts,links,graphics), RFID, NFC and these objects are given a significant level of intelligence to allow operation of actuators and even decision making. The set of all these smart objects can transform a classical campus, into a Smart Campus.

II. RELATED WORK

Kristian Hentschel et al. Here they have outlined the motivation for super sensors, based on inexpensive Raspberry Pi devices attached to off-the-shelf sensors. System uses Python language which is well supported on Raspberry Pi it also provides various libraries for connecting hardware interfaces [1].

Tejas Thaker et al. Here authors considered a cost of a designed Wireless network , here we use Low cost and energy efficient ESP8266 Wi-Fi module for developing a Wireless Sensor Network. ESP8266 module provides high performance, high integration performance [2].

Shopan Dey et al. authors focused on home automation using smart phone and computer. The IoT devices controls and monitors the appliances that may be electronic, electrical or mechanical systems. Single admin controls the various devices connected to the cloud server and also facilitates a number of sensors and control nodes [3].

Marian Cata et al. In this paper, the author developed the idea that a university campus may represent the ideal place for the creation of a smart environment. As many universities are connected through internet the implementation of the concept is a practical idea. The concept of smart university is defined like a small world where sensor enabled and networked devices work continuously and in collaboration to make the infrastructure more smart [5].

Csar Cheuque et al. Here they demonstrated an university project to control the LED devices. The purpose of the project is to give the first approximation of a system using Web technology Raspberry Pi. The system allows inclusion of modules and can be a real alternative in the implementation of a Smart Home [6].

Sheikh Ferdoush et al. Here author described about a wireless sensor network system developed using open source hardware platforms like Arduino and Raspberry Pi. The system is low-cost and highly scalable. The various type and number of sensors can be connected hence it is suitable for wide variety of applications related to environmental monitoring [13].

E. Yoneki et al. authors introduced the RasPiNET, it is a form of a Delay Tolerant Network consisting of Raspberry Pi computers. Each Raspberry Pi is equipped with WiFi communication capability and a battery pack and RasPiNET can operate a data mule communication [15].

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S. Banerjee et al. gave an unique design of a secure sensor node prototype. The proposed system communicates over bluetooth using RC4 encryption algorithm between a mobile phone and their monitoring equipment [16].

R. Szabo et al. They have described generic framework for smart city applications which is built upon XMPP ie. Extensible Messaging and Presence Protocol for mobile participatory sensing [17].

III. SYSTEM ARCHITECTURE

The smart campus system can be used in large campuses for the purpose of automating the electronic devices and also to make the overall system power efficient. In large buildings, it is not always possible to search for a vacant room like meeting room or study room and also one cannot go through all the rooms to switch off the appliances when not in use. In such cases it is always recommended to automate the appliances. Also we know that internet has been the basic need of human beings. So we can connect all the appliances to the internet. And we can get the required information from anywhere on the device connected to internet. Here, temperature sensor are used to sense the ambient temperature and according we can control the fans in the building. Similarly, with the help of LDR we can check the light intensity in the room and accordingly we can control the lights. Current sensor is used to determine the current through overall load and hence we can calculate the overall power consumption.

