# Smart Home System using Internet of Things over WiFi

Shilpa Patil[1], Prof. Ashokkumar P S[2], Prasadgouda B Patil[3]

[1]*Assistant Professor, Dept of ECE, BLDEA'S Dr P.G.Halakatti College of Engineering & Technology, Vijayapur, India*
[2]*Professor & Head of the Dept of CSE, Amruta Institute of Engineering and Management Sciences, Bengaluru, India*
[3]*Assistant Professor, Dept of CSE, SECAB Institute of Engineering & Technology, Vijayapur, India*

***Abstract-*** **Internet of Things (IoT) is a system of interconnection any physical objects around us that has an on and off switch to the Internet. IoT covers a wide area and includes variety of devices like smart phones, PDAs, sensors, actuators and digital cameras. All these devices can be connected to each other to enable smart processes and services that support our basic needs, environment and health. One such service that supports basic need is making our home a Smart Home. The main objective of the project is to develop a low cost and flexible Smart Home System using an embedded web server, with IP connectivity that will provide remote control of home appliances and also provide security against any problems by using Android based Smart phone application when the home host is not at home. This proposed work is concerned with the controlling of different home appliances automatically using internet which is meant to save the electric power and human energy. The various appliances connected to the microcontroller and sensors are connected using wireless network.**

***Key Words:*** **Internet of Things (IoT), Wi-Fi network, Microcontroller, Home Automation System (HAS), Smart Home System**

## I. INTRODUCTION

The Internet of Things (IoT) is described as the interconnection of physical objects like smart-phones, PDAs, smart TVs, sensors and actuators to the Internet where the devices are interlinked together enabling them to communicate with people and between themselves [1].

Homes of the 21st century will become Smart Homes with more self-controlled and automation by using a system that allow users to monitor and control household electric appliances from anywhere and anytime. The traditional home automation systems are based on wired communication that has no problem until the system is planned well in advance and installed during the physical construction of the building. But for already existing buildings the implementation becomes arduous and expensive. In this paper, with a vision to achieve maximized automation an effective design and protocol implementation for Internet of Things used for monitoring regular domestic conditions by means of low cost ubiquitous sensing system is presented. The system uses WiFi technology as a network infrastructure connecting its parts. In home we have different types of loads at different locations. We can control all loads at the same time from remote location without connecting any physical wire between the loads and user. Hence the proposed Smart Home system is more scalable and flexible than the commercially available home automation systems [2].

## II. RELATED WORK

Home automation System (HAS) can be described as introduction of technology within the home environment to provide convenience, comfort, security and energy efficiency to its occupants [3].

There has been a significant increase in home automation in recent years due to higher affordability and advancement in Smart phones and tablets which allows vast connectivity. With the introduction of the Internet of Things, the research and implementation of home automation are getting more popular [4]. Various wireless technologies that can support some form of remote data transfer, sensing and control such as Bluetooth, WiFi, RFID, and cellular networks have been utilized to embed various levels of intelligence in the home [5].

Adding intelligence to home environment can provide increased quality of life through the integration of multi-touch mobile devices, cloud networking and wireless communication to provide the user with remote control of various lights and appliances within their home. This system uses a consolidation of a mobile phone application, handheld wireless remote, and PC based program to provide a means of user interface to the consumer [6]. Basil Hamed proposed a Smart house system consisting of many systems that can be controlled by LabVIEW software as the main controlling system. The system is connected to the internet to monitor and control the house equipment's from anywhere in the world using LabVIEW [7].

## III. PROPOSED SYSTEM ARCHITECTURE

Earlier the traditional home automation system using GSM module comprised of the hardware consisting of a stand-alone embedded system that is based on 8-bit microcontroller (Atmega8), a GSM handset with GSM Modem and a driver

circuit as shown in the block diagram in Figure 1. The GSM modem provides the communication medium between the homeowner and the system by means of SMS messages [8] over the GSM network.

