Smart Home Automation and Security System Using Iot Technology

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Abstract: This paper presents a design and implementation of a smart home automation and security system that utilizes IoT technology. The proposed system is composed of two primary modules: a security system and an automation system. The security system uses a camera module, a keypad, to monitor and manage access to the home. The automation system, on the other hand, is controlled by an Arduino Uno and a Node MCU, and utilizes several sensors such as a gas sensor, temperature sensor, relay, bulb, and servo motor to automate various tasks within the home. The system's design is integrated with IoT technology, enabling it to communicate and exchange data with other devices connected to the internet. With the proposed system, homeowners can manage and control their homes remotely using a mobile application, improving security and energy efficiency, reducing costs, and enhancing their overall living experience. The integration of IoT technology with the proposed system provides an efficient and convenient solution for home automation and security.

Keywords: IoT, Arduino Uno, Node MCU, Camera Module

1. INTRODUCTION:

Smart home automation and security systems using the Internet of Things (IoT) technology have revolutionized the way we interact with our homes. This innovative approach enables the integration of various devices and appliances within the home, such as lights, thermostats, security cameras, and door locks, and allows for seamless control and monitoring of these devices from a central location, typically a mobile app.

IoT-powered smart home automation and security systems provide a range of benefits, including increased convenience, enhanced energy efficiency, and improved safety and security. With these systems, homeowners can remotely control their homes, receive real-time alerts in case of emergencies, monitor their energy consumption, and even automate routine tasks such as turning off lights or adjusting the thermostat.

In this proposed project, we will be using the Node MCU and Arduino Uno microcontrollers, along with various sensors and devices, to create a robust smart home automation and security system. Our system will be equipped with a range of features, including a camera module, keypad, webpage alert message, email alert, and automation system using a servo motor, relay board, bulb, temperature sensor, ultrasonic sensor, and gas sensor. The camera module will provide real-time video feed to the homeowners, allowing them to monitor their homes from anywhere. The keypad will be used to enter a security code. Using the NodeMCU and Arduino Uno microcontrollers, we can create a customizable and affordable smart home automation and security system that can be tailored to the unique needs of each homeowner.

Overall, smart home automation and security systems are becoming increasingly popular as technology advances, and this project is an excellent example of how to leverage this technology to create a powerful and efficient system for the home. By using the latest sensors, microcontrollers, and devices, we can create a smart home automation and security system that is both easy to use and highly effective.

2. LITERATURE SURVEY:

[1] Smart home automation using Arduino Uno, Bluetooth module, relay, and MIT App Inventor involves the use of a microcontroller to control home appliances through Bluetooth communication. The system consists of an Arduino Uno board, a Bluetooth module, and relay modules to control appliances. The MIT App Inventor is used to create an Android app that communicates with the Bluetooth module. The app sends commands to the Arduino Uno, which then controls the relay modules to turn appliances on or off. The system provides a convenient and efficient way to automate home appliances.

[2] Wi-Fi-based home automation using NodeMCU, relay, and Android Studio involves the use of a NodeMCU microcontroller, a relay module, and an Android application developed in Android Studio. The NodeMCU controls the relay module, which in turn controls the home appliances. The Android application communicates with the NodeMCU over Wi-Fi, allowing users to control the appliances from their smartphone. The system can be designed and implemented using various software tools and programming languages such as Arduino IDE, Java, and Lua.

[3] IoT-based home automation using Arduino Uno, NodeMCU, and a relay module involves the use of Arduino Uno and NodeMCU microcontrollers to control the relay module, which in turn controls the home appliances. The microcontrollers can be programmed using Arduino IDE and can communicate with each other using Wi-fi. The system can be designed to allow users to control the appliances remotely using a web-based interface or a mobile application. The relay module can also be replaced with a solid-state relay for better performance and longevity.

[4] RF-based home automation and security system using NRF module, Arduino Uno, NodeMCU, and relay involves the use of NRF module and microcontrollers to communicate and control the relay module, which in turn controls the home appliances. The

system can be designed to include security features such as motion detection using PIR sensors and door/window sensors. The microcontrollers can be programmed using Arduino IDE and can communicate with each other over RF. The system can be designed to be controlled using a mobile application or a web-based interface.

[5] IoT-based home security system using a camera module and a fingerprint sensor involves the use of these components to detect and identify authorized personnel, and record any unauthorized activity. The system can be designed to include features such as real-time streaming of video footage and alerts via a mobile application or email. The system can be implemented using various programming languages such as Python, C++, and Java. The camera module can be a standalone camera or integrated into a microcontroller such as Raspberry Pi.

[6] Home automation using IR TSOP, remote control, and Arduino Uno involves the use of an IR receiver module to receive signals from a remote control, which are decoded by the Arduino Uno microcontroller. The microcontroller is programmed to control various home appliances such as lights, fans, and TVs using the decoded signals. The system can be designed to include features such as voice control and mobile application-based control.

