



IOT BASED SMART RESIDENCE SYSTEM

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Abstract – As the development in technology is at a tremendous rate, it is now becoming necessary to communicate with your day-to-day interacting appliances remotely using internet-enabled devices. This is the concept of the Internet of Things (IoT). Application-based communication and data transfer online are one of the most powerful and advanced methods. The Internet helps people to stay connected within and outside the organization. The materials and materials used for internet communication are called the Internet of Things (IoT). In this paper, we present such a system for the home that will allow users to access appliances or control appliances over the internet using their android application from anywhere around the globe. The proposed system is designed in such a way that it includes all the doors, windows, curtains, etc. also controllable by the application taken into consideration in all the security surveillance also to make the home safe and secure along with the automation.

Keywords – IoT, automation, security, LPG, LDR, DHT, Node MCU, relays

I. INTRODUCTION

An automated system for controlling household appliances is known as home automation, there are various systems used for home automation that is based on different microcontrollers and take different parameters to monitor and control the home appliances. The system gives you the control of devices in your home from a mobile device or laptops or over the web anywhere in the world. The system is used for controlling various lights, appliances, electrical outlets, heating, and cooling systems that are easily controlled by web or internet-enabled devices [1]. All these types of the system becoming more popular due to low implementation costs and flexibility that can be easily configurable by everyone according to their need that's why all the IoT systems are in great demand and have great value because of their ability to help people like the disabled, as they can't walk more much, then this system is very helpful to them as well as to patients and elderly people who remain mostly on their bed, as well as to all those who live alone in their houses. [2] [3].

IoT Architecture – The architecture for the Internet of things is fully designed as showing the combination of hardware and software where multiple sensors or an environment detection device interfaced with a microcontroller through which the data or instruction is sent to the cloud from where the information is sent and visible on the application. [4].

The IoT devices that are being used in the proposed system are as follows: -

1) Relay module – It is an industrial electronic switch that is connected with the microcontroller or microprocessor that helps to control the circuit on/off. [5].



Fig 1.1 Relay Module

2) **NodeMCU** – It is a high-quality microcontroller with inbuilt Wi-Fi and Bluetooth module. It is an open-source device for which open-source prototyping board designs are available. [3]



fig 1.3 NodeMCU (ESP-32)

3) **DHT sensor** – It is a commonly used sensor that is generally used for measuring or identifying the temperature and humidity of an environment or the area.

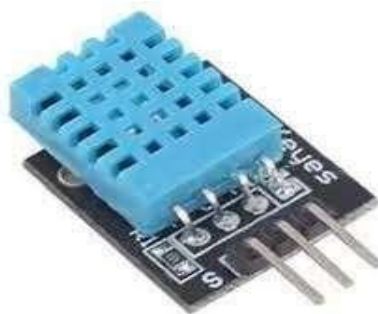


fig 1.4 DHT Sensor

$$RH = \left(\frac{\rho_w}{\rho_s} \right) \times 100\%$$

RH : Relative Humidity

ρ_w : Density of water vapor

ρ_s : Density of water vapor at saturation

fig 1.5 Mathematical formula of DHT sensor

4) Gas Sensor – It is an IoT sensor that is being used to detect if any gas leakage is in the house or any area. It is also used to detect the LPG gas leakage inside the kitchen. This sensor can also be used to identify the AQI of the atmosphere.



fig 1.6 Gas sensor

Gas	$\log(ppm) = f\left(\frac{R_s}{R_0}\right)$
LPG	$\log(ppm) = -2.5279 \log\left(\frac{R_s}{R_0}\right) + 1.8771$
CH ₄	$\log(ppm) = -2.5474 \log\left(\frac{R_s}{R_0}\right) + 2.2636$
H ₂	$\log(ppm) = -4.2302 \log\left(\frac{R_s}{R_0}\right) + 3.0935$
Alcohol	$\log(ppm) = -4.5008 \log\left(\frac{R_s}{R_0}\right) + 4.8216$
CO	$\log(ppm) = -7.358 \log\left(\frac{R_s}{R_0}\right) + 6.4758$

fig 1.7 Mathematic formula of GAS SENSOR

5) Ultrasonic Sensor – It is an IoT sensor that is being used to identify or measure the distance of anything either it is an obstacle or any object. In the proposed system, this sensor is used to automate the water tank of a house system.



