Cost Effective Home Automation System with offline mode controller and speaker verification (Voice commands) for handicapped.

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Abstract—**This paper presents a cost-effective solution for controlling devices and appliances through a Wi-Fi based microcontroller known as ESP8266.[1] The paper focuses on the concept to build an efficient and affordable home automation system where the network of home appliances will be controlled and monitored by a mobile app or through a web application. Each ESP8266 device will be controlled through a unique IP as IP can be accessible anywhere in the world. A web server is being used to control network remotely.[1] Most of the already existing home automation systems are expensive so they are not commonly used, so it can be said that this is an economical breakthrough in technological field of home automation systems. It will make our life easier and comfortable. It helps in saving power as home automation system is more accessible**.

Keywords—Wi-fi, Relay, ESP8266, Home automation, Internet of Things (IoT), switchboard

I. INTRODUCTION

Nowadays, technology has become a vital part of our lives. One of the most rapidly emerging technologies is home automation system. Smart homes will have a huge demand in near future because they are a source of comfort, luxury and security as we can control devices and appliances remotely using Android based Smart phone app.[2] Pakistan is a developing country and is trying hard to overcome various obstacle, the chief among which is the shortfall of electricity. Through this breakthrough, we are hoping to minimize the load shedding by reducing the power consumption through domestic and commercial load management. Switching of various appliance automatically or at the discretion of the user through remote access will reduce the power consumption by a lot as a major portion of the electricity usage in Pakistan comprises of domestic and commercial users [3]. This technology reduces human efforts and helps us save power but the reason it's not being used widely is that the already present home automation systems are complex, highly expensive and difficult to install and operate.[4]

Our project presents a low cost and flexible home control and monitoring system using an embedded micro-web server in which the devices are linked together enabling new forms of communication between devices and people [5]. This system does not require some complex server PC. Instead, it provides a communication protocol to monitor the home appliance with just a simple click while you are sitting on your couch. The wireless technology that we are using to transmit, sense and control the signals is a Wi-Fi network used to embed various levels of intelligence in the home.[6]
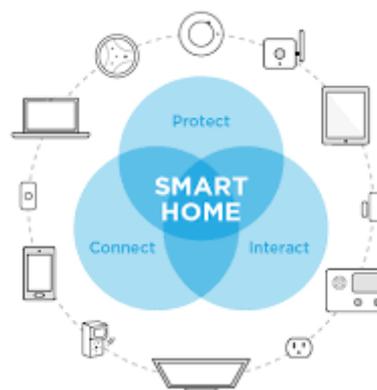

Fig. 1. Smart home

II. Literature Review

S. Amit, A. S. Koshy, S. Samprita, S. Joshi and N. Ranjitha, "Internet of Things (IoT) enabled Sustainable Home Automation along with Security using Solar Energy,"[1] discussed the Smart home and home automation by using highly efficient, and costly solar products which can be used in remote areas. This was really good approach which was not anly discussed the smart home but also give innovation concept and completely smart home for remote areas where no electricity found and the smart equpment uses solor energy and store that energy in efficeint li-on battries

[2] Discussed smart home controlled by the voice uttrences this was also good idea but it uses very costly equipment amazon alexa and othe softwares are also very costly thatswhy this sollution is not our desired solution but we got the idea of using alexa devices to understand and extract desired information from humen voice

[3]Discussed smart home by using wireless sensor network which is very costly and wireless sensor network is used in this application the major drawback of this network is about security. Wireless sensor network can be hack by some third party tool near the range of wireless [4]Discussed the almost same approach which we are using in our model. They will improve security by connecting the NodeMCU device in every

switch board along twith the relay board to control the home appliences we will improve this system by adding voice commands to control the appliances.

[13] It also uses almost exectly the same model but it will not creating network so the one ESP8266 device can be connected to only one MCU but this will not suitable if we want to create multiple networks under one umberalla for example number of rooms or making a colony. Also we are adding voice utrences is the beauty of our suggested techniques.

