

# IOT BASED SYSTEM FOR SMART AND SECURED HOME

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**Abstract** - Home automation based on internet of things (IoT) aims at making home smart and secure. In this paper, we present a prototype of an automated, secured and smart home system using Arduino Due microcontroller with IP connectivity through Wi-Fi. The system provides operation of fan, light, motor and other appliances at home to multiple users through PC or smart phone connected to the internet IP address of the system. This system has temperature sensor to turn on fan, water level sensor for sensing water level in the water tank and gas leakage sensor to control gas connection. The main advantage of these in-built sensors is that they can automatically control the appliances connected to it thereby making it intelligent. Wi-Fi has been chosen to improve system security.

**Key Words:** Arduino Due, Hitachi HD44780, LM35, MQ3, ESP8266-01 Home automation, intelligent appliances

## 1. INTRODUCTION

In the age of internet, IoT has proved useful for home automation. Intelligent home appliances improve the quality of life. Lots of research are pouring in to make self-controlled, automated and energy efficient homes by allowing users to control home appliances of varying kind.

In 2007, E. Yavuz et al. developed a PIC remote-controlled system for controlling electrical gadgets. The disadvantage is that an extra hardware is required to burn the code for PIC microcontroller [1].

In 2010, S. M. Anamul Haque et al. proposed a system that controls the home appliances using the personal computer [2]. Appliances can either be controlled by timer or by voice command. Bluetooth technology has been used in this system which has limited range (maximum of 10 km) [3].

In 2015, K. Venkatesan et al. in their paper have implemented Zigbee module in Arduino mega through which they control devices [4]. However, Zigbee and Bluetooth used in this system have limited range and less data rate and data. Moreover, Zigbee are costlier than ESP8266-01.

Around the same period Nathan David et al. presented a low cost and flexible home control an environmental monitoring system [5]. It employs an embedded micro web server in Arduino Mega 2560 microcontroller, with IP connectivity for accessing and controlling devices and appliances remotely.

These devices can be controlled through a web application or via Bluetooth Android based smart phone app [6]. Bluetooth has a lower data rate and the range is limited. They were mainly concerned about automation rather than making the appliances secure.

In 2016, Shopan Dey et al. developed a system that used Raspberry pi module to connect ESP8266-01 module to the internet [7]. These systems are single admin controlled systems.

In this work, we attempt to build a prototype of smart and secured home automation system that make the home appliances intelligent and ensures security by using various kinds of sensors[8, 9]. Through our system, any home appliances that are a part of internet can be controlled and monitored by multiple remote users. Arduino Due controls and acts upon the home appliances connected to it. Everything is controlled by the Arduino micro controller. Attached to Arduino DUE is the Wi-Fi module, ESP8266-01, that receives data sent from smart phone over Wi-Fi. ESP8266-01 network connectivity has a data rate of 1 to 11 mbps and range of 150 meters which is more than Zigbee module which has less data rate 920 to 250 kbps) and are more costly. Arduino DUE reads the data and decides the switching action of home appliances connected to it through Relays. The home appliances include fan, light, motor and gas connection. These appliances are secured and made energy efficient with the help of various sensors attached to it. Temperature sensor connected to the system automatically turns on the fan when temperature reaches 40 degree Fahrenheit. Motor will turn off when water level in the tank is sensed by the water level sensor. Gas sensor senses gas leakage and the values are displayed through LCD [10]. Hitachi HD44780 LCD is used to display the sensor values and indicates variations. The home appliances connected to the system can be switched ON/OFF using a smart phone through Wi-Fi by any number of users connected to the same network. The sensors attached to the system make the home automation system more secure.

## 2. PROPOSED SYSTEM

The proposed home automation system consists Arduino microcontroller, ESP8266-01, two double pole relays with water level sensor, gas leakage sensor (MQ3), temperature sensor (LM35) connected to fan, light, motor and LCD.

Figure 1 depicts the block diagram of the home automation system.

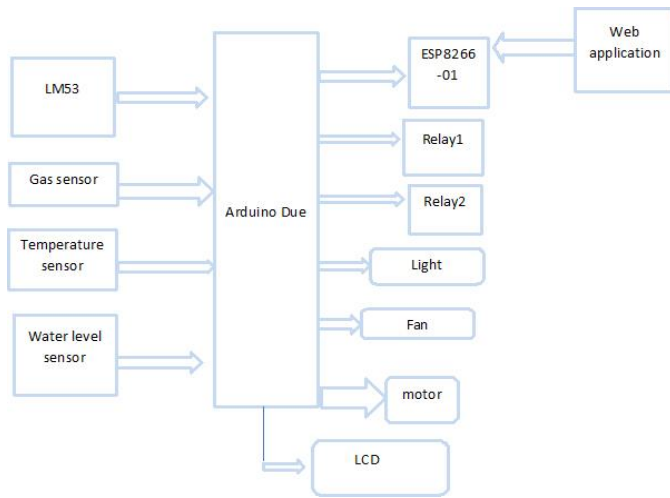


Figure 1. Block diagram of the home automation system

Arduino due controls the entire system. ESP8266-01 is the network connectivity device. LM35, MQ3, gas leakage sensor, ESP8266-01 are connected as input devices into the Arduino analog input pins. Fan, light, motor and LCD are output devices which are connected to the output pins of Arduino due.