fig 1.8 industrial ultrasonic sensor

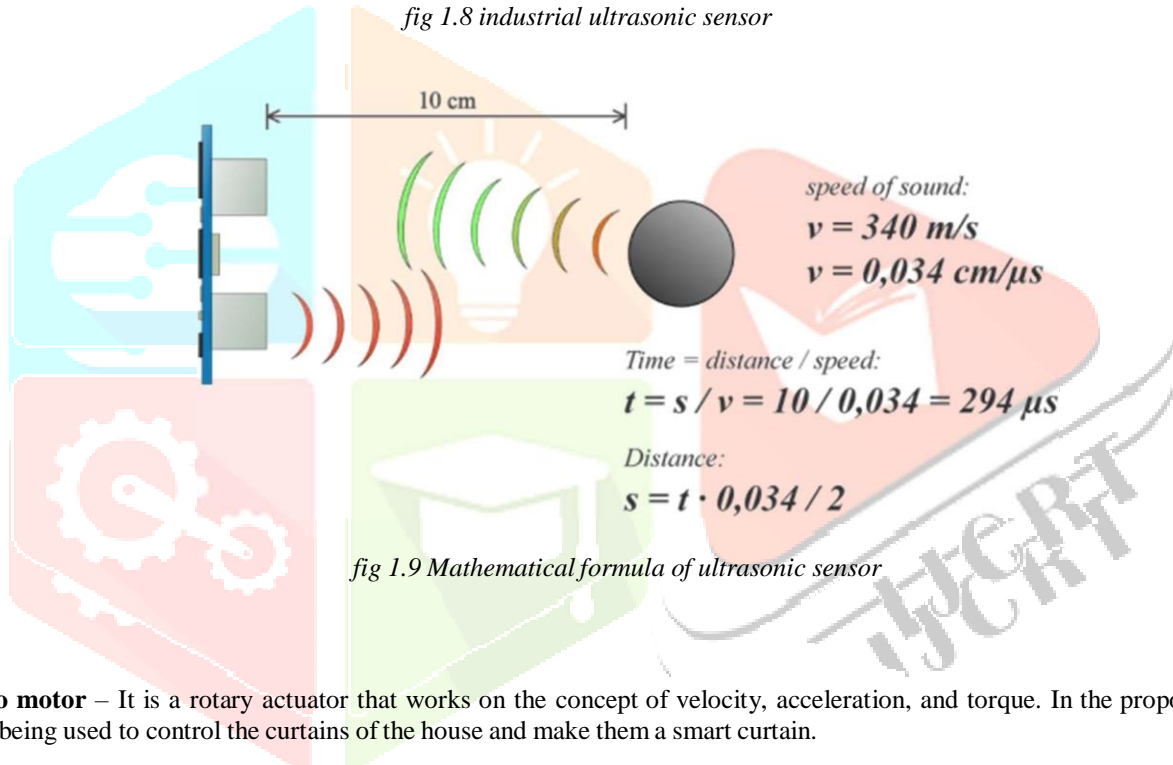


fig 1.9 Mathematical formula of ultrasonic sensor

6) Servo motor – It is a rotary actuator that works on the concept of velocity, acceleration, and torque. In the proposed system this motor is being used to control the curtains of the house and make them a smart curtain.



fig 1.10 industrial servo motor

$$\begin{array}{l}
 \begin{array}{l}
 0.5 \text{ ----> } 0 \\
 x \text{ ----> } \alpha \\
 2.5 \text{ ----> } 180
 \end{array} \\
 \begin{array}{l}
 2.5-x = 180-\alpha \\
 \hline
 x-0.5 \quad \alpha-0
 \end{array} \\
 \begin{array}{l}
 2.5\alpha - x*\alpha = 180x - 90 - x*\alpha + 0.5\alpha \\
 2\alpha + 90 = 180x \\
 x = (2/180)*\alpha + 0.5
 \end{array} \\
 \text{Duty cycle} = x*(\text{frequency}/10)
 \end{array}$$

fig 1.11 industrial servo motor

7). Firebase: It is an open-source development platform that is generally known for real-time databases, Key-value databases used for synchronizing data between user devices or smartphones, and providing storage in the cloud. [6].



fig1.12 firebase

II. LITERATURE REVIEW

This part is informing the disposition of the residence automation system. Under current conditions, home appliances, devices are available using the go up to the device and act technology like this is needed. We are here using automation technology at home. This is a distributed home automation system consisting of servers, Actuators, sensors, and microcontrollers. The server is configured or set up to control and monitor the sensors. The system can be accessed from any wireless device like mobile phones, laptops, etc. Utilizing an IP address and an internet connection with an appropriate web browser. In the proposed model, gas leakage, temperature & humidity, and turning on/off light and fan in the house is monitored and controlled. When there is a gas leakage detected in the house, an alert sound is raised by an alarm. The electrical appliances like lights and fans are also turned on/off automatically by notifying the user of any electrical appliances that are left turned on in hurry or by mistake, it can be seen and turned off using an IP address of the webserver also from a remote location. [6].

