Internet of Things based Home Automation System

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Abstract-The internet has been connecting people and making life simpler by providing all kinds of information with the click of a button. The next big wave in this domain is the internet of things which will enable physical objects used in day to day life to connect to the internet and exchange data. In this paper a home automation system based on internet of things is developed. This allows the user to automate all the devices and appliances of home and integrate them to provide seamless control over every aspect of their home. The designed system not only monitors the sensor data, but also actuates a process according to the requirement, for example switching on the light when it gets dark and it allows the user to control the household devices from anywhere.

Keywords: Raspberry Pi, Home Automation, Internet of Things

I. INTRODUCTION

The Internet of Things is connecting everyday objects intelligently to the Internet to enable communication between things and people, and between things themselves.The devices can be any physical objects like smart-phones, Internet TVs, sensors and actuators[1].For the objects to collect and exchange data electronics, software, sensors and network connectivity are embedded into them. This technology has endless possibilities and infinite applications. Everyday devices are made smart and intuitive and by enabling them to share data intelligently they can be used to improve peoples' lives. It can be used to provide better personal safety, monitor health, save time and make better use of our natural resources. IOT has made a huge impact in the way people live, work and communicate.

The emergence of new technologies and smart devices had made peoples' lives very comfortable and convenient. With the increasing demand for a high standard of living, Smart home, which is one of the most popular applications of IoT is grabbing the spotlight on a global level. Though the concept of home automation was conceived a long time ago, the technical complexity, high cost and incompatibility with existing devices prevented it from becoming a reality in every house. But now with the rapid development of internet of things, wireless technology and ubiquity of smart phones and connected devices, home automation in every

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home is now a very real possibility [2].A smart home is a network of various sensors and controllers integrated together to provide the user with remote control of various devices within their home. The sensors sense various changes, monitor them, store the data and display them in order for analysis and control. This helps us customize our home to fit every family's way of life. This is a cost effective system made from locally available components like raspberry pi, light sensors and ultrasonic sensors which allows us to control the lighting system of our house.

This paper describes a smart home where lighting system of the house is monitored and controlled remotely by establishing a remote server and by using an application based on node.js

II. INTERFACING RASPBERRY PI TO LAPTOP

The reason why it is preferred to interface the Pi to the laptop is because otherwise an additional display monitor would be required every time for debugging or project purpose. An Ethernet cable is used to connect the Pi to the laptop. There are many soft wares that can be installed to remotely view the Pi's GUI (Graphical User Interface). VNC Viewer has been used in this project. To set up the Raspberry Pi, an SD card with NOOBS pre-installed on it has been used. Raspbian is the operating system used based on Debian, which is a Linux distribution, optimized specifically for the Raspberry Pi hardware. The Ethernet cable allows the Pi to access the internet through the laptop's Wi-Fi. PuTTy is a free open source SSH software to remotely access other computers over the internet. SSH (Secure Socket Shell) is the network protocol which is used to remotely login into other computers [4]. PuTTy needs the IP address of the Pi. The IP address of the laptop being used is pinged to find the IP address of the Pi. The ping request will give back the dynamic IP address of the Pi. This IP address is used in the PuTTy software and also to set up the VNC Viewer which will display the Pi's desktop.

III. SETUP

In today's technologically advanced world where everything and everyone is dependent on technology and connected to the Internet, a home automation system is proposed which is cost effective and easy to implement and uses the wireless technology for communication. The main objective is to build a home automation system based on the Internet of Things concept consisting of a central controlling device and all the sensors which interact with the environment and which are connected to this central device. In this project, Raspberry Pi is used as the central controlling device. LED's are used as a source of light for this project. As soon as a person enters the room, the ultrasonic sensor detects the human presence and based on whether the room is bright or dark which is decided by the

LDR (Light Dependent Resistor), the LED's turn on. Also, the lights can be controlled remotely from anywhere in the world using relay. All the components communicate with each other using the wireless protocol. The following block diagram shows the structure of the proposed system and each component used is explained in brief.
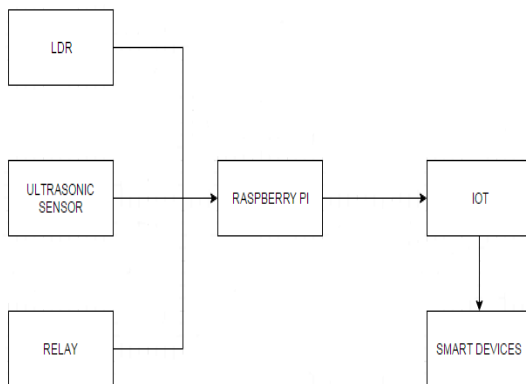

Fig. 1: Architecture of the proposed system

The core of the home automation system is Raspberry Pi which is a small size, low cost computer. It can easily interact with the outside world and is compatible with any high level language. Raspberry Pi 2 model B is used in the project which is controlled by a Linux distribution of the Debian operating system, making use of an ARM architecture. All the components are connected to the Raspberry Pi which controls their functioning. The LDR is used to detect the presence or absence of light and it works on the principle of photoconductivity [3]. Ultrasonic sensor estimates the distance of objects from it by working on the principle of SONAR(Sound Navigation and Ranging). A relay is an electromagnetic switch operated by relatively small electric currents that can turn on/off much larger currents [5]. Finally, Raspberry Pi acts as a web server and an application is run to control the relay.Wi-Fi is used for communication between the devices.