[7] The project aims to develop a voice-controlled home automation system using an Arduino Uno microcontroller, a voice recognition module, and relays. The voice recognition module detects voice commands and sends them to the Arduino, which processes the command and controls the relay modules to operate various home appliances. The system provides a convenient and hands-free way to control home appliances, enhancing home automation technology. The project requires programming skills, basic electronics knowledge, and familiarity with Arduino and relays.

[8] The project aims to develop a smart home monitoring and controlling system using an Arduino Uno microcontroller, relays, and an own server. The system is designed to remotely monitor and control various home appliances using a web application. The Arduino Uno receives commands from the server and uses relays to operate the appliances. The system also provides real-time monitoring of home conditions such as temperature, humidity, and light intensity.

[9] The system is designed to provide real-time monitoring and control of water level and gas leakage in homes and industrial settings. The NodeMCU microcontroller receives sensor data and sends it to a cloud server for processing and analysis. The relays are used to control the water pump and gas valves. The project requires programming skills, electronics knowledge, and familiarity with IoT and NodeMCU microcontroller programming.

[10] The project aims to develop a greenhouse monitoring and controlling system using IoT, Arduino Uno, NodeMCU microcontroller, relays, soil moisture sensor, temperature sensor, and irrigation system. The system is designed to monitor and control greenhouse environmental factors such as soil moisture, temperature, and irrigation. The NodeMCU microcontroller receives sensor data and sends it to a cloud server for processing and analysis. The relays are used to control the irrigation system.

2.1 EXISTING SYSTEM:

The existing system is Wireless Smart Home Automation and Security System Using Arduino and Wi-Fi Camera" - This research paper presents a smart home automation and security system that utilizes a Wi-Fi camera and Arduino Uno microcontroller, along with various sensors and actuators. The system can be controlled using a mobile app and supports remote access, motion detection, and door lock control. The existing systems don't have alert system, security keypad and live update on web Applications. Our proposed system have Face detection and Email alert system.

2.2 BLOCK DIAGRAM

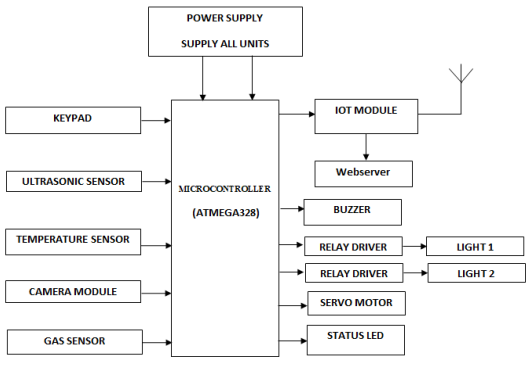

Fig. 1 Block Diagram

2.3 CIRCUIT DIAGRAM

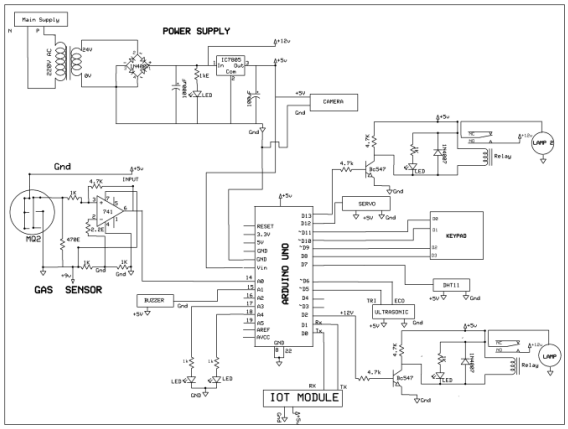

Fig. 2 Circuit Diagram

3. PROPOSED SYSTEM:

A proposed system for smart home automation and security using IoT can provide a comprehensive solution for controlling and monitoring various home appliances and security, all accessible through a webpage. The Arduino Uno will serve as the main controller for the system, processing the input from the various sensors and controlling the output to the devices. The NodeMCU will provide internet connectivity to the system, allowing the user to control and monitor the system through a webpage.

The system will be connected to a relay board that can control various appliances, such as lights, fans, and other electrical devices. The temperature sensor will be used to monitor the temperature in the home and adjust the air conditioning or heating system accordingly. The gas sensor will detect any leaks and alert the homeowner with a loud buzzer sound. The ultrasonic sensor will be used to detect the presence of objects. The webpage will allow the user to control the different appliances, monitor the temperature and gas levels, and receive alerts in case of any unusual events, such as gas leaks or the presence of intruders. The webpage can also be used to program the system to adjust the temperature based on the time of day, and set different temperature zones for different parts of the house.

The camera module will be used for face detection and image capture. When an intruder enters the home, the camera will capture an image. If it doesn't match or if an incorrect PIN is entered, the system will sound an alarm and send an email notification to the homeowner. The keypad will be used for user authentication, allowing authorized users to enter a PIN to disarm the system. In the event that an unauthorized user tries to enter the wrong PIN, the system will sound an alarm and send an email notification to the homeowner. The homeowner can then take action to protect their home.