The proposed home automation system can control and monitor the following:

1. Gas leakage.
2. Light on/off.
3. Fan on/off.
4. Temperature and humidity.
5. Security surveillance.
6. Doors and windows automatic locks.
7. Dustbin / Garbage collection smartly.

Table no. 1 Review case study

Sr. No	Author's Name	Features	Resources	
			Software	Hardware
1	Bilgunde , Gaurav kakde [7]	Security System Voice Controlled Automation	Voice Control Application	Arduino Uno and Bluetooth Module
2	G. Mallikharjuna rao [8]	Star topology-based configuration system.	Web server – flask, HTML, CSS	Raspberry Pi, NodeMCU
3	Charu Srivastava, Rohit Anand, a. Srinivas [9]	Humidity, temperature, and smoke monitored	Flutter, database, voice assistant	ESP-01, DHT sensor, smoke sensor
4	S.K. Ali Shah, WaqasMehmood [1]	Bluetooth enabled appliances automation	Android application, Database.	Bluetooth module, Arduino, sensor

III.SYSTEM ARCHITECTURE

The proposed system consists of multiple modules which work together to give a seamless working performance that enables the user to monitor and control different things in the house. The system consists of two NodeMCU which make up the brain of the system, running different processes and checks in the house. Multiple sensors connected to the NodeMCU provide real-time information which is processed and relevant actions are performed depending on the kind of data that is received by it.

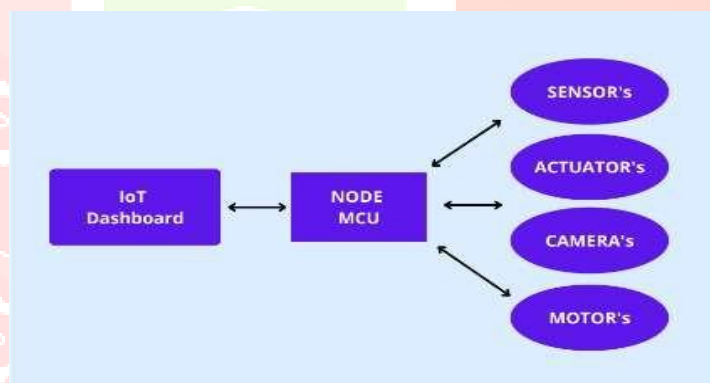


fig. 2.1. Proposed system model

Along with the sensors, the system comprises multiple ways of notifying the users of any violation that occurs in the security of the system. One of which is a Buzzer Alarm which sounds like a high pitch alarm notifying anyone nearby about a violation in security.

The other is an e-mail/SMS which is to be sent to the registered email or phone number. Similarly, the system is designed to detect the leakage of gas in the kitchen or geysers using the Gas leakage sensors and alerts the people about it by sending the notification or a message on the android phone. The system is proposed in such a design that all the electronic home appliances like fans, lights, refrigerators, AC's, coolers, geysers, television, CCTV camera, exhaust fan, washing machine, kitchen chimneys, etc. Besides these appliances all the windows, doors, curtains, main gate, garage are also controlled and automated using the locking and unlocking of doors and windows smart or controllable by using the android device, and similarly, all the curtains of the house are operated by application. [7] [1].

IV. IMPLEMENTATION

Several sensors are randomly positioned throughout the house, and the central microprocessor receives real-time data from these sensors continuously. The microprocessor contains an uploaded code that executes a set of functions continuously. These functions include operations like automatic switching on/off certain selected lights, performing requested actions like switching on/off a light, fan, etc. performing emergency actions like sounding the alarm & notifying the user, and uploading the recorded information to the cloud.

As the home appliances are connected to the system, relays will be used to match the power supply. The sensors are connected to different ports on the NodeMCU and relay continuous sensor data to the processor. On the user's end, the data will be uploaded to the cloud and switches will be provided for controlling different household features. The data will be displayed on the thinger.io dashboard. As the Above- described model is just a proposed model not implemented from our side we are continuously working on it but some work has been done in this project like we have automated all the appliances of a room (A lab in our college), all the appliances of the room are controlled by the NodeMCU as a microcontroller. The relays are powered by SMPS(Power Supply) and the internet control is handled by thinger.io (a third-party cloud server).

