United International University

QUEST FOR EXCELLENCE

IoT based Intelligent Home Automation and Security System

Microprocessors and Microcontrollers Laboratory

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Submitted To

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1.Introduction

An IoT involves extending Internet connectivity beyond standard devices, such as desktops, laptops, and smartphones which are Embedded with technology; these devices make communication over the Internet, and users can be remotely monitored and controlled. This proposed system focuses on five techniques and systems, such as a Low-cost Wi-Fi-based home automation system, which facilitates global connectivity over worldwide physical objects to serve people collaboratively, automatically, and intelligently.

2.Motivation

Home Automation has been on the rise in the past few years. Now all things are controlled by IoT ever-evolving technology, there have been smarter and more advanced solutions in the domain of home automation. To enhance the standard of living, the appliances need to be wholly automated without any user intervention in any form whatsoever. This enables the end user hassle-free interaction with the appliances as the appliances learn and react as per the user's requirements without him physically pressing a button. Thus, the importance of wireless sensor node has been on the rise and is a critical factor for efficient implementation of home automation.

3.Objectives

This project aims to implement a low-cost, reliable and scalable home automation system that can be used to remotely switch on or off any Household appliance, using an Arduino to achieve hardware simplicity. Low-cost short messaging service for feedback voice dial from phone to toggle the switch state. Furthermore, Gas sensors check the gas leak or not. Suppose the leak application sends a message to the user and turns off the fan.

4.Proposed System

The proposed system is a distributed home automation system, consists of Arduino, micro controller, sensors and some electrical devices used in home. The Arduino controls and monitors the various sensors, and can be easily configured to handle more hardware interface module (sensors). Wi-Fi module is used to connect to the internet. Wi-Fi is selected to be the network infrastructure that connects server with the sensors. Wi-Fi improves system and is useful to increase system mobility and scalability. The proposed home automation system also has the capabilities to control the following components in user’s home and monitor the following alarms: Temperature and humidity, Fire and smoke detection. The proposed home automation system can control the following appliance: Lights: on/off, Fan: on/off, Door: open/close, some security alarm various other smart devices present inside the home. Here presented the proposed block diagram of the proposed system-

