

IoT Based Advanced Home Automation

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Abstract - Home automation is a topic which is gaining popularity day by day, because of large advantages. One can achieve home automation by simply connecting home appliance electrical devices to the internet. The implementation of home automation in this project employs two systems, IoT and speech that are voice controlled based home automation. Internet of Things (IoT) conceptualizes the idea of remotely connecting and monitoring real things through the Internet. When it comes to our house, this concept can be aptly incorporated to make it smarter, safer and automated. The first scheme uses GSM/GPRS technology for controlling the electrical appliances via Internet through a website. The second scheme uses Bluetooth technology for controlling of electrical appliances by voice control when we are at home via an Android app. The proposed system is implemented on Pic 16f877a microcontroller. In this project, the goal is to develop a home automation system that gives the user complete control over all remotely controllable aspects of his or her home. The automation system will have ability to be controlled from a central host PC, the internet, and also remotely accessed with smart phone. Home automation system gives accessibility, comfort, energy efficiency, security by providing control and monitoring of appliances, security surveillance.

Key Words: Home Automation System (HAS), Internet of Things (IoT), Voice Control, PIC 16f877a Microcontroller, Smart phone.f

1. INTRODUCTION

1.1 Overview

Automation is a trending topic in the 21st century making it play an important role in our daily lives. The foremost aim of any automated system is reducing human labor, effort, time and errors due to human negligence. Automation is one such area that aims that achieves simplicity whilst increasing efficiency. Home automation may include centralized control of lighting, HVAC (heating, ventilation and air conditioning), appliances, and other systems, to provide improved convenience, comfort, energy efficiency and security.

This project presents the design of the low cost home automation system using the IoT (Internet of Things) technology along with the feature of speech recognition.

The Internet of things (IoT) is the inter-networking of

physical devices, vehicles, buildings, and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. In this project IoT technology is used to control the home appliances wirelessly over the internet. The computed control circuit consists of a 16f877a microcontroller, which processes the user commands and controls the switching of devices. The connection between the microcontroller and the smart phone is established via Bluetooth, a widespread wireless technology used for sharing data.

The project also aims to provide a speech control interface to the users to control the appliances. Speech recognition is provided using an online Speech-To-Text platform called SS voice. The home automation system listens for the user's speech and whenever a defined phrase is identified it triggers corresponding action to switch appliances on or off. With speech recognition physically challenged people can control appliances with much more ease.

Following are the parameters deployed in the proposed project:

- A. Comfort - Voice controlled lights and fans, Smart Irrigation, Automatic Garage door
- B. Security- Burglar Alarm system
- C. Safety - Gas Detection system

For the physically challenged or elder persons the mobility is quite a difficult task and they always need some assistance for doing various tasks. Even when someone returns home tired, they feel quite difficult to do the simple activities like approaching the switch board for switching various appliances, switching of fans and lights, etc. In this paper, we are going to resolve such problems. By introducing automatic voice command based home automation that can control various household appliances as well as some other tasks that constitute the home automation system.

1.2 Advantages of Home Automation Systems:

- A. To operate home security system, the user need not have data connection enabled in his phone. The system runs fine with the launch pad connected to Wi-Fi at home/office.
- B. The optional switching from voice control to website control is taken care of so that the user may also wish to control mode of control of his home appliances as required.
- C. Since the system sends a text message to only a particular number which is present in the web API there is no need to worry about security leakage as the system cannot be accessed by any other unauthenticated user. This in turn increases the fidelity of the security system.
- D. The use of Wi-Fi enabled system enables the user to control from any part of the globe contrary to Bluetooth controlled or IR remote controlled existing home automation solutions that too without any net connectivity in the phone.
- E. Flexibility, time saving, voice control and energy conservation are some other additional advantages of Home Automation.

2. RELATED WORK

- A. Ravi Kishore Kodali [4] developed a prototype using TI-CC3200 Launch pad board that allows users to control appliances from his phone from any distance irrespective of whether his mobile phone is connected to the internet but couldn't integrate the voice control feature within the same smart phone application.
- B. Abdul Aziz Md [5] proposed a system to be implemented using Arduino UNO where Arduino programming language used which was implemented only for voice controlling for appliances.
- C. Al-Ali and Al-Rousan [6] presented a design and implementation of a Java- based automation system through World Wide Web. It had a standalone embedded system board integrated into a PC-based server at home.
- D. D Kunal [7] presented the approach of controlling home appliances mainly lights and fan by using web server which employed the use of Arduino micro controller.
- E. N. Sriskanthan [8] has implemented the model for home automation using Bluetooth via PC. But, Bluetooth has range limitation.

