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Sure-H Secure IoT Smart Home System and Object Finding Device

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ABSTRACT

With the growing technology, the demand for smart things is drastically increased in daily life. The IoT (Internet of Things) is one of the major components that provides facility to interact with IoT enabled devices. In this work, we propose a secure and efficient smart home system that enable to protect homes from theft or unusual activities and parallelly saves power. Our system is developed by exploiting the features of IoT that facilitates us to monitor an IoT
enabled house from anywhere anytime over the Internet when data are stored in the cloud. This system uses a motion detector to detect a moving object from the environment where the system is deployed and door sensor to notify that the person entered the house and PIR sensor to identify the humidity and temperature of the house. IoT allows people and things to be connected any time, any place, with anything and anyone, by using ideally in any path/network and any service.Smart Home system achieved great popularity in the last decades and it increases the quality of life.The main part is Node MCU, which has inbuilt Wi-Fi module, which will helpin controlling devices over the Internet. It supports a wide range of home automation devices like power management systems. In addition to that, an app would be developed which will allow the user to control their devices. Another adding feature is that there is a object finding device which is used for finding the missed object.

Keywords : NodeMCU, Blynk application, IFTTT application, Smart phone, Google Assistant

1. Introduction

We live in an exciting time where more and more everyday things are becoming smart. Appliances have sensors and can communicate to other things and can provide control to more things. The Internet of Things, IoT, is in a huge way and people are rapidly inventing new gadgets that enhances lives. The price of microcontrollers with the ability to talk over a network keeps dropping and developers can now tinker and build things inexpensively. IoT based home automation project is done using low cost ESP8266 Espino ESP-12 WiFi Module, It uses relays and few simple components, four electrical devices can be controlled and temperature can be monitored. ESP-12 is low cost module is used here.

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Homes of the 21st century will become more and more self - controlled and automated due to the comfort it provides, especially when employed in a private home. A home automation system is a means that allow users to control electric appliances of varying kind. Many existing, well-established home automation systems are based on wired communication. This does not pose a 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 cost goes very high. In contrast, Wireless systems can be of great help for automation systems. With the advancement of wireless technologies such as Wi-Fi, cloud networks in the recent past, wireless systems are used every day and everywhere. With advancement of Automation technology, life is getting simpler and easier in all aspects. In today's world Automatic systems are being preferred over manual system. With the rapid increase in the number of users of internet over the past decade has made Internet a part and parcel of life, and IoT is the latest and emerging internet technology. Internet of things is a growing network of everyday object from industrial machine to consumer goods that can share information and complete tasks while everybody is busy with other activities. Wireless Home Automation system(WHAS) using IoT is a system that uses computers or mobile devices to control basic home functions and features automatically through internet from anywhere around the world.

BLOCK DIAGRAM:

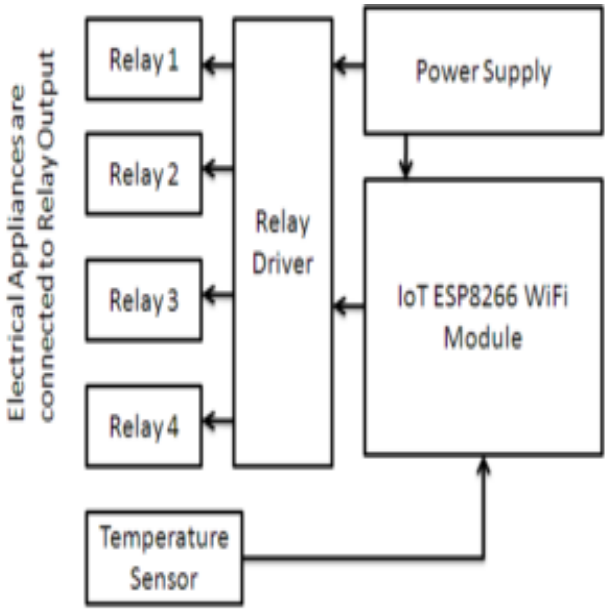

FIG 1: Block Diagram of Project

The following block diagram we live in an exciting time where more and more everyday items "things" are becoming smart! "Things" have sensors and can communicate to other "things" and can provide control to more "things". The Internet of Things, IoT, is upon us in a huge way and people are rapidly inventing new gadgets that enhance our lives. The price of microcontrollers with the ability to talk over a network keeps dropping and developers can now tinker and build things inexpensively. IoT based home automation project is done using low cost ESP8266 ESPino ESP-12 WiFi Module, It uses relays and few simple components, complete code is provided, for more details on software setup go through IOT EXPLAIN. You can control four electrical devices and also you can monitor temperature. ESP-12 is low cost module we are using here.