3.1 METHODOLOGY:

The methodology for a Smart Home automation and security system involves both hardware and software components.

4. HARDWARE EXPLANATION:

The Arduino Uno will serve as the main controller for the system, processing the input from the various sensors and controlling the output to the devices. The NodeMCU will provide internet connectivity to the system, allowing the user to control and monitor the system through a webpage.

4.1COMPONENTS LIST:

- Power supply system
- Arduino Uno
- Nodemcu
- Keypad
- Ultrasonic Sensor
- Camera Module
- Servomotor
- Buzzer
- LED
- Gas sensor
- DHT11 Sensor
- Relay Board

4.2 POWER SUPPLY SYSTEM:

A power supply system is an electrical system that converts one form of electrical energy to another form that is suitable for powering electronic devices. In particular, a 230V to 5V power supply system is an AC to DC converter that takes high voltage AC input from a mains power source and converts it into low voltage DC output suitable for powering electronic devices that require 5V DC voltage. The 230V to 5V power supply system typically consists of four major components, namely the transformer, rectifier, capacitor, and voltage regulator**.**

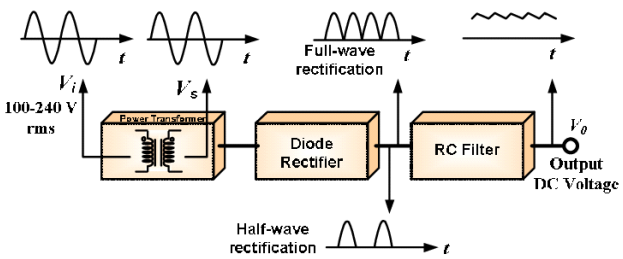

Fig.3 Power Supply System

Transformer: The transformer is the first component in the power supply system. It takes in the 230V AC voltage input from the mains power source and steps it down to a lower AC voltage suitable for rectification. The transformer consists of two coils of wire wrapped around an iron core. The primary coil is connected to the AC mains, while the secondary coil is connected to the rectifier.
Rectifier: The rectifier is the second component in the power supply system. Its function is to convert the AC voltage from the transformer to DC voltage. The rectifier is made up of diodes arranged in a bridge configuration. It allows the current to flow in only one direction, resulting in a pulsating DC voltage output.
Capacitor: The capacitor is the third component in the power supply system. Its function is to filter the pulsating DC voltage from the rectifier and convert it into a smooth, stable DC voltage. The capacitor charges up during the positive half-cycle of the pulsating DC voltage and discharges during the negative half-cycle, resulting in a constant DC voltage output.
Voltage Regulator: The voltage regulator is the fourth and final component in the power supply system. Its function is to regulate the output voltage to a constant 5V DC voltage. The voltage regulator uses a feedback mechanism to adjust the output voltage to a constant value, even if the input voltage or load current changes.

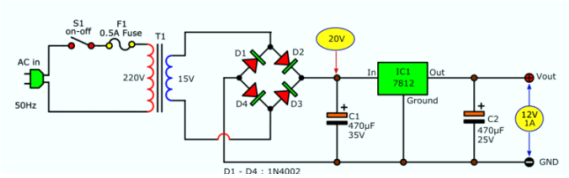

Fig.4 Voltage Regulator

The working of the 230V to 5V power supply system involves the following steps:

- The AC voltage is stepped down by the transformer to a lower voltage level.
- The rectifier converts the AC voltage to a pulsating DC voltage.
- The capacitor filters and smooth's the pulsating DC voltage into a stable DC voltage.
- The voltage regulator regulates the output voltage to a constant 5V DC voltage.
- The output voltage is then used to power electronic devices that require a 5V DC voltage.

In summary, the 230V to 5V power supply system is an essential component in the design and development of electronic devices. The transformer, rectifier, capacitor, and voltage regulator are the key components that enable the conversion of high voltage AC input to low voltage DC output, suitable for powering electronic devices that require a 5V DC voltage.

4.3 ARDUINO UNO:

Arduino Uno is a main Brain of the Project. The Arduino Uno is a microcontroller board based on the ATmega328P microcontroller chip. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal oscillator, and a USB connection. The ATmega328P microcontroller has 32 KB of flash memory, 2 KB of SRAM, and 1 KB of EEPROM. The digital input/output pins are grouped into two sets of 8 pins each, with each set capable of being configured as either input or output. The analog inputs can read signals in the range of 0 to 5 volts, and are converted to a 10-bit digital value by the on-board analog-to-digital converter. The board can be powered either by connecting it to a computer via the USB cable, or by connecting it to a 9-volt battery or an external power supply.