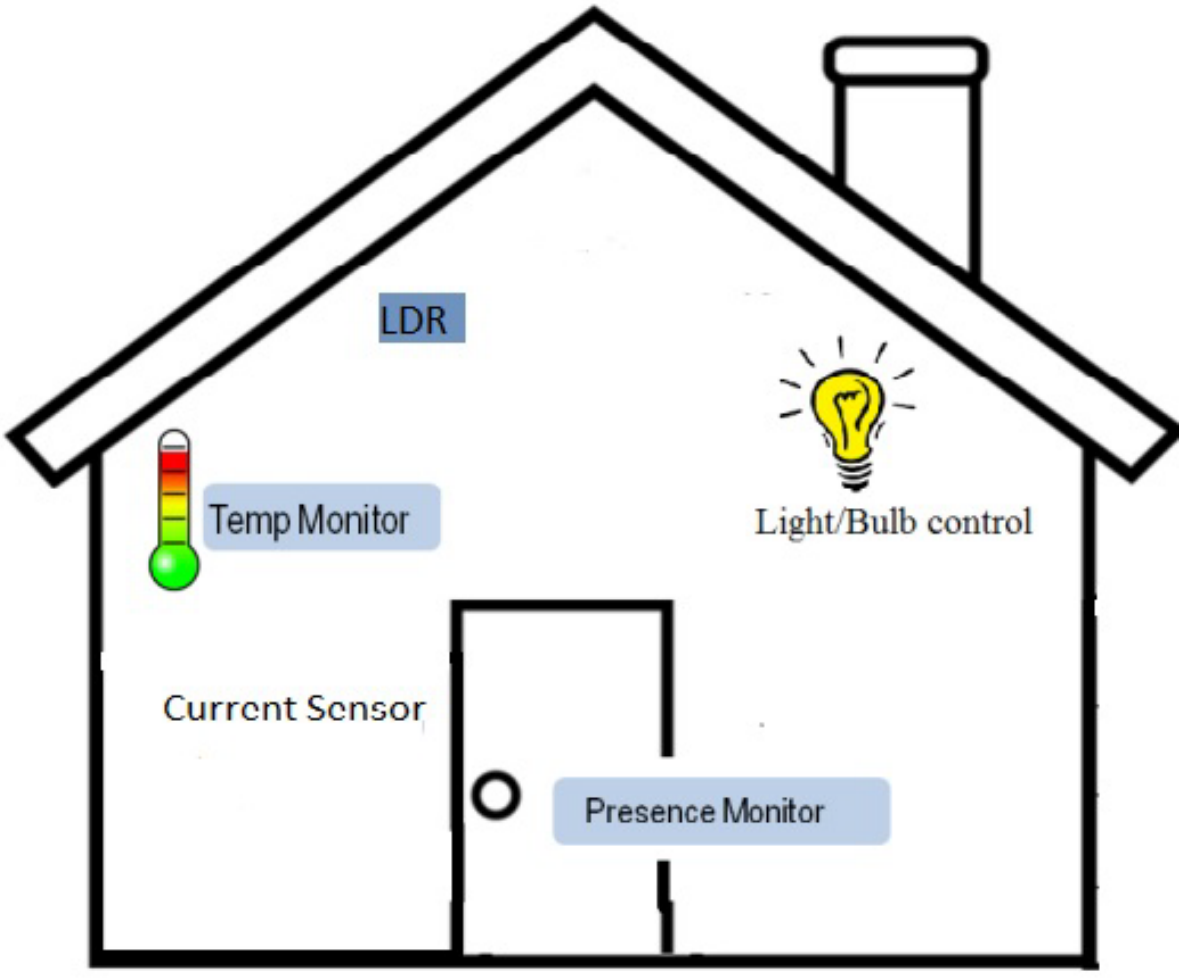

Fig. 3.1: Architecture of Smart Campus

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IV. PROPOSED SYSTEM

4.1 Block Diagram

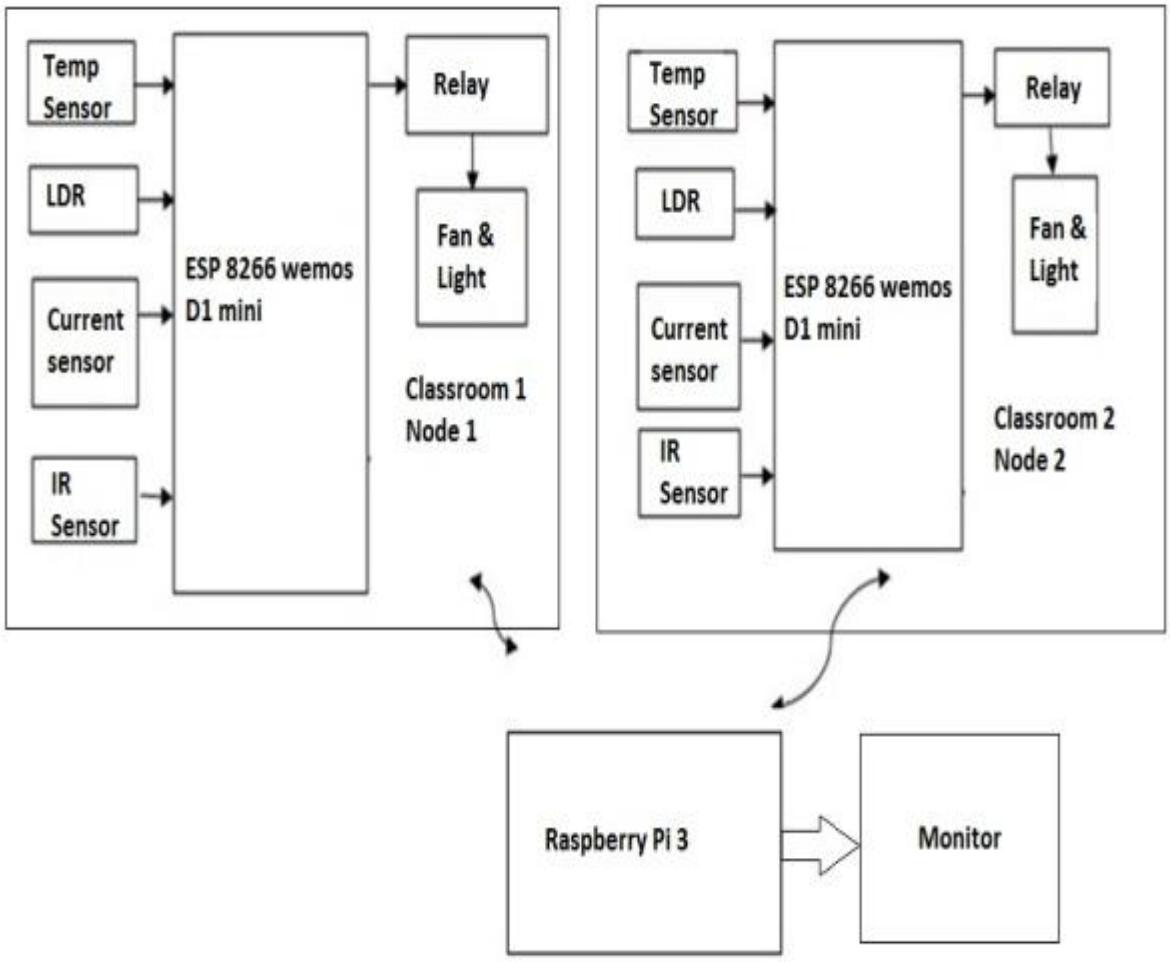

Fig. 4.1: Block Diagram of Proposed System

In this section we are proposing a low cost and power efficient smart campus system in real time using IOT environment.The temperature sensor, light sensor and current sensor monitors the temperature, light and current resp. The IR sensor is used for monitoring whether any person is present in that room. The data from all the sensors is given to the ESP8266 Wemos D1 mini wi-fi enabled board. This module transmits the information wirelessly to the Raspberry pi available within the range. Raspberry pi credit card microcontroller can store and transfer the data of different sensor. Now the Raspberry pi transfers this data to the main server which can be remotely located, this creates a web based GUI to display all the information. Also by comparing the values of temperature sensor and IR sensor to the threshold value given. If both the values are above threshold system will automatically turn on the fan. Similarly, by comparing the values of LDR and IR sensors with the threshold, if value is greater than threshold then system should turn on the lights. If any of the criteria is not fulfilled it will not turn on the lights or fan. We connect our own applications to proven scalable open source software for a persistent document data store (Mysql), and a performing publish-subscribe system, cache, and queuing system (REDIS). We make use of Protocol Buffers for serializing and parsing transmitted data using the proto3 format to specify message types and service endpoints.