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1.1 Problem Definition

Home automation refers to control the home appliances by using computer technology. Computer Systems enables from remote control of lighting through to complex micro-controller or computer based networks with various degrees of intelligence and automation. Home automation provides security, energy efficiency and ease of use hence, it is adopted more. It also provides remote interface to home appliances to provide control and monitoring on a blynk mobile application. The field of Automation has well advanced in Industries, as majority of automobile industry plants as well as bottling plants have Automated assembly lines. But automation has not yet penetrated in the homes especially in India. If automation was to be used in homes than everyday life would be get eased. Simple example of use of automation in home can be seen in the transfer of water from the under-ground water tank to the over-head water tank, by sensing the level of water in both the tanks. This process eases the every time effort the user has to put in for filling the tank and also helps in saving water. Also people are getting more acquainted daily with the use of Smartphone and tablets which are capable of doing much of PC's work handy. So we have decided to make a low cost Embedded System in which the smart phones can be used to help automate entire home. In this system the user will have remote access and control over all the subsystems present in the house.

1.2 Motivation of the Project

Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society." This description focuses on the main advantages provided by the communication connectivity between the Internet and all the devices integrated with specific electronics: the possibility to gather information and to exchange data in a fast and smart way. Indeed, the relevant aspect of IoT is not only related to the kind of objects involved, but to the kind of information retrieved. This is the reason why IoT is also called Internet of Everything. By interfacing directly with people and their experience of a product (both an object or an application), the accuracy of data is granted. The IoT is developing as more and more enterprises are getting involved in smart projects concerning business intelligence tools. Cisco, the largest networking company in the world, estimates the IoT 'will consist of 50 billion devices connected to the Internet by 2020'. So, what are the benefits of the Internet of Things and why companies should invest in the IoT? Here is a list of the top 10 reasons to develop IoT projects.

Support innovative

IoT techniques support innovative businesses by allowing the possibility to better assess their customers' feedback while using their products. The measurability of data is certainly an advantage for accelerating the (re)positioning of a product on the market.

Requirement Analysis

Manufacturing plays an important role in economic development and is still considered crucial to economic growth in the globalization era. It has a positive impact on the growth of both developed and developing countries.

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Emerging technologies are utilized by the manufacturing industry to enhance the economic competitiveness of individual manufacturers and the sustainability of the entire industrial sector. The adoption of information and communication technology (ICT) in manufacturing enables a transition from traditional to advanced manufacturing processes.

Monitoring systems, as part of ICT application, play an important part in manufacturing process control and management. Recent developments in information technology enable the integration of various. monitoring applications into one complex system for the whole supply chain. In general cases, the application of a monitoring system plays an important role in predicting disease, improving production, reducing cost, and providing an early warning system. Recent technologies such as Internet of Things (IoT)-based sensors can be utilized and integrated with monitoring systems. Studies have been conducted in the manufacturing industry and showed significant benefits from the use of IoT-based sensors for monitoring such as working condition improvements, error design prevention, fault diagnosis, quality prediction, and helping managers with better decision making. With the increasing number of IoT sensing devices available, data generated from the manufacturing industry (i.e., process logs, events, images and sensor data) are expected to grow exponentially. This type of data is called “big data”. Big data analysis has led to significant improvements in the manufacturing industry, such as reducing energy consumption, improving production scheduling and logistics planning, mitigating social risks, and facilitating better decision making. Previous studies have shown significant benefits from several big data technologies in processing and storing large volumes of data quickly, such as with the application of Apache Kafka, Apache Storm, and NoSQL MongoDB. Previous studies showed significant advantages from the integration of big data technologies such as reducing the processing time for home automation systems, providing effective and efficient solutions for processing IoT generated data for smart cities, and handling large amount sofsmart environmental data in real-time . The aforementioned big data technologies have been integrated in data processing systems, resulting in significant advantages due to processing large amounts of streaming spatiotemporal data as well as processing massive amounts of manufacturing sensor data efficiently. Therefore, it is necessary to integrate Apache Kafka, Apache Storm, and MongoDB in big data processing systems for the manufacturing industry so that large amounts of streaming manufacturing sensor data can be promptly processed, stored, and presented in real-time.