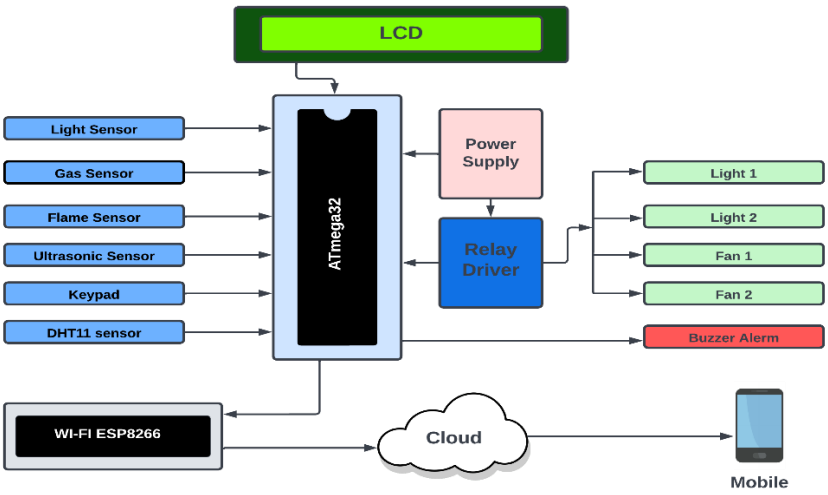


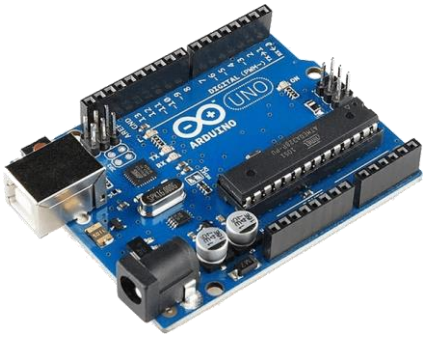
Fig 1: Block Diagram

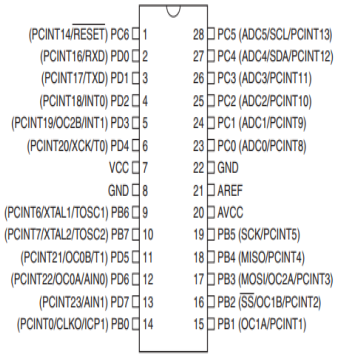
4.1 Hardware Requirements

4.1.1 Arduino UNO

The Arduino Uno R3 is a microcontroller which has an inbuilt Integrated Circuit to perform all sorts of operations. Arduino has 20 digital input/output pins in which 6 can be used as Power Width Modulation outputs and 6 can be used as Analog inputs. Programs can be loaded onto the Arduino board using Arduino Software. The Arduino Uno is an open-source Microcontroller built and developed by Arduino.cc and it also has an open-source Arduino software. Arduino board has 14 digital I/O pins which is programmable with the Arduino Integrated Development Environment (IDE) using a type B USB cable. Input/output pins operates at 5 volts in which each pin can provide or receive 20 mA and has a pull-up resistor of 20-50K ohm. The limit is 40mA which should not be exceeded on any I/O pin in case it causes permanent damage to the microcontroller. The features are given below-

- ATmega328 microcontroller
- Input voltage - 7-12V
- 14 Digital I/O Pins (6 PWM outputs)
- 6 Analog Inputs
- 32k Flash Memory
- 16Mhz Clock Speed
- Arduino Part #: A000066

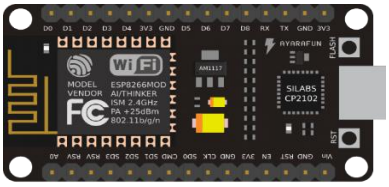




Arduino Uno R3

4.1.2 NodeMCU ESP8266:

The ESP8266 is a Wireless Fidelity microchip with TCP/IP stack and Arduino capability which is a low cost, high range and reliable device. This module allows microcontrollers to connect to a Wi-Fi network and makes TCP/IP connections using Hayes-style commands. The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocols, it gives Arduino a direct access to the Wi-Fi network. The ESP8266 can either host an application or offload Wi-Fi networking functions from another processor. ESP8266 module has a pre-programmed AT command with a set firmware which can connect ESP8266 to Arduino Uno. Wi-Fi is usually referred to as IEEE 802.11x standards i.e., to provide instant connectivity.



NodeMCU ESP8266

4.1.3 Breadboard

A breadboard is a construction base for prototyping of electronics and is referred to as Solderless breadboard means a plug board (terminal array board) does not require soldering and is reusable. Breadboards are easy to use for creating temporary prototypes and experimenting with circuit design. A strip board is used to build semi-permanent soldered prototypes which cannot be reused. The clips are often called as tie points or contact points.

4.1.4 Keypad (3×4)

Keyboard 3×4 Membrane Switches Matrix Keypad 12 Key Thin & Flexible with Cable Connector & Adhesive Back for Arduino. This keypad has 12 buttons, arranged in a telephone-line 3×4 grid. It's made of a thin, flexible membrane material with an adhesive backing (just remove the paper) so you can attach it too nearly anything. The keys are connected into a matrix, so you only need 7 microcontroller pins (3-columns and 4-rows) to scan through the pad. Check the tutorials tab for links to an Arduino library and example code.

3x4 Flexible Keyboard

4.1.5 Servo Motor

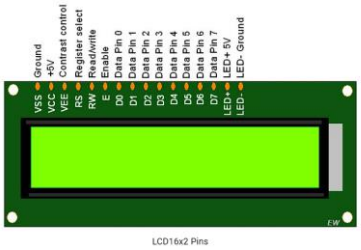
A servo motor is a kind of motor that has extremely precise rotational capabilities. Based on the type of gear arrangement and operational characteristics, there are numerous other servo motor types. A servo motor often has a gear configuration that enables us to produce a very high torque servo motor in tiny and light designs. These characteristics have led to its employment in a variety of applications, including toy cars, RC helicopters and planes, robotics, etc. Most hobby servo motors are rated at 3kg/cm, 6kg/cm, or 12kg/cm when measured in kg/cm (kilogram per centimeter). You can determine how much weight your servo motor can lift at a specific distance using this kg/cm value.