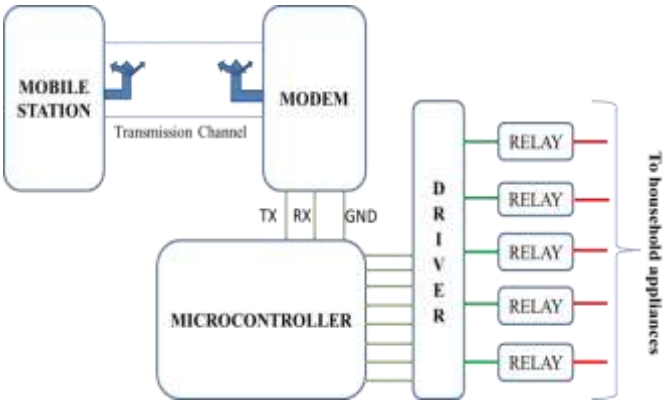


Figure 1 Block Diagram of the GSM based Home Automation System

SMS technology used in the system is easy to use, learn and can be accessed easily when needed. A microcontroller can be controlled and monitored from any GSM phone that supports SMS. The system is universal as most of the GSM phones support SMS i.e. the remote to this system can be any basic GSM phone. The range of GSM is global so the user can use the system from any corner of the world. User and/or system administrators are more likely to have their phones with them at all times than they are likely to physically be in front of their computers. After the desired operation of the system is performed the system provides the user with an acknowledgement. SMS is used as the main communication medium. Abnormal conditions like power failure or the malfunction of the device is also monitored and informed by the installed system to the user who is remotely located. The construction of this system is easy, cheap and versatile, and can be used in any process industry with a little modification. But in GSM based HAS, there should be the user intervention for controlling home appliances wherein the user has to send some commands like "#A.light on*", "#A.light off*" and so on. After receiving these commands by the GSM module, the microcontroller send signal to relays, to switch ON or OFF the home appliances using a relay driver. This user intervention can be avoided and the automation process can be still maximized by connecting objects like smart-phones, Internet TVs, sensors and actuators to the Internet where the devices are intelligently linked together enabling new forms of communication between things and people, and between things themselves using IOT technology resulting into a Smart Home.

This section describes the proposed architecture and design of flexible and low cost home controlling and monitoring system using IoT. The architecture is divided into three layers: Home Environment, IoT Gateway and Remote Environment as shown in the figure 2.

Remote Environment consists of authorized users who can access the system on their Smart phone application using the Internet using Wi-Fi or 3G/4G network. Home Environment consists of IoT Gateway and a hardware interface module. The primary function of the IoT Gateway is to provide data translation services between the Internets. The main component of the IoT Gateway is a micro Web-server based module that manages, controls and monitors system components, that enables hardware interface modules to successfully execute their assigned task using actuators and to report server with triggered events using sensors.

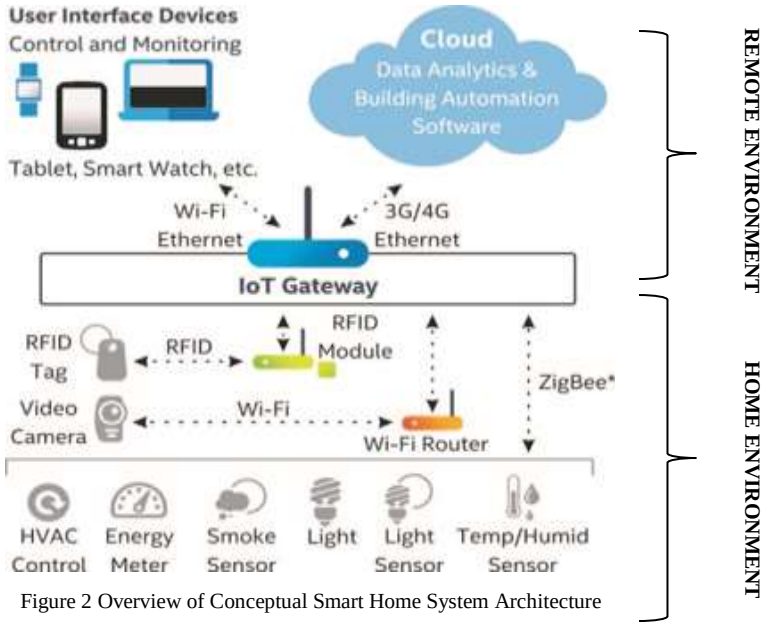


Figure 2 Overview of Conceptual Smart Home System Architecture

The hardware interface modules are interfaced with sensors and actuators through wires. It has capabilities to control the following components in users home and monitor the following alarms: Temperature and humidity, Gas leakage detection, and control the following appliances: Lights on/off/dim, Fan ON/OFF, ON/OFF of different HVAC appliances (heating, ventilation, and air conditioning), Leakage of gas.

## IV. METHODOLOGY

### *A. Hardware Description*

The methodology of this work design can be divided into two sections: hardware and software implementations. The hardware implementation consists of the development of the main controller, sensor networks and the smart home as shown in the figure 3. While the software implementation focuses on the programming of the microcontroller using Embedded C.

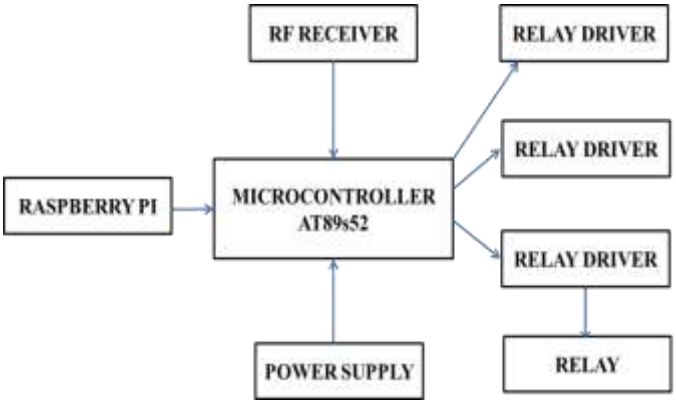


Figure 3 Control Unit of Smart Home System

Main controller is the most important part of the system that provides interface between the user and the system. AT89C52 microcontroller is used as the brain of the main controller. It is a low-voltage, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable memory. It has 32 general I/O port and the clock speed can be up to 24 MHz. In addition, it is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The power-down mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset. In order to program the device, preload tool is been used to burn the program onto this microcontroller.