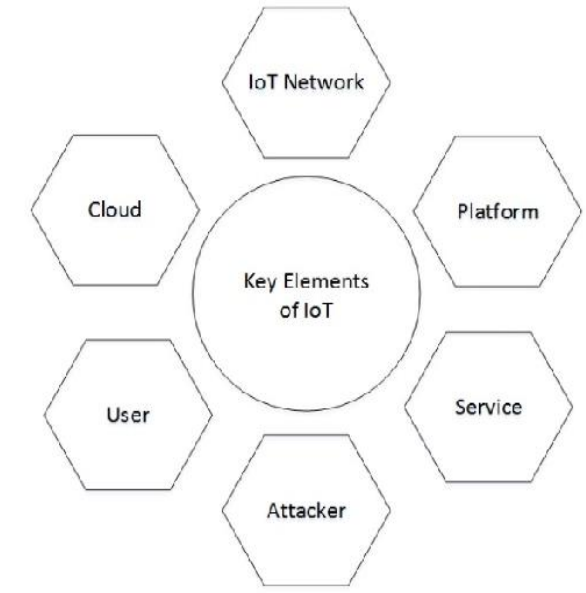

Fig-2: Six Key Elements of IoT

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2. System Requirement Specification

2.1 Requirements and Specifications

Smart IoT services demand careful requirements capturing and specification development.

A comprehensive description of an IoT service and/or its elements is needed to support the development and verification process. 7layers supports these processes with formal description techniques.

2.2 Requirements capturing and requirements specification

Requirements capturing is the first step in a requirements engineering process. The description of a capability or characteristic that provides value to a user or other stakeholder in an IoT Services process has been defined as a "requirement", whereas a set of specific requirements is called a "requirements specification". Requirements specifications are used as input into the design stage of an IoT process. Goal is to achieve a complete, valid and processable description of an IoT Service and/or its elements. To establish a complete requirements specification, 7layers performs the following activities:

- Initial requirements capturing and elicitation- For this purpose we interview IoT Services stakeholders and potential users about their demands, business cases, user stories etc. We also analyze conceptual papers, feasibility studies, already existing product or services descriptions from various sources.
- Requirements classification- Once the requirements have been captured, they are classified according to architectural / design requirements, functional and non-functional requirements.
- Structuring of requirements- Requirements are structured according to characteristics such as hardware, software, communications, interfaces, security, electrical mechanical etc.
- Description and documentation of IoT process requirement- After classification and structuring, the requirements are described using formal description techniques. Especially for processes as complex as IoT Services set-ups, the requirements should be documented in a system that allows for continuous requirements management.

2.3 IoT Services specification

An appropriate subset of the established requirements will be used to define the basic IoT Service. In some cases additional aspects like environmental or legal requirements, or functional and design aspects may be included in the services specification. All specifications must be documented in a complete, consistent, correct, unambiguous and testable way.

2.4 Software Requirements

During the stage of research, we use many types of software to integrate our project, this software varies from programming software to designing, to software for circuits, etc, these software's names discussed before.

Arduino IDE, BLYNK LIBRARY, IFTTT SERVER LIBRARY, ARDUINO PROGRAM COMPILER

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2.5 Hardware Requirements

The hardware requirements for the IOT Home Automation System consist of a computer controlled switching mechanism that will control the device to be automated.

Hardware Used In Iot Home Automation

- Nodemcu Iot Development Board
- Relays
- Power Supply
- Dht 11 Sensor
- Esp8266 01 Module
- Door Sensor
- Pir Sensor (Motion Sensor)
- Buzzer
- Loads

NODEMCU DEVELOPMENT BOARD

Description

Node MCU is an open-source firmware and development kit that helps you to prototype or build IoT product. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266.

