

IoT Based Home Automation System

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ABSTRACT— In today's world everything is becoming automated and digitized. With the recent advancements in the technology, lives of human beings are getting simpler and easier. Today mobile technology is one of the fastest growing technology which provides divergent services and applications to the users. Internet of Things (IoT) is one of the latest and up-coming technology which provides a platform wherein the devices can be allowed to connect, sense and control remotely across the world. There are many IoT applications like smart governance, smart healthcare, smart agriculture, smart homes etc. in that smart homes plays a very important role in realizing smart cities which uses IoT for effectively delivery of services without manual intervention. In this paper, we describe a smart home automation system using IoT, wherein we use a microcontroller based Arduino board that integrates the cloud computing and networking, wireless communication to grant the users with the access to lights, fans and various appliances in the home and also can monitor the sensor data and the data is stored in the cloud. This system is devised to be inexpensive, economical and can be expanded as it allows a variety of devices to be connected and controlled.

Keywords---Internet of Things (IoT), Cloud computing, Home automation, Arduino, Ethernet/Wi-Fi module, Smart cities.

I. INTRODUCTION

With the recent advances in the Automation and Mobile technology, we human beings have made internet as a fundamental thing of our daily life, without which we are helpless. With the increasing usage of internet over the past ten years resulted into internet being the essential component of life. Internet of Things (IoT) is one of the latest growing and up-coming Technologies wherein many intelligent objects are connected, controlled and can also be managed. These objects are connected to internet through an IP address. Internet of Things handles billions of intelligent devices which will be connected to sense, read and collect the data and also to transmit data with the surrounding people using smartphones, wireless and sensor technologies. The key concern of IoT is to administer, monitor and control the physical objects in a more significant and reliable manner and it will also enhance the life standards by providing low cost living which includes safety, entertainment and security.

According to one of the survey, CISCO states that approximately 50 billion devices will be connected to the internet by year 2020. Although there are many IoT applications, we proposed a distinct cloud based home automation system that can assist people to access and control home appliances remotely using their android smart phones or PC's anywhere and anytime. Among many IOT applications, a smart home plays a significant part in building smart city. A home in which all electrical and electronic devices can be monitored and controlled using smart sensors and intelligent infrastructure from the remote place can defined as a Smart home. The present Indian government has recommended creating 100 smart cities across India, which will initiate a huge requirement for smart home automations in up coming days. Hence we proposed an efficient Home Automation system using IoT, where in smart home automation is realized using arduino board and cloud based android application

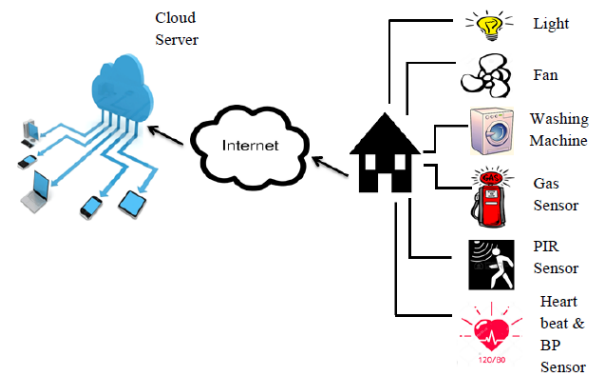


Figure 1: Proposed Home Automation System

II. RELATED WORK

The idea of smart homes in India is still new, but remarkable amount of research has been done in other places, where smart homes are already in being in use.

Author Kang proposed [1]IoT based Monitoring System for Smart Home Services wherein he explained how the sensor data are being acquired and analyzed in smart homes. he also suggested the framework using which contextual information can be obtained by analyzing the data collected from sensors and contribute context aware services. KR Kashwan in [2] discusses about how effectively power can be utilized and conservation of power in smart home using IoT. It adopts

image processing techniques for observing human activities captured through cameras.

