Final Project report

Realtime security and monitering with IOT

Sunbeam infotech
Pune ,
Year: 2024-25

Submitted in the partial fulfillment of the requirements for the PG Diploma in

EMBEDDED SYSTEMS& DESIGN (PG - DESD)

Group members

SR no	Name	PRN no

CERTIFICATE

Sunbeam Institute of Information Technology, Pune & Karad

This is to certify that

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have satisfactorily completed Project and presented a report on topic titled “Realtime Security and Monitering with IOT” at Sunbeam Institute of Information Technology in partial fulfilment of requirementofPGDiplomainEmbeddedSystems&Design (PG-DESD) academic year 2024-2025.

Date:

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SR NO	TITLE	PG NO

1.INTRODUCTION

ABOUT PROJECT:

Security and monitoring systems are crucial for various applications, including home automation, industrial monitoring, and smart surveillance. This project aims to develop a real-time security and monitoring system using IoT technology. The system employs an STM32F407 Discovery Board, Ultrasonic Sensor, PIR Sensor, ESP8266, and LCD 16x02 to detect motion, measure distances, and send real-time data to an online dashboard via Thingspeak.

PROJECT SCOPE:

This project focuses on implementing a real-time security and monitoring system using IoT and embedded systems. The key scope includes:

- **Sensor-Based Monitoring**: Utilizing Ultrasonic and PIR sensors to detect motion and measure distances in real-time
- **Embedded System Integration**: Using STM32F407 Discovery Board for processing and interfacing sensors.
- **Real-Time Data Transmission**: Sending security and monitoring data to a cloud-based dashboard (Thingspeak) using ESP8266.
- **Visual and Audio Alerts**: Displaying alerts on an LCD and activating a buzzer/LED for security notifications.
- **IoT-Based Monitoring**: Enabling remote access and monitoring via an online dashboard.
- **Scalability & Expansion**: Future enhancements like AI-based detection, mobile app integration, and cloud-based alert notifications.

System Overview & Working:

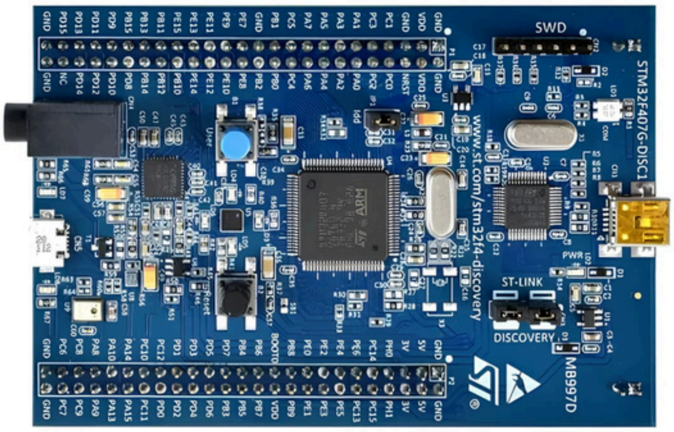
- The Ultrasonic sensor continuously measures the distance of objects and sends data to STM32 via UART.
- The PIR sensor detects motion and triggers an alert signal (LED & Buzzer).
- The STM32 board processes all the data and displays it on an LCD (16x02).
- The data is transmitted via ESP8266 to the Thingspeak cloud dashboard.
- The USB to TTL converter allows real-time monitoring on a serial terminal.

2.HARDWARE REQUIREMENTS

1 STM32F407 Discovery Board:

The STM32F407 is a powerful ARM Cortex-M4 microcontroller-based board used for real-time processing and interfacing multiple sensors.

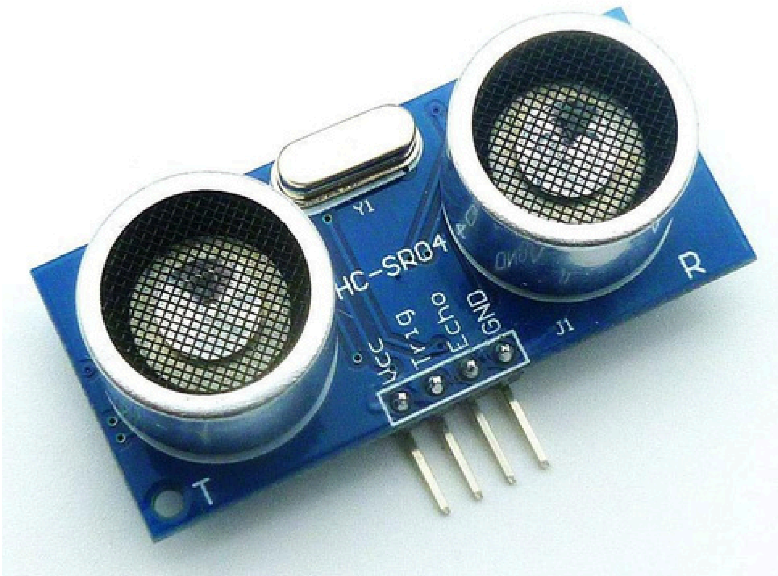
- Supports UART, I2C, SPI, and GPIO.
- High-speed processing with DSP capabilities.
- Used as the central controller for interfacing all sensors and communication modules.