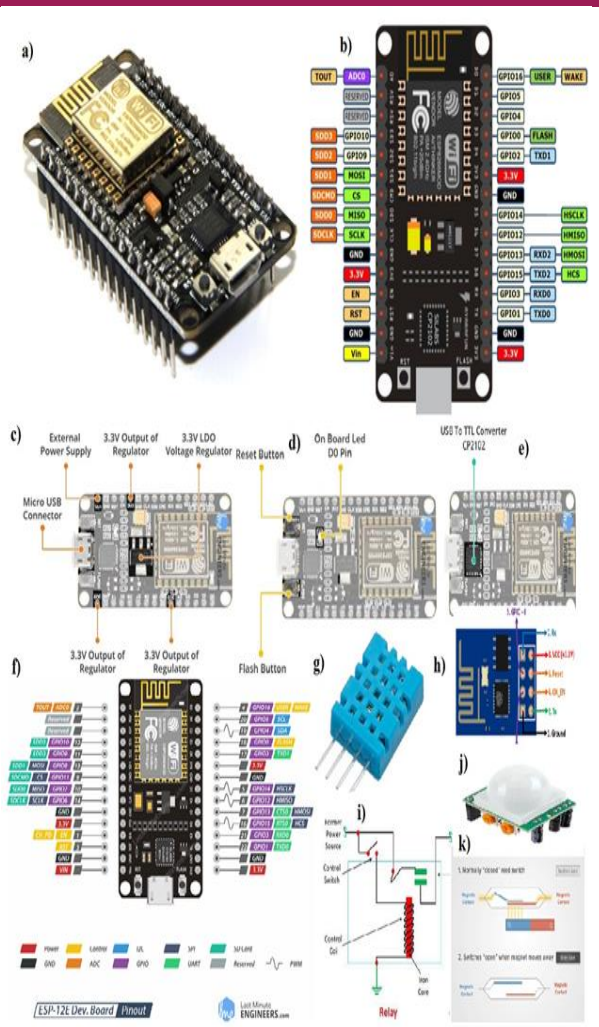

Fig 3: NodeMCU v1.0, Pin Out Diagram Of NodeMCU, ESP-12E Module, ESP8266 NodeMCU Pinout, DHT11 Sensor, Relays, PIR Sensor and Reed Switch Functionalities

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3. Design and Methodology

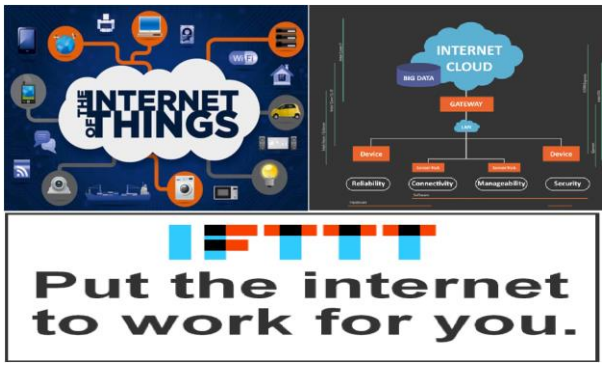

Fig- 4: Internet of Things, Basic Step of IoT

The concept of Home Automation aims to bring the control of operating your every day home electrical appliances to the tip of your finger, thus giving user affordable lighting solutions, better energy conservation with optimum use of energy. Apart from just lighting solutions, the concept also further extends to have a overall control over your home security as well as build a centralised home entertainment system and much more. The Internet of Things (or commonly referred to as IoT) based Home Automation system, as the name suggests aims to control all the devices of your smart home through internet protocols or cloud based computing.

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3.1 Controller: The Brain of Your System

The main controller or the hub is the most essential part of your Home Automation system irrespective of whether you connect single or multiple sensors in your home. The main controller or the hub is also referred to as gateway and is connected to your home router through the Ethernet cable. Most of the smart home controllers available in the market from several manufacturers cater to all three widely used protocols of wireless communication for Home Automation: ZigBee, Z-Wave and Wi-Fi.

Smart Devices: The Sensory Organs of Your Home

The IoT based home automation consist of several smart devices for different applications of lighting, security, home entertainment etc. All these devices are integrated over a common network established by gateway and connected in a mesh network.

Wireless Connectivity: How the Internal Communication Occurs

Most of the IoT based Home Automation systems available today work on three widely used wireless communication protocols: Wi-Fi, ZigBee and Z-Wave. The ZigBee and the Z-Wave controllers are assigned a network ID which is distributed over other sensors in the network. The communication amongst devices take place in a mesh topology where there is no fixed path for the signals transmitted from the controller to the sensors and vice versa.

Connected with the Cloud: Access Everything on the Go

The Cloud-based-Networking system involves storage and maintenance of data over the Internet location. This gives users the flexibility to have access to the data from any location on the planet. As a result of this, in IoT based Home Automation systems users over the cloud network can send commands to the hub even from a distant or remote location. The hub will further send the signal for the intended sensors to trigger and perform the user-requested action. Once the action is

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performed, the hub will update the status of the action taken to the cloud network and in this way users can control and monitor every aspect of their smart homes.