IV. IMPLEMENTATION DETAILS

The internal circuitry of the Raspberry Pi works on a voltage of 3.3V and exposing it to voltages higher than this can damage the board. A distance range and a threshold resistance value are specified in the Python code. The threshold value basically differentiates between the room being bright and dark. The LDR and the ultrasonic sensor are integrated in such a way that the light intensity of the room is checked only after the distance range condition has been met. If the resistance is higher than the threshold resistance it indicates that the room is dark and then if a person enters the room, lights are turned on. Switching on/off of lights is controlled through a relay.

Fig. 2: LX terminal displaying the result

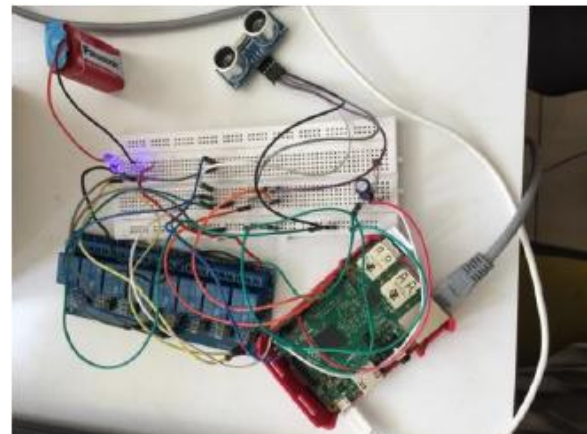Fig. 3: Hardware setup

V.CONCLUSION

This paper presents a home automation system based on internet of things which works successfully by connecting various appliances and providing the user remote control of the lighting system of their home. The objective is accomplished by using a Raspberry Pi which is connected to different sensors and run by python program. The lights are programmed to turn off automatically if there is no one inside the room or if a person enters the room but the room is bright. JavaScript application is used to control the relay from anywhere. The proposed system is flexible, cost effective and energy efficient. This system functions on its own as well as can be controlled from anywhere with the help of a program code.

To control the relay from anywhere i.e. any network, a cloud platform called aREST has been used. It is a framework for developing server side applications for developmental boards like Arduino, Raspberry Pi etc. The code has been written in JavaScript on a Node.js platform. Node.js is installed on the Pi which is an open source runtime environment for developing server side applications. After the code is run in the Linux terminal, the Pi gets connected to the cloud platform. A web browser is opened and the link to control the relay is typed into it appended by a zeroor a one to switch the relay on or off. The link can be typed into any web browser on any smart device connected to the internet.
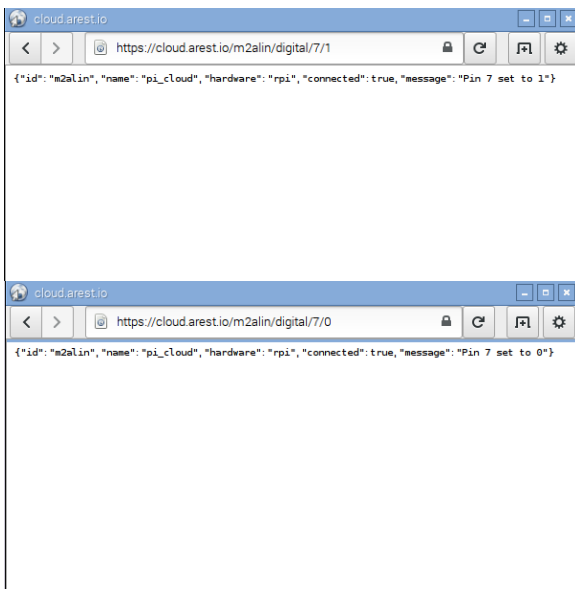
Fig. 4: Browsers showing the typed URL

VI. FUTURE WORK

Internet of things has numerous applications in almost every aspect of our life. The concept of internet of things is not just limited to smart home. It has applications in various other domains. This system is highly scalable and many other features like security, energy monitoring and health monitoring can be integrated. In the near future the concept of internet of things can be seen in applications like Industrial automation and management through internet, machine-driven fireplace exit systems, improvement of security problems in extremely restricted areas, environmental monitoring in weather stations and in industries where human invasion is impossible or dangerous.

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