IoT Based Home Automation and Smart Security System

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Abstract – *Internet of Things is network of all devices that can be accessed through the internet. These devices can be remotely accessed and controlled using existing network infrastructure, thus allowing a direct integration of computing system with physical world. Home automation achieved great popularity in the past decade and increased comfort and quality of life. We represent a new smart security through IoT based camera authentication. The purpose of this security system is only verified personnel can access or enter the system.*

This paper represent the design and implementation of a low cost yet scalable, flexible and secure IoT based home automation system. The main focus of technology is in controlling the household equipment's like light, fan, door etc. automatically.

Key Words: **Internet of Things (IoT), Home Automation, Smart Security System, Wi-Fi Module, Authentication.**

1. INTRODUCTION

Technology is never ending process. The recent scenario shows that in this century of digitization people are fond of automatic devices which are often referred to as smart devices. Homes of 21st century will become more and more self-controlled and automated due to the comfort it provides especially when an employed in a private home. Home automation system is growing rapidly, they are used to provide comfort, convenience, quality of life and security for resident but these system are expensive to install for the small business and middle class home owners. So we are building home automation and smart security system at low cost.

In recent years, wireless sensors and actuators networks have gained high momentum, receiving significant attention from academia, industry and standard development organizations. The main concept of IOT is that it can create a virtual connection between a hub or a network and electronic and electrical objects.

1.1 Internet of Things

The Internet of Things (IoT) is a system of physical things embedded with sensors, software, electronics and connectivity to allow it to perform better by exchanging information with other connected devices.

In simple terms, it is a network in which physical objects can exchange data internally or with other connected machines. IoT is a vision that is being built today with an expectation of massive expansion by 2020 as connections move past computers to power billions of other devices, such as home thermostats and parking meters.

1.2 Home Automation

Home automation gives you access to control devices in your home from a mobile device anywhere in the world.

A home automation system is a technological solution that enables automating the bulk of electronic, electrical and technology-based tasks within a home.

It uses a combination of hardware and software technologies that enable control and management over appliances and devices within a home.

Home automation is also known as domestics, and a home with an automation system is also known as a smart home.

1.3 Smart Security

Smart systems incorporate functions of sensing, actuation, and control in order to describe and analyze a situation, and make decisions based on the available data in a predictive or adaptive manner, thereby performing smart actions. In most cases the "smartness" of the system can be attributed to autonomous operation based on closed loop control, energy efficiency, and networking capabilities.

In smart security we are using face detection for entering the home automation system, only verified persons can enter the system.

1.4 Hardware Components

For the cost effective home automation system we are using Raspberry Pi 3 module for hardware to smartphone connectivity. PIR sensor for motion detection and Thermal sensor for temperature sensing in the room. Also we are using a door camera for the smart security system. Also we are using relay board for the connectivity of the Raspberry Pi and the main power supply of home.

1.5 Connectivity

In this paper we are presenting a system can be connected through Bluetooth and Wi-Fi enabled devices as well as through web based application. The smart security

system is also connected to database for face detection and also classification of the person wants to enter the home.

2. SYSTEM ANALYSIS

2.1 Proposed system feature

In this paper the designed model of home automation fulfils the unique demands of the increasing population of today's world. The peak advantage of our model is that the functionality of an array of electrical and electronic devices can be controlled with ease. Sometimes the busy life and traffic makes it difficult for us to be at work and to be at home at the same time. One of the features of our model makes it possible as it provides home system accessing remotely saving a lot of time. Another feature of our proposed model is that turning of lights and fans and other electronic and electrical devices remotely if they are not in use helping to manage the energy consumption of that home. To control these appliances remotely smart devices needs to be synchronized with the main server. The user may use the login id and password to change the status of any appliances saving time, energy and money. In addition to that our proposed model provides absolute security.

If the user is not sure of weather closing the door or switching on the security alarm, the user may check the data on-line from the database present along with the main server and change the status accordingly. In there is any intruder the system automatically alerts the user with a message helping the user to take action as soon as possible. Altogether our home automation system provides 100% efficiency as it saves time, helps to manage energy consumption which in turn saves money and provide optimum security to the user making the user's home a safer and a smarter place to live in.
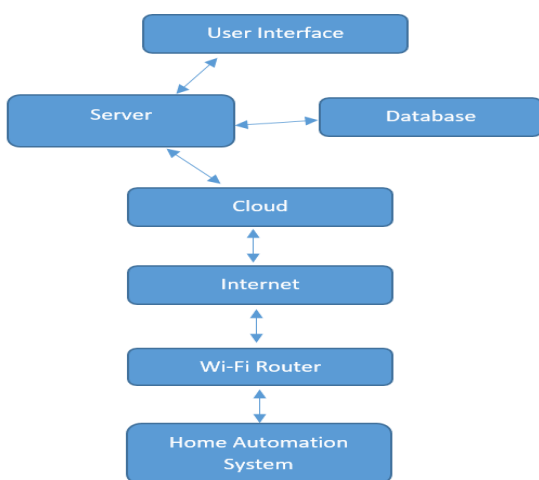
2.2 Network Architecture