Events and Notifications: Get Notified Instantly

Real-time monitoring and notifications is one of the key features of IoT based Home Automation systems. Since the hub is connected over the cloud network through the Internet, you can schedule various events as per your routine activities or daily schedules. The cloud network can receive and store all the user inputs and transfer them to the hub as per the scheduled events.

IFTTT Integration: Put Internet to Work for You

It is not practically possible to trigger every action one by one in your day long busy schedule. This is where you can put the Internet to work for you. The IF This Then That (IFTTT) Integration helps you in this condition. This enables you to create cascading effect of actions where the target action will trigger only when the IF condition is satisfied. Some of the examples of IFTTT triggers are like "IF" day temperature above 25 degrees, turn the ACs on and roll-down the curtain blinds. IF Movie Mode is ON, then turn the lights to 10% brightness, IF soil moisture less then specific values, turn the water sprinklers in the garden ON.

There are endless possibilities that you can create with IFTTT triggers and thus make the optimum use of your Home Automation system thereby making optimum use of energy and simultaneously enjoying a comfortable lifestyle.

3.2 Software Tools

ARDUINO IDE

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

INSTALLATION OF ARDUINO IDE SOFTWARE

After learning about the main parts of the Arduino UNO board, we are ready to learn how to set up the Arduino IDE. Once we learn this, we will be ready to upload our program on the Arduino board. In this section, we will learn in easy steps, how to set up the Arduino IDE on our computer and prepare the board to receive the program via USB cable. Step 1 − First you must have your Arduino board (you can choose your favorite board) and a USB cable. In case you use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, you will need a standard USB cable (A plug to B plug), the kind you would connect to a USB printer as shown in the following image. Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.

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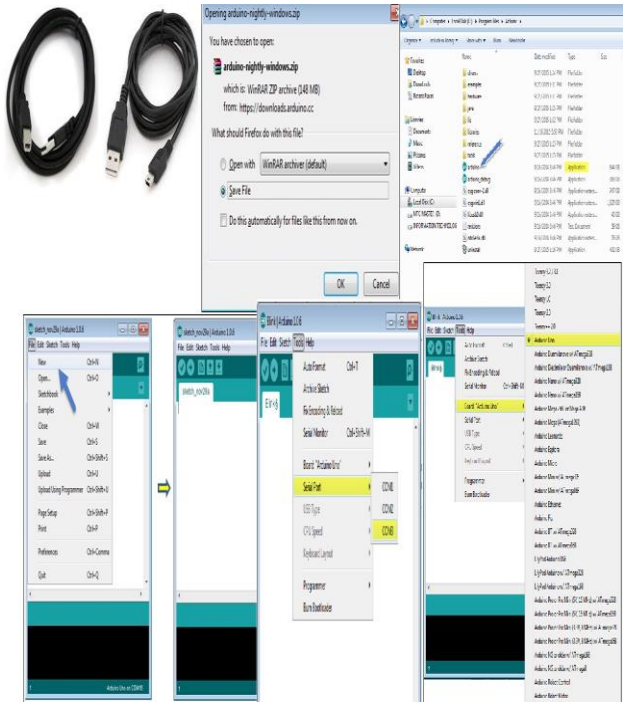

Fig- 5. In case you use Arduino Nano, you will need an A to Mini-B cable instead, Download Arduino IDE Software, Power up your board, Launch Arduino IDE, Open your first project, Select your Arduino board, Select your serial port and Upload the program to your board.

CODE FOR BLYNK SERVER IOT HOME AUTOMATION

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <DHT.h>
BlynkTimer timer;
char auth[] = "hE2iI1zVPVdfD-eB83QO87dqS749t9lC"; //Enter the authentication code sent by Blynk to your Email
char ssid[] = "IOT"; //Enter your WIFI SSID
char pass[] = "IOTSMART"; //Enter your WIFI Password
int flag=0;
int plag=0;
int pinValue;
#define DHTPIN D4          // D3

// Uncomment whatever type you're using!
#define DHTTYPE DHT11     // DHT 11
//#define DHTTYPE DHT22     // DHT 22, AM2302, AM2321
//#define DHTTYPE DHT21     // DHT 21, AM2301