IR sensors allow to sense motion, and detect whether an object has moved in or out of the range. They are inexpensive, low-power, small and easy to use. They are normally found in appliances and devices used in households. They are frequently mentioned to as PIR, "Passive Infrared", "Pyro electric", or "IR motion" sensors.


Figure 4 Wireless Sensor Unit of Smart Home System

The next important module is ESP8266EX WiFi module. It offers a complete Wi-Fi networking solution and can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any microcontroller-based design with simple connectivity using SPI/SDIO or I2C/UART interface. ESP8266EX is among the most integrated Wi-Fi chip in the industry as it integrates the antenna switches, RF balun, power amplifier, low noise receive amplifier, filters, power management modules. ESP8266EX is often integrated with external sensors and other application specific devices through its GPIOs.

The software part consists of programming AT89C52 microcontroller using Embedded C using Keil µVision. The Graphical User Interface is designed by using PHP. The gateway flowchart for the establishment of connection to the internet is shown in figure 4.

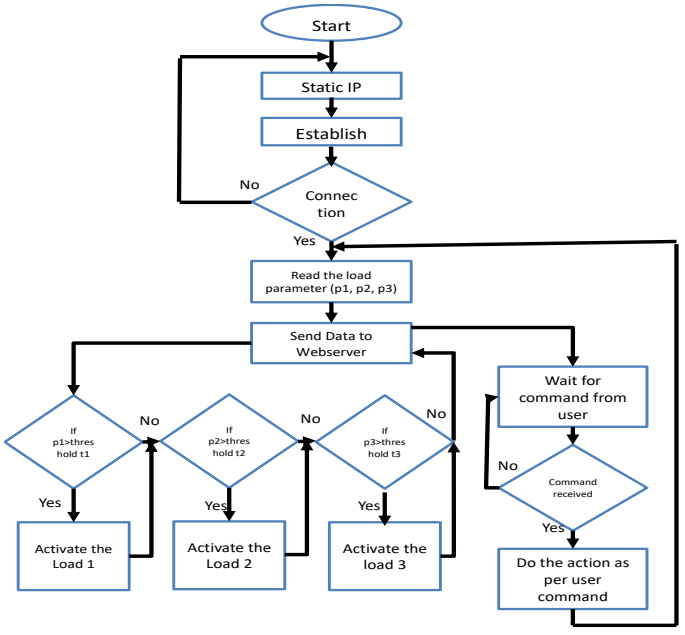


Figure 6 IoT Gateway f low chart for the connection establishment with the Internet

The sequence of activities in the Smart Home System is as follows:

- When the connection is established it will start reading the parameters of loads like p1, p2, p3 etc.

- The threshold levels for the required loads are set as t1, t2, t3, etc. The sensor data are sent to the web server.
- The data can be analysed anywhere at home.
- If the load parameters are greater than the threshold level then the respective load is activated and the required actuation is done for the controlling of the parameters.

## V. EXPERIMENTAL RESULT

A model house is built for the home automation system and is as shown in the figures 5 and 6. The AT89S52 connects to the internet through Wi-Fi. When the connection is established it will start reading the parameters of loads. The threshold levels for the required loads are set as per the parameter and stored in the database. The load data are sent to the web server. The data can be analysed anywhere, any time. If the load parameters are greater than the threshold level then the respective sensor will be activated and the required actuation is done for the controlling of the parameters. The user can also monitor the electric appliances through the internet via web server. Person knowing the user name and password can control the system by entering the assigned IP address in the web browser through which the web server page will appear. The web server gives the information about the loads and their parameters in different places of the house and motion state in the house.

Figure 6: Experimental Setup of Smart Home System


Figure 7: Screenshot of Web Server Page of Smart Home System

## VI. CONCLUSION

In this paper, a novel architecture for low cost and flexible home control and monitoring system using IoT is proposed and implemented. The proposed architecture utilizes Web services as an interoperable application layer for communicating between the remote user and the home devices. The home automation using IoT has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement with the support of inbuilt WiFi module, for example switching on the light when it gets dark. It also stores the sensor parameters in the database in a timely manner which helps the user to analyze the condition of various parameters in the home. IoT has the potential to add a new dimension to this process by enabling communications with smart objects, thus leading to the vision of ‘‘anytime, anywhere, any media, anything” communications.

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