Fig 1: Network Architecture

The main ingredient for any IOT based operation is a server. The centralized sever acts as the heart of all the IOT rooted operation. In this paper the cloud server is used for data storage, sensor feedback and control. A virtual connection between the server and the IOT devices needs to be created. There are several ways to make an internet connection from which we have used point-to-point web socket. A programming language known as the PHP is used to create the point-to-point web socket and a web application for communication with IOT device and taking logical decision. Through this point-to-point web socket an internet connection is made between the home automation system and the server. Due to this connection IOT devices will now be able to send and receive data to the cloud server. All the received data of the server is stored in a database present along with the server. The user may go through all the data stored in the database of the server anytime from anywhere with the help of a web browser or with the assistance of an android application embedded in an android device synchronised with the main server and the IOT devices. To provide optimum security to this whole system a unique login id and password is provided to each user at the time of installation. Any user can only go through the data of his/her devices connected with the main server with the help of the login id and password and can change the status of his/her any IOT devices connected with the main server but the admin can access the data of all the devices connected and can change the status of any devices connected to the main server. All the above operation will not work and will show an error if the whole system is not online. Here the internet acts as the backbone of the whole system. This proposed model will provide easy control and ensure 100% security if the IOT devices and the user are connected to the internet.

3. SYSTEM ARCHITECTURE AND IMPLEMENTATION

In this system, we are using Raspberry Pi and establish the internet connection for the purpose of automation using IoT by accessing the IP address. Figure 2 represents the block diagram of smartphone based home automation system using IoT.
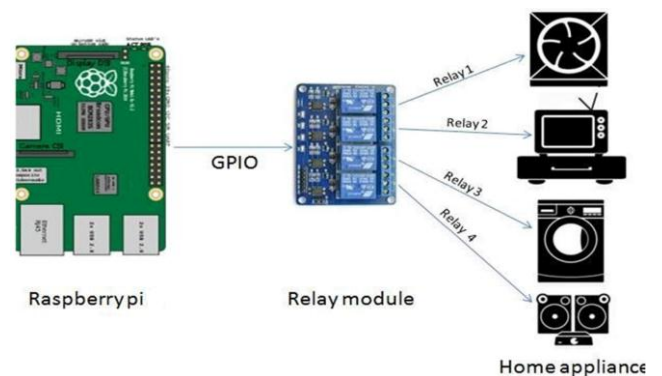

Fig 2: Block Diagram of Home Automation System

All the home appliances are connected with Raspberry Pi. Mobile phone and Raspberry Pi are connected through Wi-Fi. Raspberry Pi is used as the board controller to connect the appliances via input and output port. We can use cloud server for controlling and monitoring the home appliances from anywhere. PHP coding is used for controlling home appliances. Copy the saved program in SD card and inserting it in Raspberry Pi and then run the program. While the program is executing, enter the IP address in the URL to open the webpage. It establishes the connection between the smart phone and the Raspberry Pi board.

3.1 Hardware

A. Raspberry Pi

Raspberry Pi is a low cost credit card size computer that plugs into a computer monitor or TV and uses a standard keyboard and mouse. Most importantly it's open source hardware. Computing Programmable Language like python and scratch under Linux platform. Raspberry Pi 2 model B has CPU 900MHZ quad-core ARM cortx-A7 processor. The Ethernet adaptor is connected to an additional USB port. In model A and A+ the USB port is connected directly to the Silicon on Chip (SoC).

Raspberry Pi3 is the third generation Raspberry pi. It replaced the Raspberry pi 2 model B in February 2016. Compared to the Raspberry pi 2 it has:

- A 1.2GHZ 64-bit quad-core ARMv8 CPU
- 802.11n Wireless LAN
- Bluetooth 4.1
- Bluetooth Low Energy(BLE)

B. Relay circuit

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contact in another circuit. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. It is an electromagnetic switch operated by relatively small electric current that can turn on or off much larger electric current the heart of a relay is an electromagnet (a coil of wire that becomes a temporary magnet when electrically flows through it).Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults, in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Two channel relay diagram is shown in figure 4.This is a 5V, 10A 2-Channel Relay interface board. It can be controlled various appliances, and other equipment with large current. It can be controlled directly with 3.3V or 5V logic signals from a microcontroller (ARM, 8051, PIC).