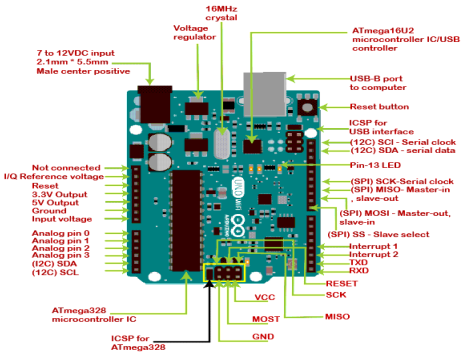

Fig.4 Arduino UNO

The board also has a power jack and an ICSP header for programming the microcontroller using an external programmer. The board is programmed using the Arduino Integrated Development Environment (IDE), which is a free software tool that provides a user-friendly interface for writing, compiling, and uploading code to the board. The IDE supports the C++ programming language and provides a large library of pre-written code, making it easy for beginners to get started with programming the board.

4.4 NodeMCU:

NodeMCU is a low-cost open-source firmware and development board based on the ESP8266 Wi-Fi module. The board has an 80 MHz 32-bit Tensilica CPU, 4 MB flash memory, and integrated Wi-Fi connectivity, which allows it to connect to the internet and exchange data with other devices.

The board also features 11 digital input/output pins and one analog input pin, which can be used to interface with a variety of sensors and actuators. The NodeMCU firmware is based on the Lua scripting language and can be programmed using the NodeMCU Lua API. It also has support for the Arduino IDE, allowing it to be programmed using the familiar C++ programme ng language. Additionally, the NodeMCU supports the MicroPython programming language, which is a popular choice for IoT projects.

The board can be powered using a micro-USB cable or an external power supply, and can be programmed and debugged using a USB-to-serial converter. The NodeMCU firmware provides a range of networking protocols, including HTTP, HTTPS, MQTT, and Web Socket, which makes it an ideal choice for IoT applications that require cloud connectivity.

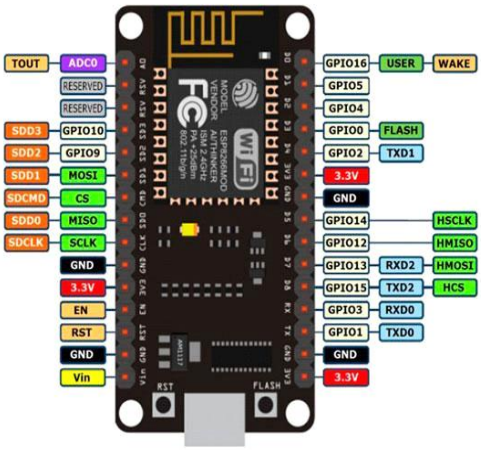

Fig.5 Node MCU

NodeMCU is widely used for a range of IoT applications, such as home automation, weather stations, robotics, and wireless sensor networks. The open-source nature of NodeMCU means that it has a large community of developers who have created libraries, tools, and resources to help users get started with their projects. Overall, NodeMCU is a versatile and powerful development board that offers an affordable solution for IoT projects.

4.5 KEYPAD:

A 4x4 keypad is an input device that can be used to enter data or commands into a microcontroller, such as the Arduino Uno. It is made up of 16 keys arranged in a 4x4 matrix, with each key having a unique combination of rows and columns. This allows the keypad to be wired in a way that only requires 8 pins for connection to the microcontroller, rather than the 16 pins that would be needed if each key had its own dedicated pin. To connect a 4x4 keypad to an Arduino Uno, you will need to connect the keypad pins to the appropriate digital pins on the Arduino. The rows of the keypad are connected to four digital pins on the Arduino, while the columns are connected to another four digital pins. This allows the Arduino to determine which key has been pressed by sensing the voltage levels on the rows and columns.

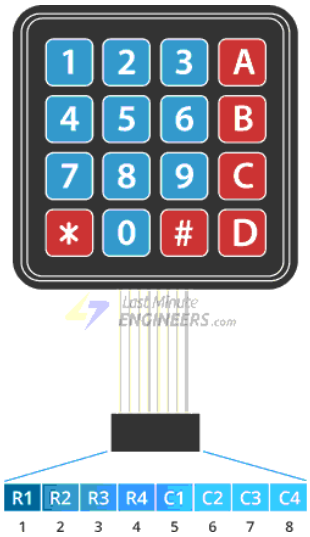

Fig.6 Keypad

It is important to note that the pins used for the keypad can be changed in the code, but it is essential that the pins used for the rows and columns are connected to separate pins on the Arduino. This is because the rows and columns must be read and written to separately in order to detect key presses. In addition to its use as an input device, a 4x4 keypad can also be used for password authentication, security systems, or other applications that require user input.

4.6ULTRASONIC SENSOR:

The HC-SR04 is an ultrasonic sensor module that is commonly used for distance measurement applications in robotics and automation. It operates by emitting ultrasonic waves from a transmitter and detecting their reflection from nearby objects using a receiver. The time taken for the waves to travel to the object and back is measured, and this is used to calculate the distance to the object using the speed of sound in air. The sensor requires a 5V power supply and has four pins: Vcc (power), GND (ground), Trig (trigger), and Echo (echoed signal). To use the sensor, a trigger signal is sent to the Trig pin, and the resulting echo signal is received at the Echo pin. The distance to the object can then be calculated using the formula Distance = (Time * Speed of Sound) / 2. The HC-SR04 is a low-cost, easy-to-use, and accurate sensor that has become popular in many applications.