Pitsillides in [3] 'Towards Interoperable and Sustainable Smart Homes' wherein he explained the necessity for implementing common standards and developing sustainable protocols for IoT based applications in smart home. Basil Hamed in [4] 'Home automation and security System using android' here he used LabView software as main controlling part in the system. The designing and setting up of monitoring system in the home is the key concern of this paper. The remote control access is given to this system acts as a sub-controlling system to the smart home. This remote access is made possible the system which have internet connection for controlling and monitoring of home applications. And this remote access is provided in and around the world. Author Abdelmonim Fakhreldin in [5] suggested a new method for the smart home which incorporates the use of wireless sensor networks and the biometric technology. In this system high security is provided where in at the home entrance biometrics is used for authentication purpose thus increasing the security. This system is flexible which can be incorporated in a building automation system and which includes offices, schools, hospitals and other places. Author concluded this paper by adding future scope of the smart home when it incorporates the biometric technology in a more sophisticated pattern.

III. SYSTEM DESIGN

A. Problem Definition

Generally Home Automation System have to deal with few challenges which are high investment cost, poor manageability, inflexibility of the network, poor security issues. The primary goal of this work is to build an inexpensive home automated system using IoT which has the capability of controlling, monitoring and automating all most all the home appliances using an easy user interface. Because most of the time we cannot be at home due to our busy life and traffic. Hence our proposed model solves the above problem by providing remote access to the home appliances and saving lot of time and energy.

B. Proposed System feature

The proposed model of Home Automation system is as shown in the Figure 1. The model consists of gas sensor, PIR motion sensor, heart beat and BP sensor, a relay board which in turn connects to different home appliances such as light, fan, washing machine and three different sensors. This relay board is connected to Arduino Uno board. Internet connectivity is given to arduino board through Ethernet module. All the status of appliances and sensors data are stored in cloud. In simple language Arduino is a programmable logic controller which can be used for programming any hardware and software. Arduino is like a computer which can be programmed to receive any sensor data or keyboard data and control the

various electrical appliances and sensors connected to its output pins. Once the arduino board is connected to internet through Ethernet module, all the sensor data and status of home appliances will get connected to cloud server. Cloud server stores the data and provides a platform to the user to monitor and control the appliances. The home automation can be controlled through a web page or through the android app installed in the smart phone.

IV. IMPLEMENTATION DETAILS

A. Proposed Home Automation

Proposed Home automation system consists of different sensors and physical electrical appliances connected through relay board. All these data is stored in a cloud server. Once the internet is connected to the system, it starts reading all the values of sensors. If the sensor value exceeds the threshold value, notification is sent to the android device. The main part of this IoT operation is the centralized server. This servers plays a major role the IoT operation. Here we are using a third party cloud called Cayenne. At the first time we need to register in that cloud. It provides an unique ID and password, through that we can login in any web browser or in the android app in our smart phone. After logging in the app we can monitor all electrical appliances status, if in case we have forgotten to switch off light/fan we can switch it off, or if we need to switch on the washing machine we can switch it on. If the sensor value of gas sensor exceeds the threshold we will get a notification in our android phone, after which we can switch on AC or Exhaust. For security purpose we have used PIR sensor to detect any unauthorized person or theft in the house. If any old people are there in the home, we cannot monitor their condition remotely. Hence we have implemented heart beat and BP sensor, to monitor the heart beat and BP, a person needs to keep his finger tip in the sensor. It will calculate approximate heart beat rate and BP, if that value exceeds threshold we get a message notification in mobile, immediately we can call the doctor.

B. Implementation setup

The figure 2 shows the set of activities performed by our home automation system. When the internet connection is established it will start to read the sensors values and states of the home appliances. The sensor data is transmitted to the web server and then stored in the cloud. That data can be examined by user anytime and anywhere. If the sensor's values are greater than threshold value, we will get notification in the mobile then required action can be taken by the user for controlling.