DHT dht(DHTPIN, DHTTYPE);
//BlynkTimer timer;
void sendSensor()
{
  float h = dht.readHumidity();
  float t = dht.readTemperature(); // or dht.readTemperature(true) for Fahrenheit

  if (isnan(h) || isnan(t)) {
    Serial.println("Failed to read from DHT sensor!");
    return;
  }
```

CODE FOR IOT SMART REMOTE FINDER WITH GOOGLE ASSISTANCE

```
#define BLYNK_PRINT Serial
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>

// You should get Auth Token in the Blynk App.
// Go to the Project Settings (nut icon).
char auth[] = "hE2iI1zVPVdfD-eB83QO87dqS749t9lC";
// Your WiFi credentials.
// Set password to "" for open networks.
char ssid[] = "IOT";
char pass[] = "IOTSMART";
```

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```
voidsetup()
{
// Debug console
Serial.begin(9600);

Blynk.begin(auth, ssid, pass);
// You can also specify server:
//Blynk.begin(auth, ssid, pass, "blynk-cloud.com", 80);
//Blynk.begin(auth, ssid, pass, IPAddress(192,168,1,100), 8080);
}
voidloop()
{
Blynk.run();
// You can inject your own code or combine it with other sketches.
// Check other examples on how to communicate with Blynk. Remember
// to avoid delay() function!
}
```

4. Testing Modules

NODEMCU Interface with Relay Modules Test

The relay module is an electrical switch. It isolates the input side from the output side. When it reads input, it uses an electro-magnet to turn the switch on or off.

It's output side has three pins – COM(Power Supply), NC(Normally Closed), NO(Normally Open).

NO and NC has the load (in this case an LED is being used).

If I give a high input through the input side, NO pin will go LOW and NC pin will go HIGH. Due to it's isolation, the output side and input side must be two different circuits. I used two different power supplies for the input (Including NodeMCU) and output sides(COM, NC, NO).

Here, I connected the NO (Normally Open) pin of the relay to the LED.

Step 2: Wiring

Here's the fritzing image (Click to enlarge)

NODEMCU INTERFACE WITH DHT11 SENSOR TEST and NODEMCU INTERFACE WITH DOOR SENSOR TEST

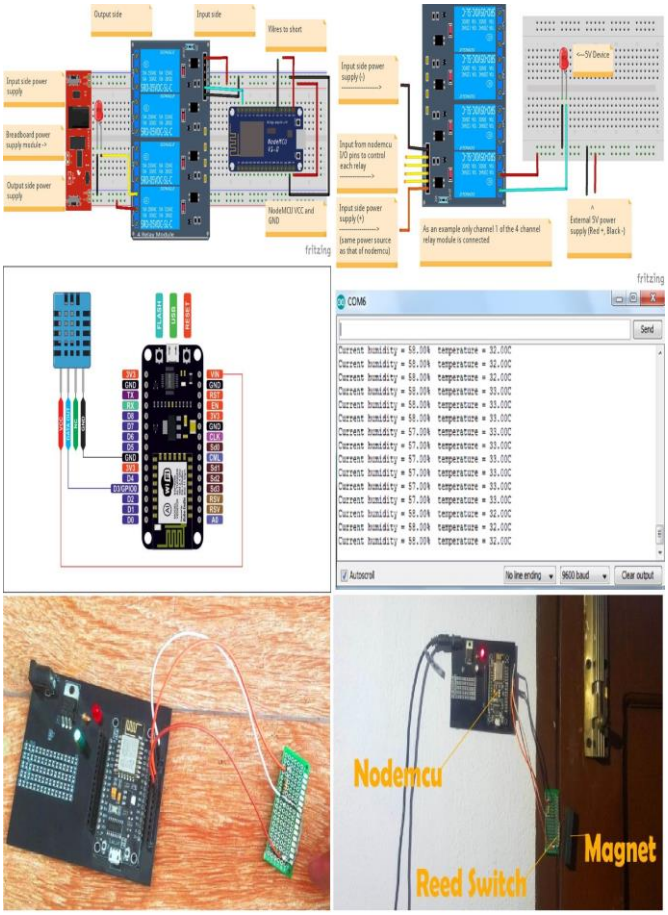

Fig-6. Circuit Diagram, Following output should be shown on the serial monitor, Reed Switch Interfacing with Nodemcu ESP8266, Working of Nodemcu and Magnetic Reed Switch.