3.2 Software

A. Python

Python is a widely used high-level programming language for general-purpose programming, created by Guido Van Rossum and first released in 1991. An interpreted language, Python has a design philosophy which emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly braces or keywords), and a syntax which allows programmers to express concepts in fewer lines of code than possible in languages such as C++ or Java. The language provides constructs intended to enable writing clear programs on both a small and large scale.

B. Java

Java is a general-purpose computer-programming language that is concurrent, class-based, object-oriented, and specifically designed to have as few implementation dependencies as possible. It is intended to let application developers "write once, run anywhere" (WORA), meaning that compiled Java code can run on all platforms that support Java without the need for recompilation. Java applications are typically compiled to "bytecode" that can run on any Java virtual machine (JVM) regardless of the underlying computer architecture.

3.3 Interface

An interface is an interconnection between system and user. By using application the user can access the home automation system at any place. If the user gets late from work they can turn on sprinkler to water the plants or to turn on the fans or light for the pets. The interface works as a manual override for the system, which means the automatic system will not work while in manual mode.
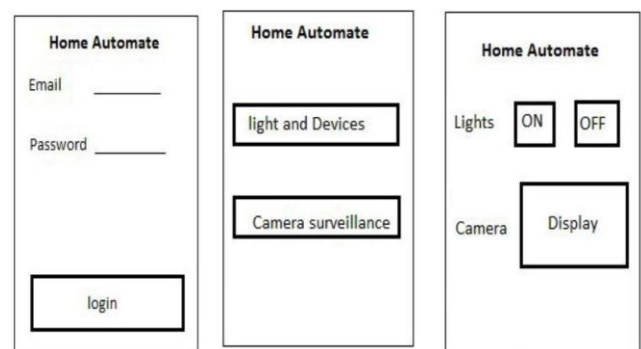

Fig 3: Application Prototype

Above figure shows the prototype design of android application development. The initial design had to be kept in mind the functional and nonfunctional requirements.

The flowchart below shows the working of the system application. Where user login with unique username and password to access the whole system.
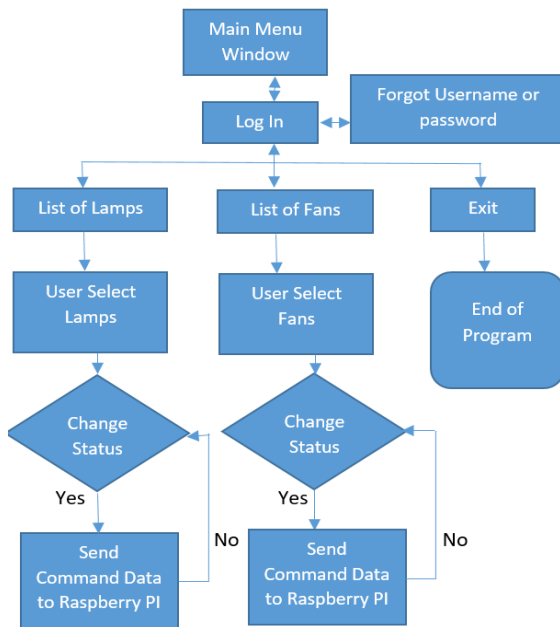

Fig 4: Program Flowchart for Main Menu Window of the GUI.

4. FUTURE WORK

Although the final products were very successful at accomplishing the objectives, it must be kept in mind that the products produced are simple prototypes and much more work would need to be done to create a marketable product. Several areas that need to be improved are the size of the devices, the power sources used and the range of communication.

We are also developing the system not just lights and fans but also for every home appliances such as washing machine, microwave oven, sprinkler etc.

The door security camera also takes data from nearby police station for wanted criminals. And when the criminal identified by the system it will inform the home owner as well as police station. The system will also classify people as friends, neighbor, family etc.

5. CONCLUSION

In this paper we have introduced design and implementation of a low cost, flexible and wireless solution for home automation system. The system is secured for access from any user or intruder, only valid and verified users can get access into the system. This adds a protection from unauthorized users. This system can be used as a test bed for any appliances that requires on-off switching applications with internet connection using cloud services.

The system uses have automatic which works using sensors and as well as manual mode which can accessed by authorized user from anywhere in the world.

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