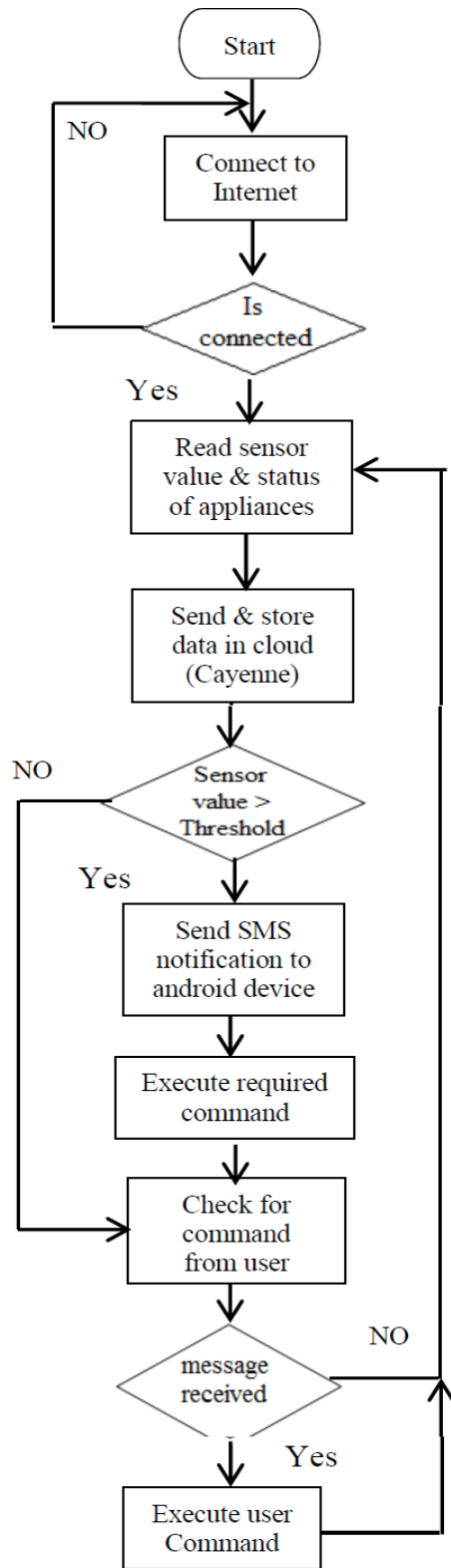


Figure 2: Flow chart of home automation system and controlling

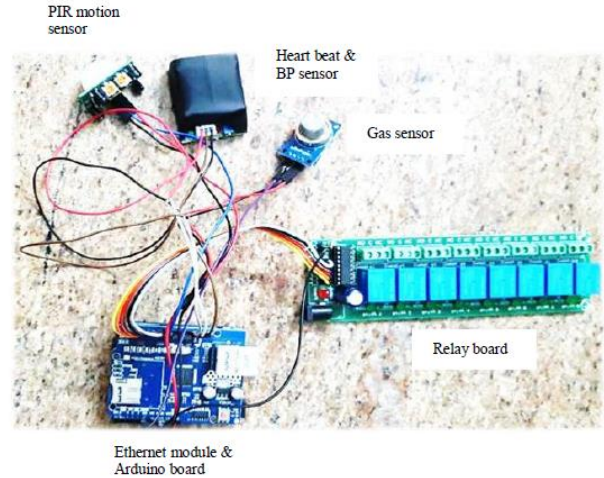


Figure: 3 Experimental setup

The experimental setup is shown in above figure wherein all three sensors are connected to last 3 pins of relay board. This relay board is of eight pins. First five pins are connected to physical appliances such as light, television, fan, washing machine and oven. On/OFF conditions can be observed by the LEDs in the relay board. These physical appliances can be directly connected to relay board but for simplicity it is not shown in above figure. Arduino board is placed below the Ethernet module.

C. Software Design

Generally PHP programming language should be used to form a point-to-point web socket and a web application. Through internet connection it can be connected to the cloud server, after formulation of such a socket. But in our case we have used a third party cloud called Cayenne which takes care of all these point-to-point connection and the connection of internet to cloud. Cloud computing is nothing but storing and accessing data and programs over the Internet instead of our computer's hard drive. Cloud computing falls into three main categories Infrastructure-as-a-Service, Platform-as-a-Service, and Software-as-a-Service. IaaS follows a utility model, which provides servers and storage as per user requirement for which the consumers need to pay accordingly. PaaS allows the users to create their own custom applications within a provider's configuration, like Google Application Engine. SaaS permits consumers to subscribe to the applications which can be accessed over the Internet. A general example of cloud computing is Google drive. Where we can store our information like photos, google Docs etc. on this and we can access these stored information from any desktop or phone with internet access. The cloud which we are using here is the Cayenne cloud which is free of cost and it provides the user a platform to create their own required applications according to their project. Since it is the first drag and drop project builder. We can add any sensors, microcontrollers and other devices through drag and drop, hence we need not write any separate

program for it. This is the main advantage of this cloud. To access this cloud first we need to register, after registration it provides unique id and password. Through this id and password we can login into our application either in desktop or in the smartphone. The android app for this Cayenne can be installed from google play store.