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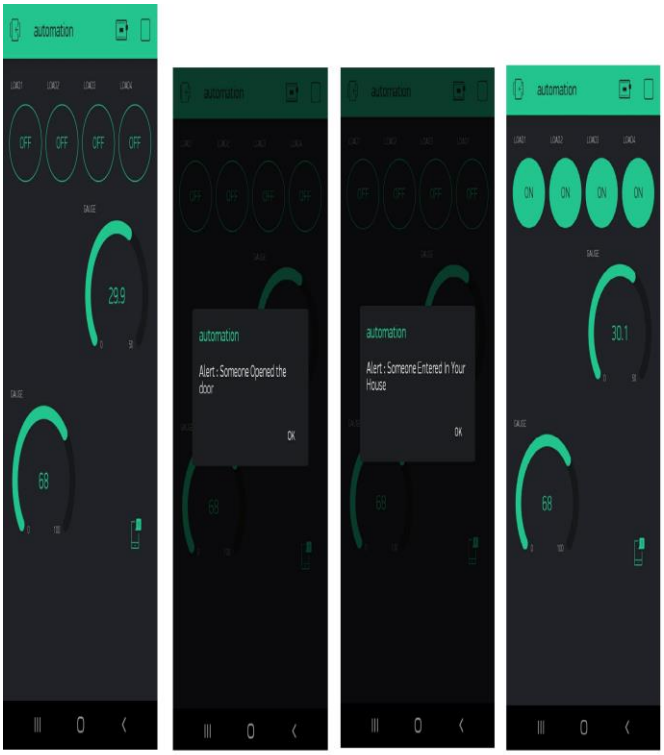
RESULT



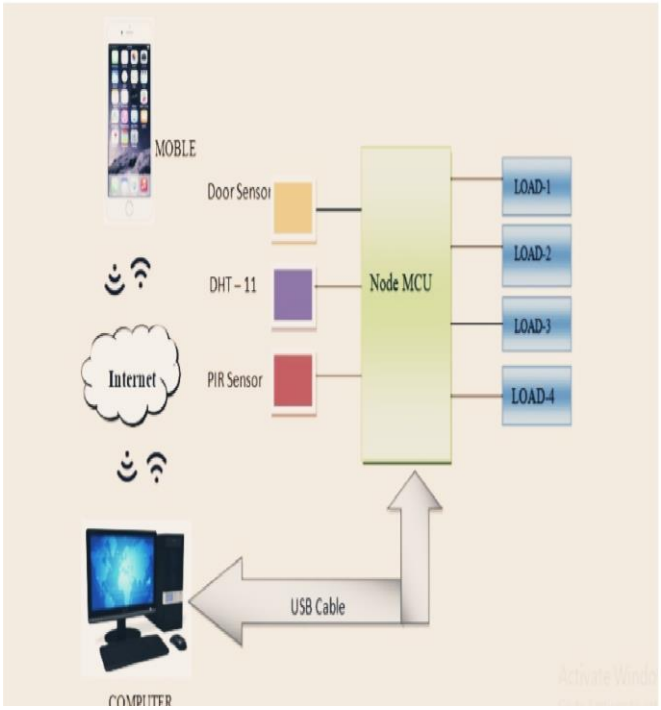


Fig-7 Generation of an alert message when an unauthorized person entered the house

CONCLUSION

In this paper, SURE-H system is presented to ensure security of smart home automation system with multiple components such as users, motion sensors, cloud server, moving object detection module, and temperature sensors. It is controlled remotely based on user authentication. The SURE-H system has been designed in such a way that it can fullfil the needs of the user that reduces manual effort, save power and makes more secure. Any android device can be used to monitor the smart home environment to detect any robbery. It has several features include low cost, minimum time, highly scalable, resist against man-in-the-middle and online dictionary attacks, and needs minimum infrastructures. SURE-H can be extended to the large-scale environment such as offices and companies. It is also having the extra feature to find the object with a buzzer sound. It can also add additional features such incorporating camera, call alerts and live video streaming for future reference and analysis.

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Objective Finding Device

1. IFTTT: https: //ifttt.com/discover. https://www.pocketlint.com/Smarthome/smarthomenew.
2. Google Assistant: https://www.pocketint.com/apps/appsnews/Googleapp.
3. Arduino IDE: https;//www.arduino.cc/en/guide/Envirnment.