V. MODULE

Module I – Data Collection Unit This module consists of all the sensors that are being used in the Home Automation system. These sensors collect the different types of sensor data like the environmental condition of a particular room in which system is implemented and shows this information to Using third-party servers such as thinger.io (to visualize the data) and transferring it to the microprocessors so the processors can take decisions based on the data now what should be done next.

DHT11(Digital Humidity & Temperature sensor): -It is a low-cost sensor. It uses a resistive component to measure surrounding air. The design of DHT11 includes the sensing element of capacitive humidity and a thermistor. That sense of wetness and connected with a high-performance microcontroller and gives output understandable by us or means. [9]

LDR (Light Dependent Resistor): - A light-dependent resistor (LDR) or a photoresistor device that uses the resistivity function of electromagnetic radiation is called a light-dependent resistor (LDR). Hence, they are light-sensitive devices. The material used for constructing LDRs is semiconductor material When light falls on the resistor, due to the photoconductive properties of the materials, the resistance decreases.

MQ 2 (Grove Gas Sensor): - MQ-2 sensor module is a good option for detecting gas leakage in homes. the sensor can detect different types of gases like H₂, LPG, CH₄, CO and It is highly sensitive, accurate measurement, and responsive. [9]

Module II – (Central Processing Unit): - NodeMCU is an open-source IoT board generally means it is firmware, not the development kit. The programming language of this device is Lua. This board performs appropriate actions based on the input. It is combination of ESP8266 Wifi SOC and ESP-12. The ESP8266 is a Wi-Fi SoC that is widely used in IoT applications, ArduinoIDE and the relevant programming language are used to run all relevant programming which uses a variety of libraries and functions to execute different operations.



fig. 3.1 Pin-configuration diagram.

Module III – Interface Unit This module comprises the third-party cloud server for the user so that it can take the utilization of the functionality of firebase. It is a cloud platform that provides functionality like monitoring the data, collection of the data (provides free cloud storage for storing the data) and helps to operate the devices via the application with the help of this firebase. It is a google opensource platform. [5]

VI. RESULT



fig 4.1 login UI

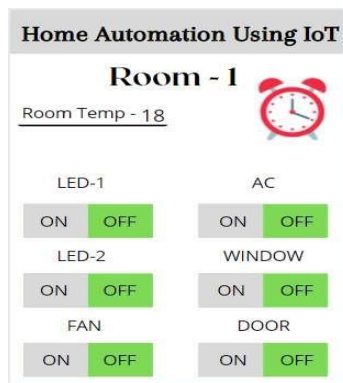


fig 4.2 Room UI



fig 4.3 Kitchen UI

Total power consumption of the home will be monitored and wastage of power is reduced. Water leakage detection and motion detection features can also be added to the working model as well which will make this one system useful for many causes.

GSM module can also be embedded in the system which can enable a calling option along with notification and e-mail features. Appliances and sensors can be included in the future to check the home environment for further hazards.

When all the sensors are tested together, we get a consolidated positive output. The temperature sensor detects the current temperature and is also fed with a threshold of 45 degrees Celsius, wherein a rise beyond the threshold will set an alarm to the user. Whenever gas is detected by the gas detection sensor in and around its surface, the user is alerted with the message "Gas Detected" otherwise the dashboard simply displays "Gas Not Detected".

The humidity sensor detects the current humidity and its threshold is set to default 100. When there is sufficient visible light around, the dashboard shows "Light" and the connected lights are switched off. When there is insufficient visible light, the dashboard shows "Dark" as the output, and the connected lights are switched on. Lights and fans can also be remotely controlled using mobile phones or tabs or laptops by using the virtual switch on the dashboard.

VII. CONCLUSION

This project can be scaled up to apartments but when it will be implemented on large scale then the security issues will occur, proper actions should be taken like weeping the alarm or notifying the user will be performed. All the appliances like light, fan and cooler, fridge, A.C, and more can be remotely controlled using internet-enabled devices. doors can also be controlled remotely using the portable internet enabled. Thinger.io provides the account creation means authentication and authorization on every account so that the authorized person can control, monitor, and can take actions according to what they need hence the home automation system can have more and more options for making, updating, modifying, or making it smarter.

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