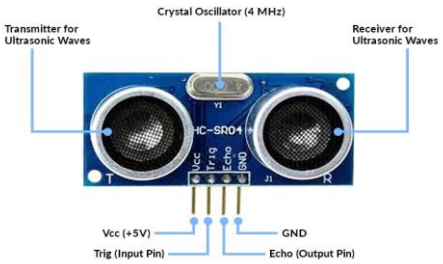

Fig.7 Ultrasonic Sensor

ESP32 CAMERA MODULE:

The ESP32 camera module is a small camera unit that can be integrated with the ESP32 microcontroller for a wide range of applications. The module features a 2 megapixel OV2640 camera sensor with a resolution of 1600 x 1200 pixels, capable of capturing JPEG images and video up to 640 x 480 pixels at 60 frames per second. It also includes a built-in lens with a 120-degree field of view, making it suitable for applications such as surveillance cameras, video streaming, and facial recognition systems.

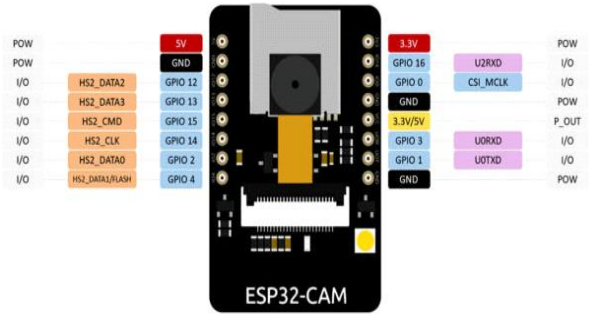

Fig.8 ESP32-CAM

The camera module is connected to the ESP32 via a standard SPI interface, requiring a minimum of 4 GPIO pins for operation. It also includes an SD card slot for storing images and video. The module can be powered using a 3.3V power supply and consumes approximately 100mA of current during operation. It also includes a sleep mode for low power consumption when not in use.
The pin details of the ESP32 camera module are as follows:

- 3V3: 3.3V power supply pin
- GND: Ground pin
- CS: Chip select pin, used to enable the camera module
- SCK: Serial clock pin for SPI communication
- MOSI: Master out slave in pin for SPI communication
- MISO: Master in slave out pin for SPI communication
- XCLK: External clock pin, used to control the sensor clock
- PWDN: Power down pin, used to turn off the camera sensor when not in use
- RESET: Reset pin, used to reset the camera module
- D7: Data pin for camera control

These pins can be connected to the appropriate GPIO pins on the ESP32 microcontroller for operation. The ESP32 camera module can be programmed using the Arduino IDE or the ESP-IDF development framework, which provides a range of libraries and tools for developing applications on the ESP32**.**

4.7 BUZZER:

A buzzer is a device that generates sound, typically used to provide audible alerts or signals in electronic devices. Buzzer modules are commonly used in electronic projects and can be found in a variety of shapes and sizes. A buzzer typically consists of a metal or plastic housing that contains an electromagnetic coil and a spring-mounted armature. When an electrical current is passed through the coil, it creates a magnetic field that pulls the armature towards the coil. This movement of the armature causes the device to vibrate, producing a sound. Buzzer modules are typically driven by a digital signal from a microcontroller or other digital device. The sound produced by the buzzer can be controlled by varying the frequency and duration of the digital signal. Buzzer modules can produce a wide range of sounds, from simple beeps and tones to more complex melodies. Some buzzers have built-in sound generators, allowing them to produce a variety of pre-programmed sounds or music.

Fig. 9 Buzzer

4.8 LED (LIGHT EMMITING DIODE):

A Light Emitting Diode (LED) is a semiconductor device that emits light when a current flows through it. LEDs are commonly used in a wide range of applications, from indicator lights on electronic devices to decorative lighting in homes and buildings. The basic working principle of an LED is that it converts electrical energy into light energy. The LED consists of a p-n junction, which is formed by doping two regions of a semiconductor with different types of impurities. When a voltage is applied across the p-n junction, electrons and holes combine, releasing energy in the form of photons. This energy causes the LED to emit light.

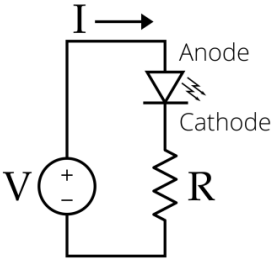

Fig. 10 LED

To connect an LED to an Arduino board, you need to first identify the polarity of the LED. LEDs have two leads: the anode (positive) and cathode (negative). The anode is usually the longer lead or has a flat edge, while the cathode is the shorter lead or has a rounded edge. Connect the anode of the LED to a digital output pin on the Arduino using a resistor. The resistor limits the current flowing through the LED to prevent it from burning out. The value of the resistor depends on the specific LED and the desired brightness. A common value is 220 ohms. Connect the cathode of the LED to the GND pin on the Arduino. To program the Arduino to control the LED, you can use the digitalWrite() function to set the output pin to HIGH or LOW, depending on whether you want to turn the LED on or off. You can also use pulse-width modulation (PWM) to control the brightness of the LED by varying the duty cycle of the output waveform.