III. Gap Analysis

The objectives of writing this paper are as follows:
1. Make the Cost as low as possible.
   The least cost hardware is used in [13] Node MCU the architecture of NodeMCU can be seen in[12] but Node MCU is controller of ESP8266 which is main hardware (module) to control the appliances via WIFI. In this paper instead of using NodeMCU we are using ESP8266[Fig 4] which is half of the price of NodeMCU and a relay board [Fig3]
2. Disabled Friendly smart home

The objective of this paper is to design a cost-effective smart home for disabled person. In order to mitigate this task, we are using voice commands (utterance free recognition) for disabled (dumb/ deaf) or a handicap person. The previous work in speaker recognition can be seen in [2] but this is not utterance free we will improve its technique by adding one more hidden layer in our deep learning model in order to recognize utterance of even a baby who is not able to talk.[Fig 1]

3. Security
   Security is our main concern our deep learning CNN model making it sure that the voice commands has an appropriate threshold value to recognize.

IV. Methodology

Home automation system is an advanced project which has created the wireless connection between different devices via internet resulting in producing a network called 'internet of things (IoT)'[7]. It allows us to share data and control devices through mobile app/web browser. The devices and mobile app will communicate with each other via Wi-fi signals generated by ESP8266[Fig4] and mobile app. ESP8266 is programmed only once using NODMCU which has a USB to Serial convertor chip on it[1][8]. We just have to connect the USB slot of the NODMCU to the USB cable that is plugged into the PC and simply start programming ESP8266 using Arduino IDE. The EEPROM present in microcontroller will also be activated as needed. The user will ON/OFF the appliance through the switch control button available in app. Once he switched the button, the Wi-Fi will send the signal to Wi-Fi chip. When the signal is received, microcontroller activates the EEPROM and the operation will be performed accordingly. In the same way, all other appliances will be dealt with.

V. Design

The system design will include
- The user interface that takes the commands from the user.
- The communication system that carries the user commands to the terminals.
- The action taken by the terminals when receiving the user command from the main controller.

The user interface is an android application which will convert the commands coming from the user into binary commands and allows the user to interact with the system. The communication system includes the hardware components which identifies the input from the user and communicates with the response section. The terminals then generate response according to the received commands.[Fig 2]
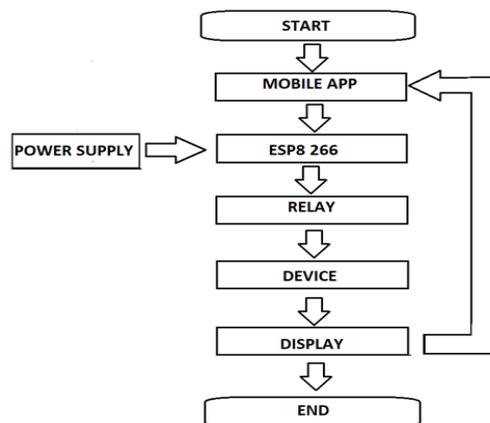

Fig. 2   Flowchart of design process

VI. System Specification

The system is specified into two sections:
- Hardware
- Software

A. Hardware Specifications

The hardware tools required for this system are Node MCU, Relay board, ESP8266 (Wi-Fi module) and connecting wires. All these components are cheap and easily available. These components will be required to make a chip.

1) Adaptor: An adaptor is used to power ESP8266. It will control the incoming ac voltage to 3.3v which is used to power the ESP8266.[Fig 4]

2) Relay: A Relay is an electromagnetic switch which uses relatively small amount of current to operate its coil to control a high-power circuit. It is a low-voltage circuit that is used to turn on or off high-voltage circuits while they are separated. [Fig 3]

Fig. 3. Diagram of Relay

3) ESP8266(Wi-Fi module): ESP8266 Wi-Fi module is a System on Chip (SOC) with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. It operates on 3V. Home automation systems can be wired or wireless. We will use ESP8266 Wi-Fi module as it eliminates the need for wired connections between the Arduino board and operating device and will be easy to install. We just have to burn the program into the chip once using ARDUINO IDE. As a low-cost alternative to a router, we will use AP (access point) mode of ESP8266 Wi-Fi module to use it as a soft Access point. It also provides lower level control on devices which is known as firmware.
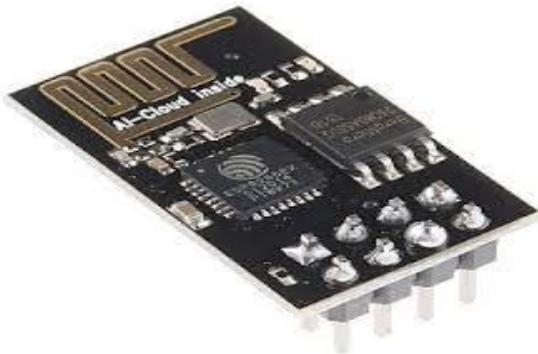

Fig. 4. Diagram of ESP8266

4) Connecting wires: Connecting wires will be used to connect the hardware (ESP8266 to relay) to make the chip.