Temperature sensor continuously senses the temperature in the house and it passes the information to the controller. When temperature becomes high (40 degree Fahrenheit or more in this system) it is displayed in LCD and the fan automatically turns on. The user can turn off the fan if they do not require it.

MQ3 continuously senses gases like Butane, carbon monoxide, LPG etc present in the surroundings and the readings are passed to controller and displayed through LCD. If gas reading varies it will be notified through LCD by the controller.

Water level sensor is connected to the tank and the motor is connected to the relay. Water level sensor senses the water level and the reading is passed continuously to controller. When the water level becomes high it is displayed in LCD by the controller and the motor connected to the relay is turned off automatically. If the water level is low, the controller can turn on the motor. The user through smart phone or PC can remotely switch ON/OFF the motor too.

In the proposed model the temperature, gas leakage and water level in the house is controlled automatically without user intervention. The system also allows the users to turn OFF /ON fan, light and motor at the same time. The user can also monitor the electric appliances through the internet via web server. When the user performs actions, the information passed to the controller through ESP8266-01 and controller

takes actions on the basis of given information and the relays corresponding to the device are turned on or off.

## 2.1 HARDWARE

**ARDUINO DUE:** Arduino Due board is one of most powerful development boards in ARDUINO series. This has been used in our work to control the entire system. This board has AT91SAM3X8E Microcontroller with SAM3X8E processor from Atmel. It has 12 analog inputs (ADC) and 12 bit high resolution output, 4 serial communication port and 70 input/output pins along with 2 I2C bus and USB 2.0.

**Hitachi's HD44780:** This is a Character based LCDs of Hitachi's HD44780 controller. The LCD used is 2 Line with 1 controller and support at most of 80 characters. They are used as an output for reading the temperature and the status of the system.

**Relay:** A relay is an electrically operated switch which turns OFF/ON devices according to instructions from Arduino Duo. Two relays are used.

**ESP8266-01:** ESP8266-01 is a highly compact board which we have used for Wi-Fi networking functions. In our system, we have used the ESP8266 module as it performs on-board processing and can be integrated with the sensors used.

**Temperature sensor:** A temperature sensor is a thermocouple or a resistance temperature detector (RTD) that gathers the temperature from a specific source. We have used LM35 Temperature sensors. The LM series originated with integrated circuits made by National Semiconductor. This sensor generates a high output voltage than thermocouples and may not need that the output voltage is amplified. In this system, fan will automatically turn on when temperature exceeds 40°F (value can be customized according to the user desire). The sensor draws 60 microamps from its supply and acquires a low self-heating capacity.

**Water level sensor:** Water level sensor has two conducting plates. First plate is connected to the +5V supply through series resistance of 10K ohm and second plate is connected directly to the ground. The output will change in the range of 0 – 5 Volt, in proportion with change in content of water in the tank. When there is no water in contact, the sensor acts as open circuit and 5V is obtained at the output.

**Gas sensor (mq3):** The Grove - Gas Sensor (MQ3) module is useful for gas leakage detection. It is suitable for detecting Alcohol, Butane, CH<sub>4</sub>, Hexane, LPG, CO. The sensitivity of the sensor can be adjusted by using the potentiometer. When gas sensor senses Arduino Due notifies user on Hitachi HD44780 LCD.

## 2.2 SOFTWARE

The Arduino controller is activated through code written in Embedded C using Arduino Integrated Development Environment (IDE). Arduino (IDE) is a free, integrated toolset and environment used for programming Arduino processor. The program instructions are passed to the controller using a USB cable. The Front End is designed using HTML. It is appended with the code to invoke Arduino controller. Figure 2 illustrates the front end of the application.



Figure 2. Front End of the application

## 3. CONCLUSIONS

Here we have developed a useful, smart and intelligent home automation system using Arduino-Due board integrated with Wi-Fi Module and different sensors that is experimentally proven to work satisfactorily. It controls various appliances and is intelligent enough to initiate a process according to the need of the moment. It is user friendly and provides security features to prevent gas leakage and avoid electrical accidents caused by use of switches. It intelligently controls the level of water in the tank.

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