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V. SYSTEM FLOW

5.1 Hardware Flow

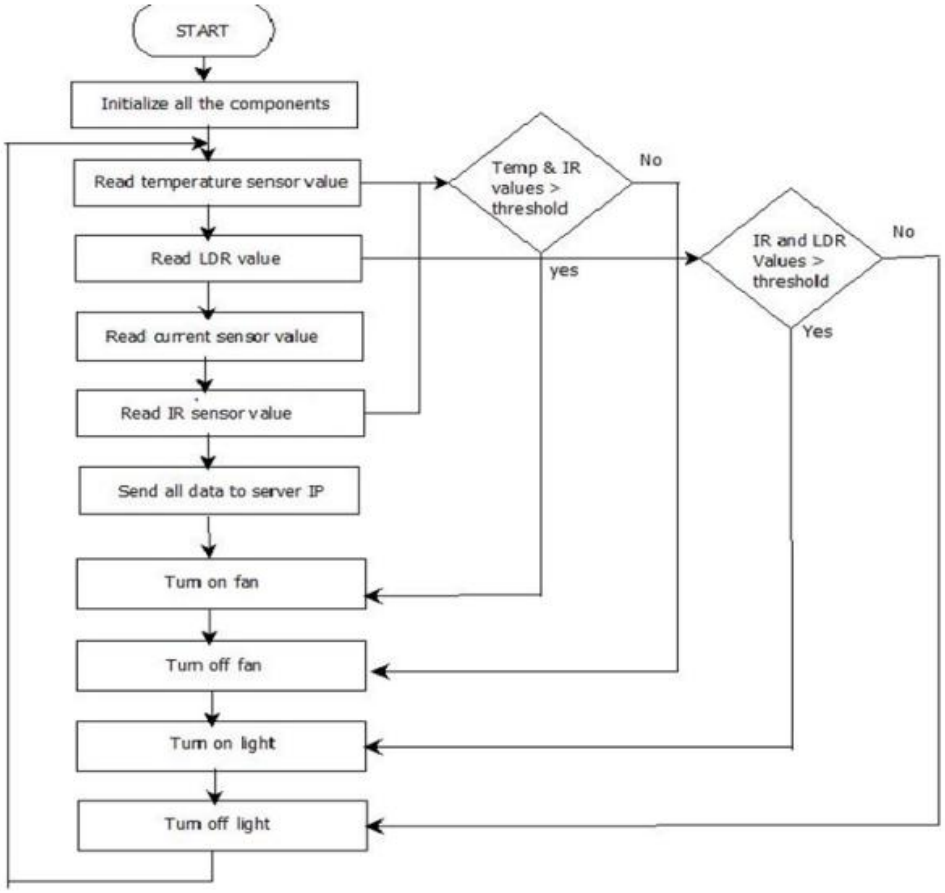

Fig. 5.1 : Hardware flow of Proposed System

5.2 Software Flow

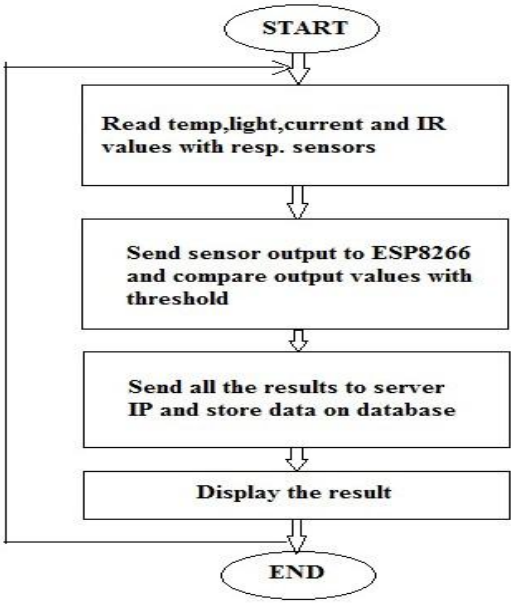

Fig.5.2 : Software flow of proposed system

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Above figure shows the software flow of the system. ESP8266 controller reads the sensor readings from temperature,LDR,Current and IR sensor. Now as ESP8266 is wifi based microcontroller it transmits the data to the Raspberry pi which is available within the wifi range of the ESp8266 controller.The communication between these two uses the TCP/IP protocol. Now Raspberry pi transmits this information to the main server where we can create a database of the information display the information on the web based GUI.