Servo motor

4.1.6 LCD Display

There are several uses for LCD (Liquid Crystal Display) screens, which are electrical display modules. A 16x2 LCD display is a very fundamental module that is frequently included into many different devices and circuits. With a 16x2 LCD, there are 2 lines that can each display 16 characters. Each character on this LCD is presented using a 5x7 pixel matrix. The 224 different characters and symbols that can be displayed on the 16 x 2 intelligent alphanumeric dot matrix display. The Command and Data registers on this LCD are its two registers. Various commands issued to the display are stored in the command register. Data for display is kept in a data register. Data that make up the desired image are placed in the data registers as part of the control process for the display, and instructions are subsequently placed in

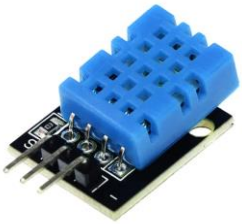
the instruction register. Liquid Crystal Library simplifies this for you in your Arduino project so you don't have to be familiar with the low-level instructions. By altering the potentiometer that is linked across the VEE pin, the contrast of the display can be changed.



16x2 LCD display

4.1.7 DHT11 Temperature & Humidity sensor

The Temperature and Humidity Sensor module is used to detect temperature and humidity of the place. The humidity range is 20% - 80% and the accuracy is 5%, its temperature range is 0℃ - 50℃ and the accuracy is ±2℃. The DHT11 module makes use of a single-bus serial communication. DATA is involved in the communication and synchronization between the microprocessor and DHT11 as the data transfer takes 4ms. The data format is an integer and a decimal. This sensor is connected to the Wi-Fi and the Wi-Fi to the Arduino board. The data about the Temperature and humidity are sent to the smartphone where it can be viewed and monitored.



DHT11 Module

4.1.8 Ultrasonic Distance Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e., the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target). features are given below-

- Operating Voltage: 5V DC
- Operating Current: 15mA

- Measure Angle: 15°
- Ranging Distance: 2cm - 4m

Ultrasonic Sensor

4.1.9 Buzzer Module

As a type of electronic buzzer with integrated structure, buzzers, which are supplied by DC power, are widely used in computers, printers, photocopiers, alarms, electronic toys, automotive electronic devices, telephones, timers and other electronic products for voice devices. Buzzers can be categorized as active and passive ones (see the following picture). Turn the pins of two buzzers face up, and the one with a green circuit board is a passive buzzer, while the other enclosed with a black tape is an active one. Working voltage: 3.3 - 5V; PCB size: 2.0 x 2.0 c

Buzzer Module

4.1.10 Flame IR Sensor

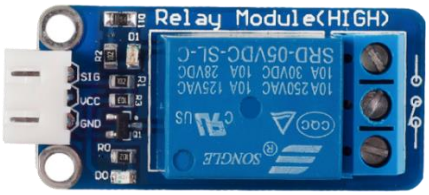
The IR flame sensor is used to detect the presence of fire or other infrared source (Flame or a light source of a wavelength in the range of 760 nm to 1100 nm can be detected). It can be used in firefighting robot or heat seeking robot.

- Small and compact in size
- Adjustable threshold value
- 2 state binary output (logic high and low)
- Easy mounting with a screw hole

Flame IR Sensor

4.1.11 High-Voltage Relay Module

A relay is an electrically operated switch with of a set of input terminals to control single or multiple signals with a set of operating contact terminals. Relays with usually calibrated operating characteristics and multiple operating coils are used in the protection of electrical circuits from overloading. The electric power systems in modern time's uses digital instruments called protective relays. Latching relays requires a single pulse of power control to operate the switch persistently. Another pulse applied to a second set of control terminals, or a pulse with opposite polarity, resets the switch and the repeated pulses of the same kind has no effects. The Magnetic latching relays are used to control interrupted power which affect the circuits in the relay.



Relay Module

4.1.12 Gas Sensor

A gas sensor detects the presence or concentration of gases in the atmosphere. The sensor produces a potential difference based on the concentration of the gas by changing the resistance of the material inside the sensor which is measured as an output voltage. The voltage value of the type and concentration of the gas can be estimated using the output voltage. The gas type can be detected depending on the sensing material present inside the sensor. This is set for a certain threshold value of gas concentration. When the concentration of the gas exceeds this threshold, the digital pin goes high. The concentration of the gas can be measured using the analog pin.

Gas Sensor

4.2 Software Requirements

4.2.1 Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a

series of menus. It connects to the Arduino hardware to upload programs and communicate with them. The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++.