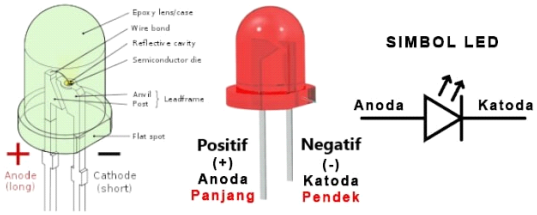

Fig. 10.1 LED

4.9 GAS SENSOR:

The MQ2 gas sensor is a widely used gas detection module that is capable of detecting a variety of gases such as smoke, propane, butane, methane, and carbon monoxide. The sensor module consists of a sensing element and an integrated circuit, and works on the principle of gas conductivity. When the gas comes into contact with the sensing element, it changes the resistance of the element, which is measured by the integrated circuit. The sensor requires a 5V power supply and has four pins: Vcc (power), GND (ground), Dout (digital output), and Aout (analog output). The sensor's output signal can be read as either a digital signal (high or low) or an analog signal (varying voltage level). The MQ2 gas sensor is often used in gas leakage detection systems, air quality monitoring, and safety applications. However, it should be noted that the sensor has limitations and can give false readings in certain conditions, and thus should not be relied upon as the sole means of detecting dangerous gases.

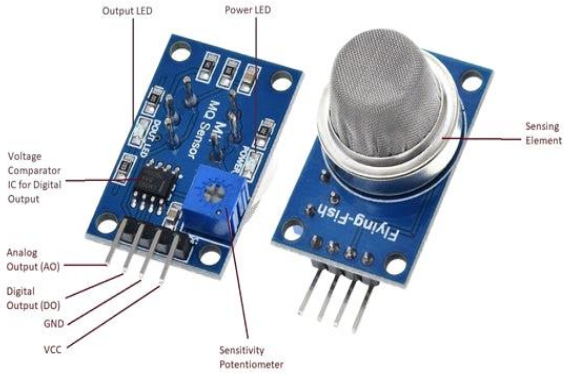

Fig. 11 Gas Sensor

4.10 DHT11 SENSOR:

The DHT11 sensor is a digital temperature and humidity sensor that is commonly used in a variety of applications, including environmental monitoring, HVAC systems, and indoor gardening. It is a low-cost sensor that provides reliable temperature and

humidity readings in a wide range of conditions. The sensor uses a thermistor and a capacitive humidity sensor to measure the temperature and humidity, respectively. It then converts these values into a digital signal, which can be read by a microcontroller or a single-board computer like Arduino or Raspberry Pi.

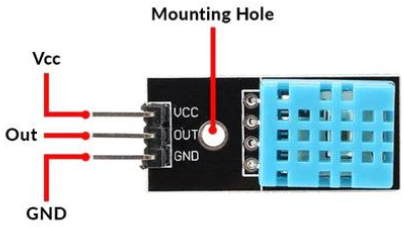

Fig. 12 DHT11 Sensor

The DHT11 sensor has four pins: VCC, GND, DATA, and NC (not connected). VCC and GND are used to power the sensor, while the DATA pin is used to communicate with the microcontroller. The NC pin is not used and can be left unconnected. When reading data from the DHT11 sensor, the microcontroller sends a start signal to the sensor, which responds by sending a low signal for 18ms, followed by a high signal for 20-40us. The sensor then sends the temperature and humidity data as a 40-bit signal, with each bit being transmitted as a 50us low signal followed by a 26-28us high signal. Overall, the DHT11 sensor is a simple and reliable sensor that can be easily integrated into a wide range of projects with its straightforward pin connection and digital output.

4.11 RELAY BOARD:

A single channel 5V relay is an electronic switch that can be controlled by a digital signal from a microcontroller, such as an Arduino or Raspberry Pi. The relay is used to control high-voltage or high-current devices, such as lights, motors, or appliances, from a low-voltage and low-current signal. The relay consists of a coil, which is powered by the low-voltage signal, and a set of contacts that switch on and off in response to the coil's activation. The contacts can be connected to the high-voltage or high-current circuit, allowing the microcontroller to control the device remotely.

Fig. 13 Relay Board

The 5V relay has five pins: VCC, GND, IN, NO, and NC. VCC and GND are used to power the relay, while IN is the input pin that receives the digital signal from the microcontroller. NO (Normally Open) and NC (Normally Closed) are the output pins that connect to the device being controlled. When the relay is not powered, the NC contact is closed, and the NO contact is open, allowing the current to flow through the normally closed circuit. When the relay is powered by a digital signal on the IN pin, the coil energizes, causing the NO contact to close and the NC contact to open, interrupting the current flow through the normally closed circuit and allowing the current to flow through the normally open circuit.