F. Hasan [9] has developed a telephone and PIC remote controlled device for controlling the devices pin check algorithm was used to implement the system where it was with cable network but not wireless communication.

G. Jitendra R. [11] implemented a system with the ZigBee network and showed how to eliminate the complication of wiring in case of wired automation.

3. WHY HOME AUTOMATION SYSTEM?

IoT BASED ADVANCED HOME AUTOMATION is a project which aims to provide the user the facility to control their home appliances through internet and also control it through their speech.

The main objectives of this project are as follows:

- A. Develop a low cost home automation system which is easy to install and configure
- B. Provide a secure and reliable web portal for the user to control the home appliances through the internet
- C. Embed a speech control interface for controlling the electrical appliances for physically challenged people.

4. SYSTEM DESIGN AND IMPLEMENTATION

The system is built around pic16f877a microcontroller. The choice of microcontroller is based on the inbuilt peripherals and pin count. It has inbuilt ADC, UART and TIMERS required for our system in a 40 pin IC package. The system is working with the crystal of 8MHz and instruction cycle at 2MHz.

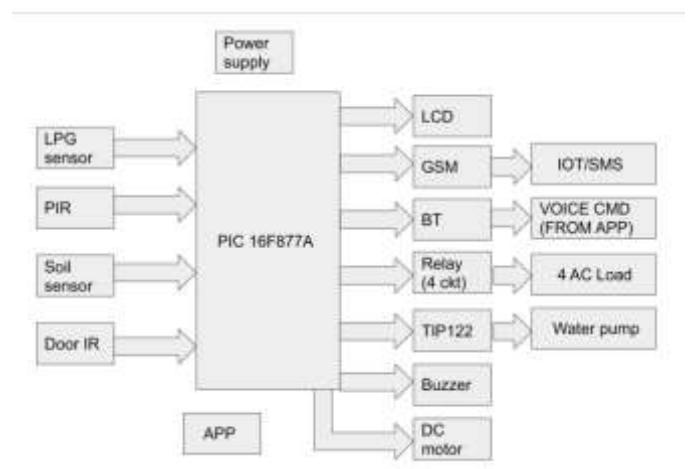


Fig -1: Proposed Model

The system connects with internet via GSM SIM900A Modem. The server side scripts are written in 'php' and database is in MySQL. The GSM modem is also used for sending SMS. The LEDs are used for the indication of data reception from internet. The system has following peripherals attached at the given interface:

GSM SIM900A Modem	UART
IR Sensor	ADC
PIR Sensor	ADC
LPG GAS Sensor	ADC
Water Level Sensor	ADC
Bluetooth	Software UART (Timer)
LCD	Digital IO
Relays	Digital IO
Buzzer	Digital IO
LEDs	Digital IO
Water Pump	Digital IO

Table 1: Peripherals Attached

The IR sensor is implemented for theft detection. It detects any obstacle in front of it and gives a small beeping alarm. It is also considered as the security breach event and SMS is sent to the concerned person about the event. The event is also recorded online.



Fig -3: LCD for Monitoring

The PIR sensor is implemented for the automation of the garage door. If any movement is detected near the sensor in the span of 180 degrees, the garage door opens up automatically. The door automatically closes back after the predefined time. LPG sensor is implemented for detection of gas leakage. If the sensor detects the leakage, the

continuous buzzer alarm is rung to indicate the event. This event is also considered as the security threat and hence SMS is sent to the concerned person. The event is also recorded on internet. Water level sensor is implemented for automatic water level detection and pump on off. The pump is operated by using TIP122 BJT transistor as driver. The pump state is recorded online.



Figure 2: 4 Channel Relay Module

4 relays are connected to operate AC loads. The relays can be controlled via online interface in ONLINE mode only. They can be controlled via Bluetooth in OFFLINE mode. The Bluetooth is connected on software serial interface and is operated at 9600 bits per second. If any data is available on the receive buffer, it is indicated by the LED. 16 X 2 LCD is used for displaying status as well as sensor values. The buzzer is used for audible indications while LEDs are used for event indication.

Used voice commands:

Voice Commands	
1. Fan On	5. AC On
2. Fan Off	6. AC Off
3. Light On	7. Heater Off
4. Light Off	8. Heater On

Table 2: Programmed Voice Commands

By using above voice commands the home appliances can be controlled.

5. SOFTWARE USED

The Android application used in this project is SS voice. SS Voice reduces complexity unlike other applications like AdaFruit and IFTTT which are comparatively difficult to operate.