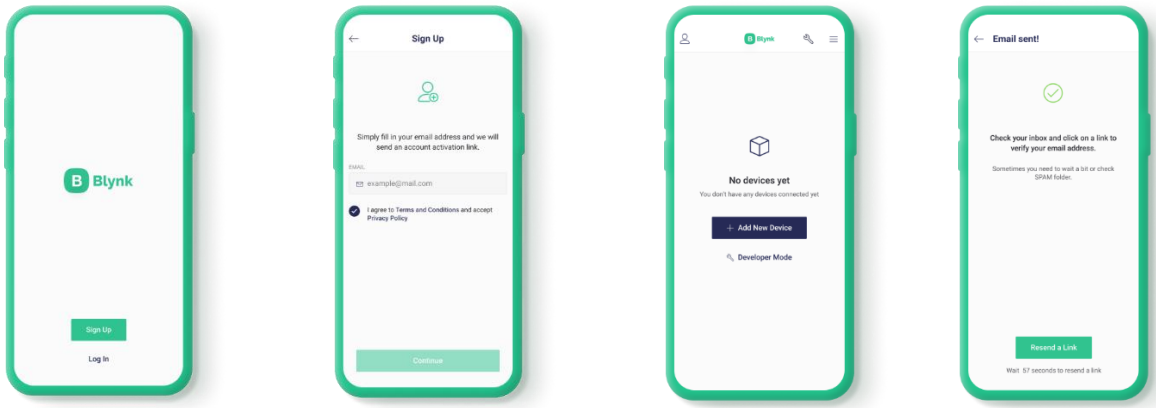
4.2.2 Blynk.io App

As a hardware-agnostic IoT platform, Blynk.io comes with device management, data analytics, and machine learning functionalities while allowing you to connect to any device. You also have a mobile app constructor that allows you to build IoT apps per drag-and-drop. You get a variety of ready-made widgets to create white-labeled native iOS and Android apps for any use case.

Blynk comes with a free Developer plan intended for personal use. IoT engineers, developers and tinkerers can test the platform and build their own IoT projects. The free version

- allows you to add up to 5 IoT devices for free,
- comes with a selection of free mobile apps for Android and iOS,
- gives you some limited free cloud data storage and libraries to work with the hardware of your choice.

These capacities are enough for a first prototype or for building a first small-scale IoT project. Blynk's free version is not suitable for commercial use.



Blynk.io App Interface

5. Feature List

1. ***Security based door system.***

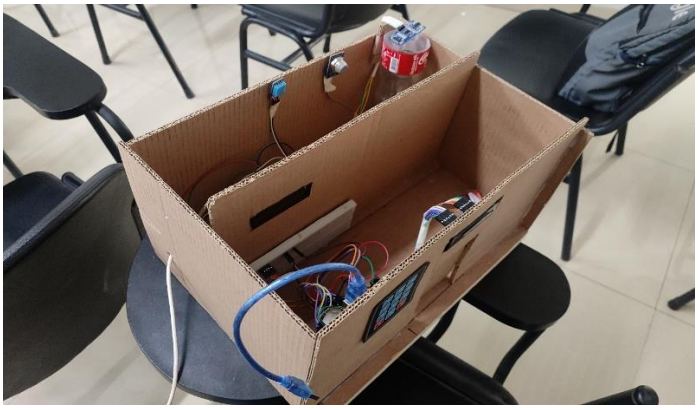
   This feature includes the security part of the project that ensure the authorized access to the main door of the house. The user will have to put a password that are already programmed and the status will be shown in the LCD.

2. ***Humidity and temperature status through LCD.***
   There will be an LCD display which will show the continuous status of Humidity and temperature.

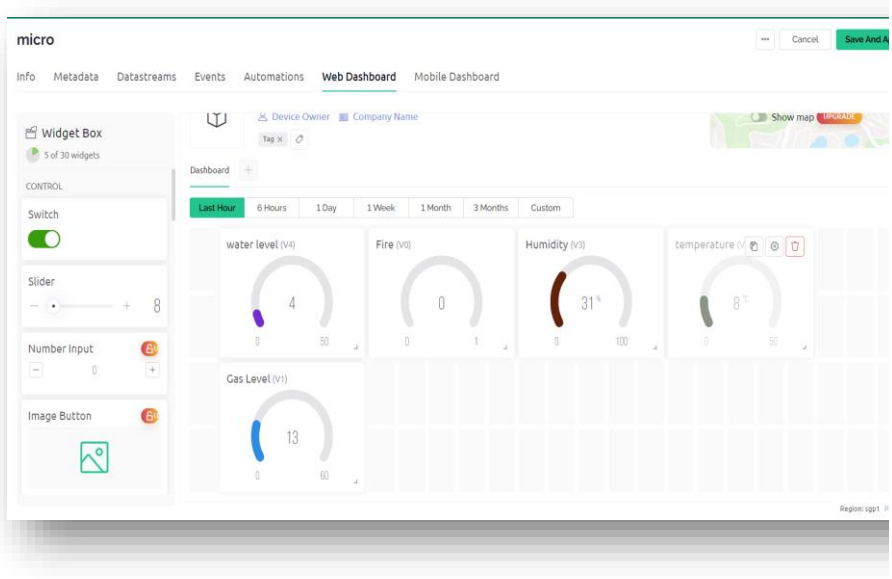
3. ***Gas and Fire Detect and Alarm.***
   In case of any unwanted situation like gas leakage and Fire flame, they will get instant notification through app and Email and that will make him enable to take Immediate action. If the gas leakage and fire attack occur the respective gas sensor and IR flame sensor will detect it, Instantly the Buzzer will start beep and an exhausted fan will be turned on to release the gas outside.