VI. EXPERIMENTAL SETUP

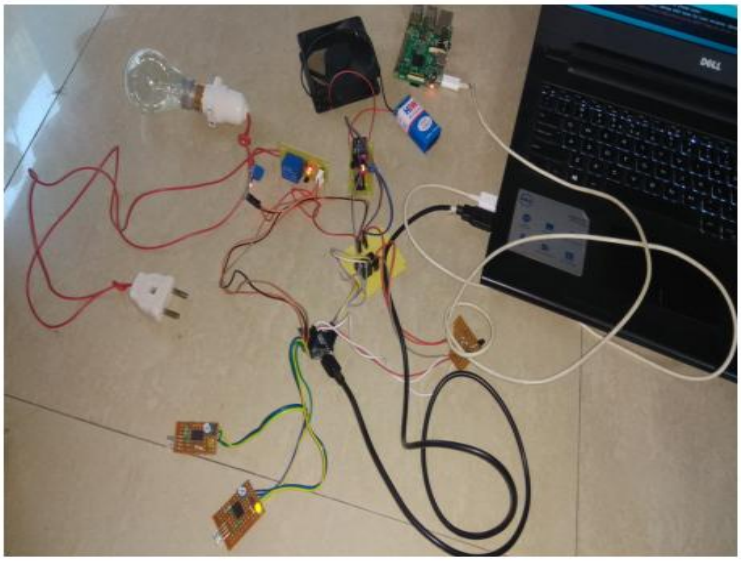

Fig. 6.2 : Experimental setup

Figure above shows the location of the sensors mounted. Temperature and IR sensors are directly connected to ESP8266 controller whereas Current sensor and LDR is connected to the analog to digital converter MCP3204.The output of MCP3204 is now given to the ESP8266.So in this way we have taken the readings to perform further operations.

6.1 Monitoring Section

Figure below shows the monitoring section of system. From field site the data from microcontroller Esp8266 is given to raspberry pi via WiFi. Raspberry pi can store and transfer the data of different sensor. Now the Raspberry pi transfers this data to the main server. A website of Smart Campus is designed to display all the information of sensors. We can provide facility to access data remotely with the help of IoT environment from all over the world.

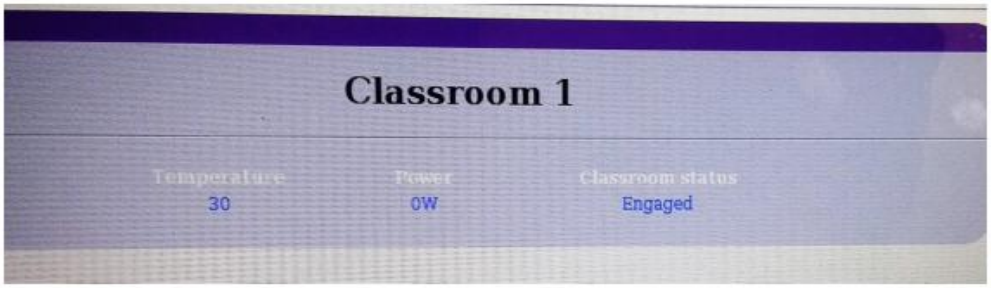

Fig. 6.3 : Monitoring Section

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VII. EXPERIMENTAL RESULTS

The results of this experiment can be seen by the controlling action of the devices. After receiving sensor data controller decides the action to be taken according to the instructions given. Here from the output of temperature sensor and IR sensor, the fans in the room can be automatically turned ON or OFF. With the help of LDR and IR sensor output, lights in the room are controlled by the controller. Similarly the current sensor calculates the overall current for all the devices connected in each classroom and then calculates the overall power consumption. This power consumption in each classroom can be displayed on the web based GUI.

VIII. CONCLUSION

These kind of Systems are required in the university campus as the area is very large and number of rooms are also large. And human can make mistakes and forget to switch off the appliances when in no use and in this case, these systems are useful in order to increase the power efficiency. The system can be viewed as a future of artificial intelligence. This is a powerful and dependable system. It fulfills the goal of energy saving and helps in achieving the efficient use of energy resources. With the help of internet of things (IoT) we can monitor the information from anywhere in the world. Hence, due to survey it became possible to make power efficient, cost efficient, fully automated system. This system is taking a step forward towards the goal of increasing the technological advancement and Smart City.

IX. FUTURE SCOPE

The system is flexible and can be enhanced with more sensors such as proximity sensors and fire sensors to realize a comprehensive smart campus system. Future work could include by connecting number of stations together to form a network and using wireless communication for different user friendly purposes. Also, the web interface can be further developed to implement more functionality in data visualization, management, and analysis among many others to provide better user interface and better user experience. In future, devices can be made more smart by using machine learning algorithms. The system can be applied to not only campuses but also other various areas using IoT.

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