Figure 4: Android app Home Screen



Figure 5: Login screen



Figure 6: Control screen of Home Automation



Figure 7: screen consists of home Unique token

The above figures shows the set of activities which can be performed on android app installed in the smartphone.

Figure 4 shows the home page of Cayenne app after installing the app in the phone

Figure 5 shows the login/signup page where we need to register for the first time or else we can sign in whenever we want to launch our home automation system.

Figure 6 shows the second screen of app wherein there are 8 icons corresponding to home appliances and sensors. To switch On/OFF we can just tap on the icon. On the top side of the screen the controller which we added is present i.e Arduino Uno.

Figure 7 consists of screen corresponding to settings of the app. Where we can see the unique token id generated during registration as Auth code, and below that version number and hardware used is displayed. In this page we can add/remove any devices.



Figure 8: Login page of Cayenne in the web browser

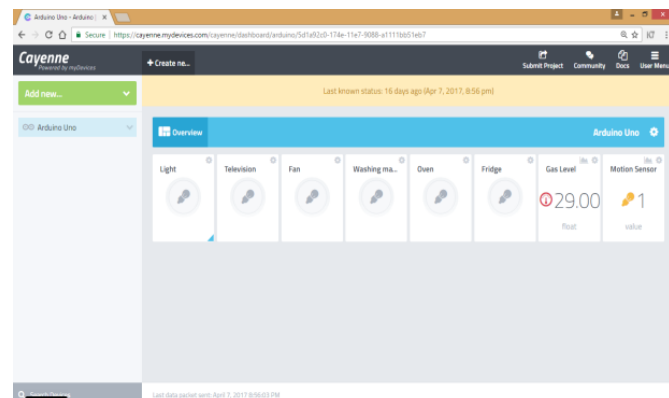


Figure 9: Second screen corresponds to control application

V. RESULTS

Here in this paper we presented a smart home automation system using less expensive Arduino board for controlling various electrical devices using an android smart phone. This Home Automation system has been tested by installing sensors practically in the home. First user needs to install the arduino software and cloud software i.e Cayenne in the laptop or smart phone. After that user should signup in the home automation cloud server. During registration a distinct user id and

password is given to user from the cloud server. After that user can login from the android app in the phone or in the web browser. As soon as user login he can monitor all the appliances and sensors as shown in the figure 6 and he can keep track of all the devices. This Home automation system can also be controlled through web browser, for that the user needs to go to the login page of cayenne as shown in the figure 8. From figure 9 user can control the home automation system. A specific threshold limit is given to each sensor, when the sensor value exceeds threshold limit sms notification is sent to the user phone this is possible through the cloud server. If the user wishes to change status of any device according to his requirement he can change from anywhere across the world with a laptop or desktop or android smartphone provided with the internet connection. Our designed system is highly efficient in terms of communicating with the sensors and electronic devices.

VI. CONCLUSION AND FUTURE WORK

In this paper, we presented a basic model of Home automation using IoT. This model has its origin in an IOT suite that provides the access to different devices to match with the IOT platform so that it can be controlled and accessed remotely. This IoT platform makes the home a smarter place by creating a network connection between cloud server and electrical-electronic devices of home. The entire system is having single authentication which provides security to our system as the accessing authority of all the nodes in the network is given only to the admin. For future work the whole city can be made automated by introducing more number of automation system and access is given to single user. And also keeping this model as the framework we can add other options like home security feature such as capturing the picture of a moving person and then storing it on to the cloud by this feature we can eliminate the use of CCTV camera which records all the time.

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