

# Design and Implementation of Wi-Fi based Smart Home System

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**Abstract:** The rapidly advancing mobile communication technology and the decrease in costs make it possible to incorporate mobile technology into Smart Home systems. We propose a mobile and internet based Smart Home system that consists of a mobile phone with android capabilities, an internet based application, and a home server. The home appliances are controlled by the Arduino which receives commands from the server computer, which operates according to the commands received from the mobile application via the wireless network or the internet. In our proposed system the home server is built upon a Wi-Fi technology which receives commands from the client and the command is processed via Arduino, which allows a user to control and monitor any parameters related to the home by using any Android capable smart phone or via the internet. This paper presents an innovative low cost design and implementation of automated control based on weather conditions, appliance control, and, home security together with the design of android application to enable the smart phone to send commands and receive alerts through the server based system.

**Keywords:** Home Automation, Arduino UNO, Wi-Fi Network.

## 1. INTRODUCTION

### A. Overview

Today's world is digitized. Starting from our handheld devices to computers to smart appliances, our world is digitized. Thus a smart home would be the next step for a better future. The system efficiently controls the lights and appliances, thus minimizing power consumption. The system makes use of the internet to control the house appliances and the lights. Apart from merely switching off and switching on the lights, the system can control it efficiently using ambient temperature sensors and can adjust the weather conditions of the home. It enables the user to control various aspects of their appliances from a remote location through a hand held device. It hence makes a versatile system which expands the mobility of the user.

### B. Features and benefits of Smart Home System

In recent years, wireless systems like Wi-Fi have become more and more common in home networking. Also in home and building automation systems, the use of wireless technologies give several advantages that could not be achieved using a wired network only.

1.) Reduced installation costs: First and foremost, installation costs are significantly reduced since no cabling is necessary. Wired solutions require cabling, where material as well as the professional laying of cables (e.g. into walls) is expensive.

2.) System scalability and easy extension: Deploying a wireless network is especially advantageous when, due to new or changed requirements, extension of the network is necessary. In contrast to wired installations, in which cabling extension is tedious.

3.) Aesthetical benefits: Apart from covering a larger area, this attribute helps to full aesthetical requirements as well. Examples include representative buildings with all-glass architecture and historical buildings where design or conservatory reasons do not allow laying of cables.

4.) Integration of mobile devices: With wireless networks, associating mobile devices such as PDAs and Smart phones with the automation system becomes possible everywhere and at any time, as a device's exact physical location is no longer crucial for a connection (as long as the device is in reach of the network). For all these reasons, wireless technology is not only an attractive choice in renovation and refurbishment, but also for new installations.

## 2. RELATED WORK

[1] Sirsath N. S, Dhole P. S, Mohire N. P, Naik S. C & Ratnaparkhi N.S. This paper proposes a Home Automation system that employs the integration of multi-touch mobile devices, cloud networking, wireless communication, and power-line 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 customers. [2] Basil Hamed. The main objective of this Paper is to design and implement a control and monitor system for smart house. Smart house system consists of many systems that controlled by LabVIEW software as the main controlling system in this paper. Also, the smart house system was supported by remote control system as a sub controlling system. The system also is connected to the internet to monitor and control the house equipment's from anywhere in the world using LabVIEW.

[3] Deepali Javale, Mohd. Mohsin, Shreerang Nandanwar The prime objective of this paper is to assist handicapped/old aged people. It gives basic idea of how to control various home appliances and provide a security using Android phone/tab. The design consists of Android phone with home automation application, Arduino Mega ADK. User can interact with the android phone and send signal to Arduino SDK which in turn will control other embedded devices/sensors.

## 3. SYSTEM ANALYSIS

### A. Problem Definition

Smart Home systems face four main challenges, these are high cost of ownership, inflexibility, poor manageability, and difficulty in achieving security. The main objectives of this research is to design and implement a home automation system using IoT that is capable of controlling and automating most of the house appliances through an easy manageable web interface. The proposed system has a great flexibility by using Wi-Fi technology to interconnect its distributed sensors to home automation server. This will decrease the deployment cost and will increase the ability of upgrading.

## B. Proposed System design and features :

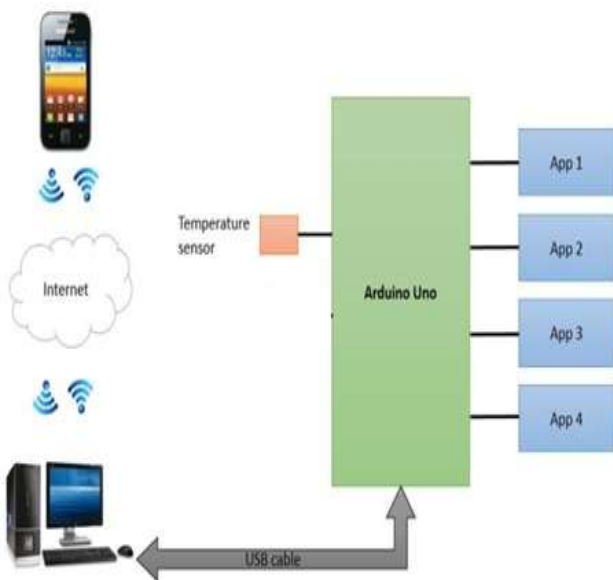


Fig. 1. Proposed home automation system architecture.