B. Software Specifications

The user interface would be a web page and an android application which will be used to control different devices connected to the network having following functions.

1) Functions of the App
- Sign up an account.
- Log in an account.
- Log out of an account.
- Scan devices to control them.
- Add devices to system.
- Remove devices to system.
- Switch devices connected to the network ON/OFF.
- Schedule the device to switch ON/OFF (set the timer).
- Remove bugs from application (in case of errors).
- Remove connection errors from microcontroller.

- Send confirmation messages etc.
- Receive confirmation messages etc.

2) Tools to devolpe App
The software tools used to develop this project are:
- Android Studio
- Adobe Photoshop
- Visual Studio 2013
- Arduino IDE (used to program ESP8266).

JAVA is used to develop the mobile application and low-level programming language is used to operate the hardware.

VII. result

The proposed system will fulfill the following requirements:
- User will register his /herself to the app, giving his/her name and password. User will login to the application to use it. User will give commands to control the switching on/off of the appliances. The system will receive the commands and generate the response.
- The user will send commands from the mobile app. The system will receive the commands from the mobile app, decode the commands, generate the response according to the request and switch on/off the home appliances.
- The system will send an alert to the user in case of any interruption. The system should receive the request and operate according to it.

Part 2 Voice activation Switch (Future Work)

Voice activation is a kind of biometric which is mostly used part in this paper we will discuss how voice activation is used for control home appliances. Basically, there are two parts of this voice activation.
- Speaker recognition
- Speaker verification

Speaker recognition is not the scope of this paper any how speaker verification is in the scope but a little bit.

VIII. Speech and Signal processing

Speech recognition is also same like signal processing. The speech signal can be analyzed and process with different numerous techniques. There are Four popular speech processing problem areas are Speech recognition, Speech synthesis, Language Recognition and Speaker Recognition as shown in figure 5 below.
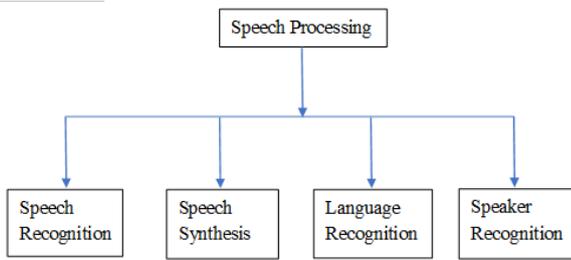
Figure 5: Speech and signal processing

There are two phases of speech analysis.

- Training phase
- Recognition Phase

We will use numerous technologies to analyses and control home appliances but this was not the scope of this paper. Any how we are more interested text of synthesis independent speech recognition. For this purpose, we require a deep learning neural network which will analyses speech and perform action on it.[13]

IX. Amazon Alexa As voice input command

Fig 6: Amazon Alexa for voice input commands

Voice commands received from Amazon Alexa as voice input commands this was directly connected from NodeMCU and a firmware written after processing voice commands to act on it and perform action. For example, if a voice command received "Alexa Light five on" it will first check that the voice command is verified and then if the light # 5 is not already on position it will command the switch to turn on the desired light. Same in the case with off command. The architecture is as follows:

There are vide range of amazon Alexa compatible devices but in order to make our solution cost effective we will use our ordinary NodeMCU for voice recognition and cheap relay board for switching conventional home appliances[20]

X. Conclusion

This project will make home automation system affordable so that it could be extensively used in homes, offices, restaurants, banks, industries, shopping malls, universities or any residential building. It will also help the disabled and elderly people to control some common home appliances like lights and fans. Smart home systems save power, time, and human efforts. The app has a built-in support for Wi-Fi can be used to access and control the devices. Another advantage is that the user can also schedule the appliances to turn ON and OFF. Our system is wireless and compact so it's easier to install and it only requires an android smart phone with the smart home application to operate and control the appliances by the user. Hence, this proposed system is scalable, flexible and highly reliable.

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