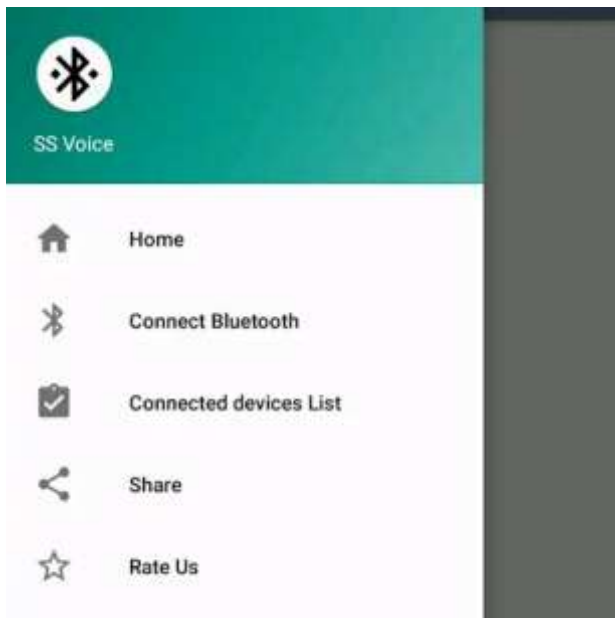


Fig -4: SS Voice Menu Page

SS Voice is used to control the lighting and HVAC appliances which are connected to PIC 16f877a microcontroller through voice commands and the voice commands are sent to the Bluetooth module that is connected to the microcontroller. It basically does the Speech-to-text conversion and sends the converted command to the system for further actions. The Bluetooth module can be either HC-05 or HC-06.

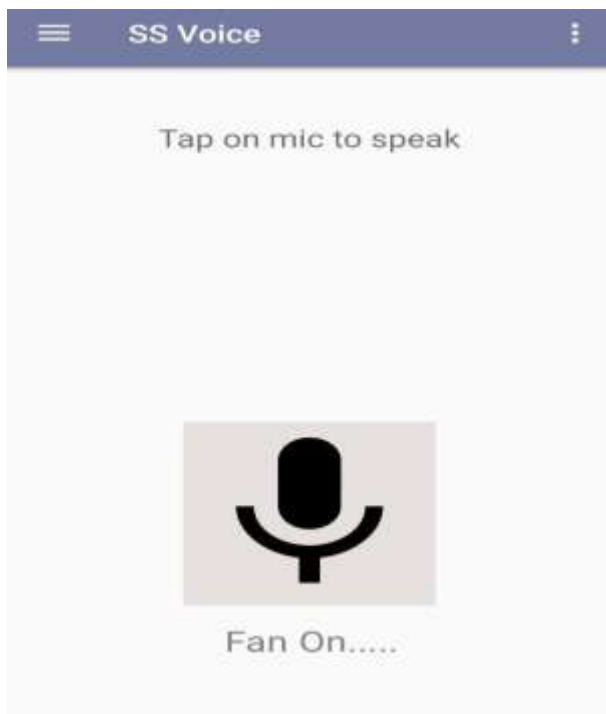


Fig -5: Voice Command Input Page

6. RESULTS



Figure 6: Website Page

The above figure shows the web page that will allow the user to control and monitor the appliances. After the successful connection to the server, the data from the sensors are sent to the website for monitoring and control of the appliances. It also gives the status of all running appliances connected to the system.

7. FUTURE SCOPE

Present prototype proposed is implemented using PIC micro controller programmed to control home appliances via website where appliances are semi- automated which means a command from the user is required for operation of the electrical appliances. In future, development for lighting and HVAC, sensors like motion detection, temperature etc, can be employed for sensing parameters and taking appropriate actions themselves via actuators, thus making the system completely automated.

For security, a CCTV or an IP camera may be employed with face recognition which would provide visual streaming directly on the user's smart phone and would notify on detecting any unknown person. Implementation of voice commands in variety of languages is also set for future implementations

8. CONCLUSIONS

The proposed project undertakes a viable solution of the need of automation at the very basic level, that is, in our homes. This system, though primarily aimed to reduce human effort, will be of much importance to old aged

people and physically handicapped people. The project enables us to bring every appliance at every corner of our home under our control from a single point without having to get up and manually switch on or off the appliance. The use of a Bluetooth module assists the use of this system from various locations in our house. It provides security and saves energy. As we are accessing devices by website, we can access it even if we are far away from home where the Wi-Fi is available. The system is fully functional and controlled through the wireless system with good accuracy of performance.

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