6.System Implementation

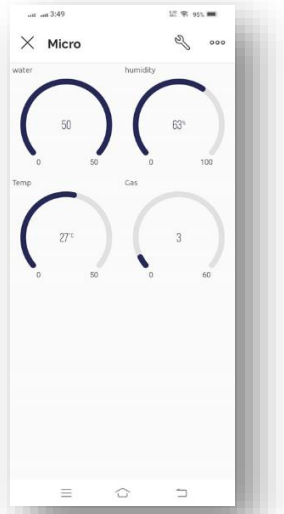
Along with all the components that required both hardware and IOT cloud app the full home automation implementation was quite tough and maintaining security and web app simultaneously lots of difficulties had to face. For the door lock system Arduino and keypad was the main components and to make the user input visible LCD display was set up. To open and lock the door servo moto had to attached with the door. Servo position shift initialized 90 degree each time. For the automation NodeMCU was the main component as a microcontroller. First all the value of Gas sensor, DHT11, Ultrasonic sensor stetted in Blynk web. Dashboard had to set as an interface with provide gauze icon. Then auth token has to import into the Arduino code. The increment of value can be observed through both Blynk.io app and web. When the value increases 5the user get notification through email and the buzzer start to beep.



6.1 Blynk.io web and App

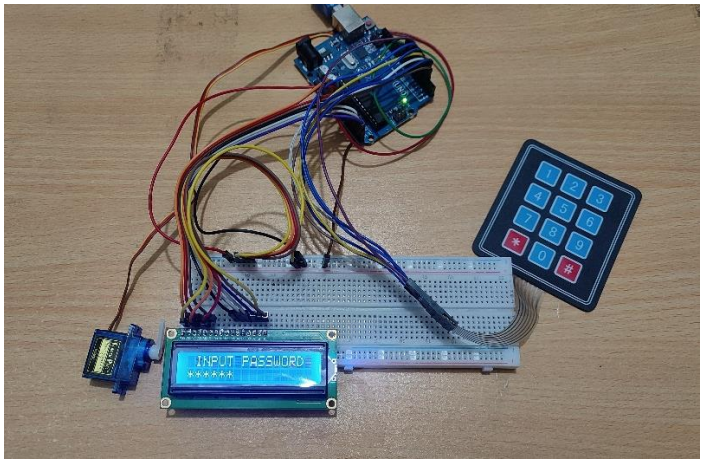


Blynk Web dashboard

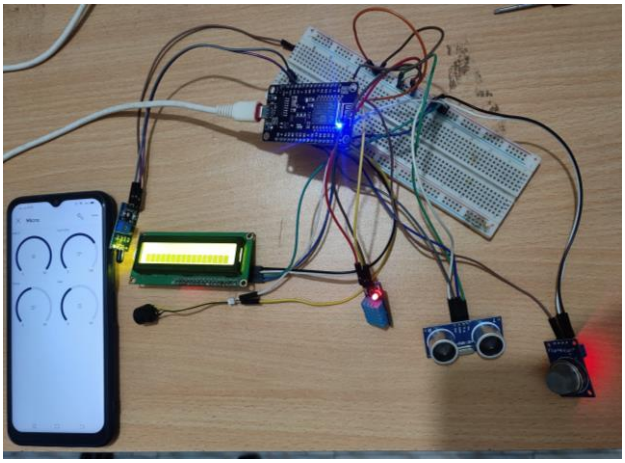


Blynk.io App

6.2 Hardware implementation



Keypad Door Lock System



IOT based Home automation

6.Conclusion

In this project, an automated home and security system is provided. There are lots of features that can be generated through modern technologies. But due to limitations we use a few sensors along with Arduino and Wi-Fi module that will includes the mentioned features.