To connect the relay to a microcontroller, VCC and GND pins are connected to the corresponding pins on the microcontroller, and the IN pin is connected to a digital output pin. The NO or NC pin is connected to the device being controlled, depending on whether the circuit should be normally open or normally closed when the relay is not powered. Overall, the single channel 5V relay is a versatile and reliable switch that can be easily integrated into a wide range of projects with its straightforward pin connection and digital control.

4.12 SERVO MOTOR:

The SG90 servo motor is a small, low-cost motor commonly used in hobbyist and educational projects. It can be controlled by a microcontroller or other digital device using a pulse width modulation (PWM) signal.

The SG90 servo motor has three pins:

- Power pin (usually red wire): This pin is used to supply power to the motor. It typically operates at 5V DC and draws a current of around 100mA.
- Ground pin (usually brown or black wire): This pin is used to connect the motor to the ground or negative terminal of the power supply.
- Control pin (usually yellow or orange wire): This pin is used to send the PWM signal to the motor to control its position. The control signal typically has a pulse width of between 1 and 2 milliseconds and a frequency of 50 Hz. The duty cycle of the PWM signal determines the position of the motor's output shaft. It is important to note that the SG90 servo motor should not be directly powered by a microcontroller or other digital device, as it requires more power than these devices can provide. Instead, it should be powered by a separate power supply with sufficient current capacity.

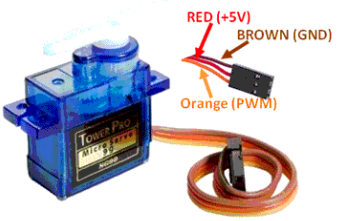

Fig.14 Servo Motor

5. SOFTWARE DESCRIPTION:

5.1 ARDUINO IDE:

Arduino IDE (Integrated Development Environment) is a software tool used for programming and development of Arduino boards. It is an open-source platform, available for free, and is compatible with multiple operating systems including Windows, Mac OS, and Linux.

The main features of the Arduino IDE include:

- **Code Editor:** The code editor is the main interface of the Arduino IDE where you can write, edit and upload code to the Arduino board. It includes features such as syntax highlighting, auto-completion, and code snippets to make programming easier.
- **Sketches:** Arduino programs are referred to as "sketches" and can be easily created and saved within the IDE. The sketch contains two main functions: the setup() function, which is called once at the start of the program, and the loop() function, which is called repeatedly as long as the program is running.
- **Library Manager:** The Library Manager allows users to easily install and manage libraries for their Arduino projects. It includes a collection of pre-built libraries that can be used to add functionality to your projects. Users can also create their own libraries and add them to the IDE.
- **Serial Monitor:** The Serial Monitor allows users to communicate with the Arduino board and monitor the data being sent and received through the serial port. This is particularly useful for debugging and troubleshooting.
- **Board Manager:** The Board Manager allows users to select the type of Arduino board they are using, configure settings, and install the necessary drivers. This is important because different Arduino boards may have different specifications and require different drivers.
- **Upload:** The Upload feature allows users to upload their sketches to the Arduino board and begin executing the program. Users can select the correct board and serial port before uploading the sketch.
- **Tools:** The Tools menu includes a range of options for configuring and customizing the IDE. This includes options for setting the board type, serial port, programmer, and other settings.

Overall, the Arduino IDE is a user-friendly software tool that simplifies the programming process for beginners and experienced users alike. It is compatible with a wide range of Arduino boards and shields, making it a versatile tool for a variety of applications. With its many features and community support, the Arduino IDE is an essential tool for anyone interested in electronics and programming.

Fig. 15 Arduino IDE

In addition to the basic features listed above, the Arduino IDE also supports advanced features such as debugging and profiling tools, version control integration, and multiple file editing. The IDE can also be extended through plugins and add-ons, allowing users to customize the tool to their specific needs. Additionally, the Arduino community provides a wealth of resources and tutorials to help users get started and troubleshoot any issues they may encounter.

5.2 EXPRESS PCB:

Express PCB is a free-to-use software program for designing printed circuit boards (PCBs). It is a simple and user-friendly tool that is ideal for beginners and hobbyists who want to design and create their own PCBs.

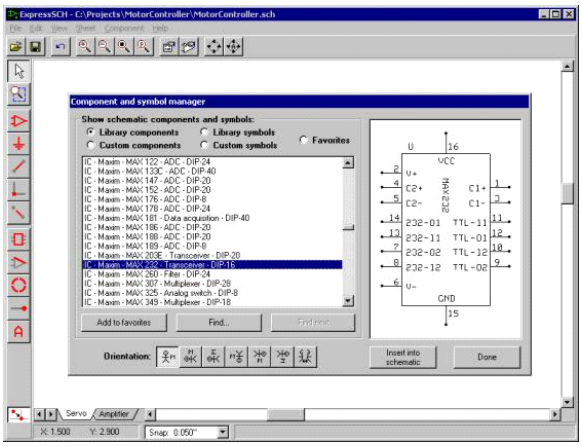

Fig. 16 Express PCB

Some of the key features of Express PCB include:

- **Schematic Capture:** Express PCB allows users to create schematic diagrams of their circuits using a library of pre-built symbols. The software also provides a range of editing tools to help users create and modify their schematic diagrams.
- **Board Layout:** Express PCB includes a powerful board layout editor that allows users to place components on the board, route traces between components, and add text and graphics. The software also includes a range of design rules to ensure that the PCB meets the required specifications.
- **Gerber Export:** Once the board design is complete, Express PCB allows users to export the design as Gerber files, which can be used to manufacture the PCB.
- **Parts Library:** Express PCB comes with a large library of pre-built parts and components that users can use to create their designs. Users can also create their own custom parts library.
- **Auto-Router:** The software includes an auto-router feature that can automatically route traces between components on the board. This can save users a lot of time and effort, especially for complex designs.
- **3D Viewer:** Express PCB includes a 3D viewer that allows users to view their board designs in 3D, providing a realistic view of how the final product will look.

Overall, Express PCB is a powerful and user-friendly software tool that can help users design and create their own PCBs quickly and easily. The software is free to download and use, making it accessible to hobbyists and beginners who may not have a large budget for PCB design software. Additionally, Express PCB provides a range of tutorials and resources to help users get started and troubleshoot any issues they may encounter during the design process.

5.3 WEB SERVER:

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capabilities. It can be used as a standalone microcontroller or as a Wi-Fi enabled communication module with other microcontrollers. One of its popular applications is to create a webserver page to control and monitor devices over the internet.

Fig.17 Web Server

Here are the details on how to create a webserver page with ESP8266:

- Set up the ESP8266 with Arduino IDE and connect it to Wi-Fi.
- Import the required libraries such as ESP8266Wi-fi.h and ESP8266WebServer.h.
- Create a web server object using the ESP8266WebServer class.
- Define a callback function that will handle requests made to the webserver. The callback function can take inputs from HTML forms and execute specific actions on the ESP8266.
- Write HTML code for the web page that the user will see.
- Create a server.begin() statement in the setup() function to start the web server.
- In the loop() function, run the server.handleClient() method to handle incoming client requests.
- Upload the sketch to the ESP8266 and test the web page in a browser by entering the IP address of the ESP8266 in the browser address bar.

By following these steps, the ESP8266 can serve up a web page to control and monitor devices over the internet. This can be useful for remote control of home automation devices or other internet of things (IoT) applications.

6. CONCLUSION:

In conclusion, a smart home automation and security system that combines and integration of the security system with the automation system ensures that the home is protected while making it convenient to control various appliances remotely. The camera module for face detection and live stream webpage, and keypad provide additional layers of security, ensuring that only authorized individuals can access the home. In case of any unauthorized access or any unusual events, the alert message and image through email provides an immediate notification to the homeowner. The automation system provides easy control of various appliances, such as lights and fans, through a webpage, allowing for remote access and control from anywhere in the world. The temperature sensor, gas sensor, and ultrasonic sensor provide the homeowner with accurate and up-to-date information on the temperature and gas levels in the home.

Overall, a smart home automation and security system using the described components and webpage provides homeowners with peace of mind, convenience, and control over their home's security and various appliances, making life easier, safer, and more comfortable.

7. DISCUSSION:

Smart home automation and security systems have become increasingly popular in recent years, offering convenience, energy efficiency, and improved security. The system you've described includes several components that work together to create a comprehensive system. The system has several advantages and limitations.

Advantages:

- **Enhanced Security:** The integration of the security system with a camera module for face detection and a live stream webpage provides homeowners with real-time information about the presence of people in their home. The keypad provides an additional layer of security, ensuring that only authorized individuals can access the home. In case of any unauthorized access or any unusual events, the alert message and image through email provides an immediate notification to the homeowner.
- **Convenient Control:** The automation system allows homeowners to control various appliances in their home through a webpage. This feature provides a convenient way to control and monitor various home appliances, such as lights, fans, and temperature sensors, from anywhere in the world.
- **Cost-Effective:** The use of Arduino Uno and NodeMCU provides a cost-effective solution for home automation and security. These devices are readily available in the market and have a low cost compared to other alternatives.
- **Easy to Use:** The webpage provides an easy-to-use interface for controlling various appliances in the home. The use of servo motors and relay boards makes it easy to automate various tasks in the home.

Limits:

- **Technical Expertise:** The installation and setup of the system require technical expertise. The system involves programming, wiring, and configuring various components. The homeowners need to have some technical expertise or have someone with the necessary expertise to install and configure the system.
- **Limited Expandability:** The system has limited expandability. The use of Arduino Uno and NodeMCU provides a limited number of digital and analog pins that limit the number of components that can be added to the system.
- **Internet Dependency:** The system requires an internet connection to access the webpage and control various appliances. In case of an internet outage, the system may become inaccessible, limiting the homeowner's ability to control various appliances.
- **Privacy and Security Concerns:** The use of a camera module for face detection and live streaming may raise privacy and security concerns. Homeowners need to ensure that they secure their network and access to the system to prevent any unauthorized access or data breaches.

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