The proposed design of Smart home is using the Wi-Fi as the connecting media to interact with the database. As shown smart phone when connected to internet through the Wi-Fi than all the basic home appliances can be controlled.

The proposed Smart home system has the capabilities to control the following components in users home and monitor the following :

- Temperature and humidity
- Motion detection
- Door status
- Video monitoring

The proposed home automation system can control the following appliance;

- Lights on/off
- Fans on/off
- HVAC on/off
- On/off different appliance

## 4. HARDWARE DESCRIPTION

- **Arudino Uno R3:**



Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller based kits for building digital devices and interactive objects that can sense and control the physical world. The Uno is a microcontroller board based on the ATmega328P. It has 14 digital inputs/outputs pins( of which can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, as ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get start.

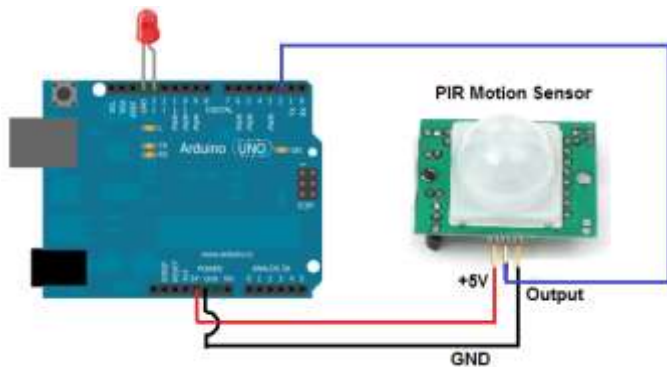
- **8 Channel Relay:**



A relay channel is a probability model of the communication between a sender and a receiver aided by one or more intermediate relay nodes. This is a 8 Channel Relay module, it can be controlled directly by a wide range of microcontrollers such as Arduino. It is used to control various appliances, and other equipments with large current. 8 Channel Relays are included in this module, with “NC” ports means “Normally connected to COM” and “NO” ports means “Normally open to

COM". This module also equipped with 8 LEDs to show the status of relays.

- **PIR Sensors:**



A Passive Infrared Sensor(PIR Sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. A PIR-based motion detectors is used to sense movement of people, animals, or other objects. They are commonly used in burglar alarms and automatically-lighting systems.

- **Temperature Sensor:**



Temperature is the most often-measured environmental quantity. This might be expected since most physical, electronic, chemical, mechanical, and biological systems are affected by temperature. Above temperature sensor has three terminals and required Maximum of 5.5 V supply. This type of sensor consists of a material that performs the operation according to temperature to vary the resistance. This change of resistance is sensed by circuit and it calculates temperature. When the voltage increases then the temperature also rises. We can see this operation by using a diode. Temperature sensors directly connected to microprocessor input and thus capable of direct and reliable communication with microprocessors. The sensor unit can communicate effectively with low-cost processors without the need of A/D converters

## 5. SOFTWARE DESCRIPTION

- **Android SDK:**

Android software development is the process by which new applications are created for the Android operating system. Applications are usually developed in Java programming language using the Android Software development Kit(SDK), but other development environments are also available. To build the android application to receive the live video feed

from the camera and to send the control signals to control the robot.

- **Arduino IDE:**

The Arduino open source IDE makes it easy to write code and upload it on any arduino board. It runs on Windows, Mac OS X, Linux and many other operating systems. The environment is written in java and based on Processing and other open source software.

## 6. CONCLUSION

This paper proposes a low cost, secure auto-configurable, remotely controlled solution. The approach discussed in the paper is novel and has achieved the target to control home appliances remotely using the WiFi technology to connects system parts, satisfying user needs and requirements. WiFi technology capable solution has proved to be controlled remotely, provide home security and is cost-effective as compared to the previously existing systems. The home automation using Internet of Things has be 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, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the database in a timely manner. This will help the user to analyze the condition of various parameters in the home anytime anywhere. Finally, the proposed system is better from the scalability and flexibility point of view than the commercially available home automation systems.

## 7. FUTURE ENHANCEMENTS

There can be a lot of future enhancements associated to this research work, which includes a useful feature would be to add support for remotely controlling an infrared transmitter. This transmitter can be placed within range of an infrared enabled appliance such as an air conditioner. The user would then be able to control more advanced features of the appliance such as temperature control, fan speed, etc.

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