2 Ultrasonic Sensor (HC-SR04):

The Ultrasonic sensor is used to measure the distance of any moving object.

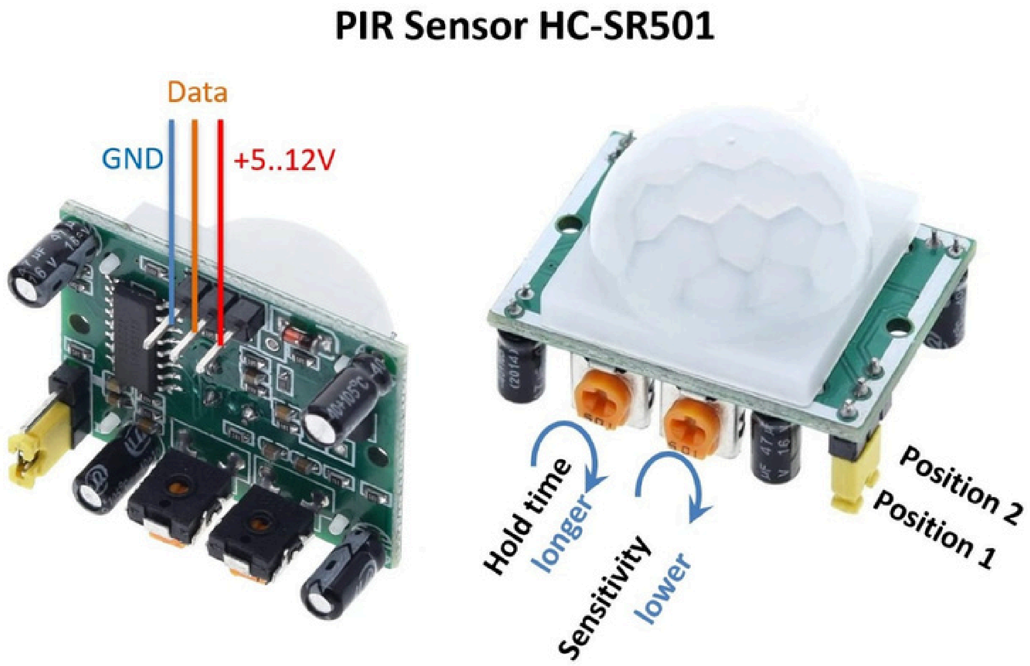
- Works on the principle of sound wave reflection.
- Provides accurate distance measurement in centimeters.
- Interfaced with STM32 using UART.



3 PIR Sensor:

The Passive Infrared (PIR) sensor detects motion based on infrared radiation emitted by moving objects.

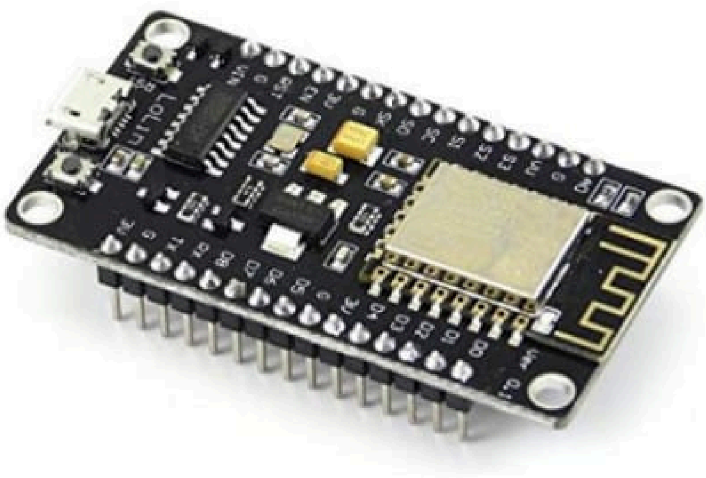
- Outputs a HIGH signal when motion is detected.
- Interfaced with STM32 GPIO.



4 ESP8266 Wi-Fi Module:

The ESP8266 module is used to send real-time data to an IoT platform.

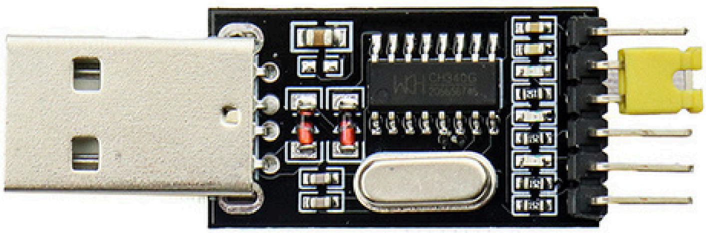
- Communicates with STM32 using UART.
- Sends distance and motion detection alerts to Thingspeak Dashboard.



5 USB to TTL Converter:

The USB to TTL converter allows serial communication between the STM32 board and a laptop.

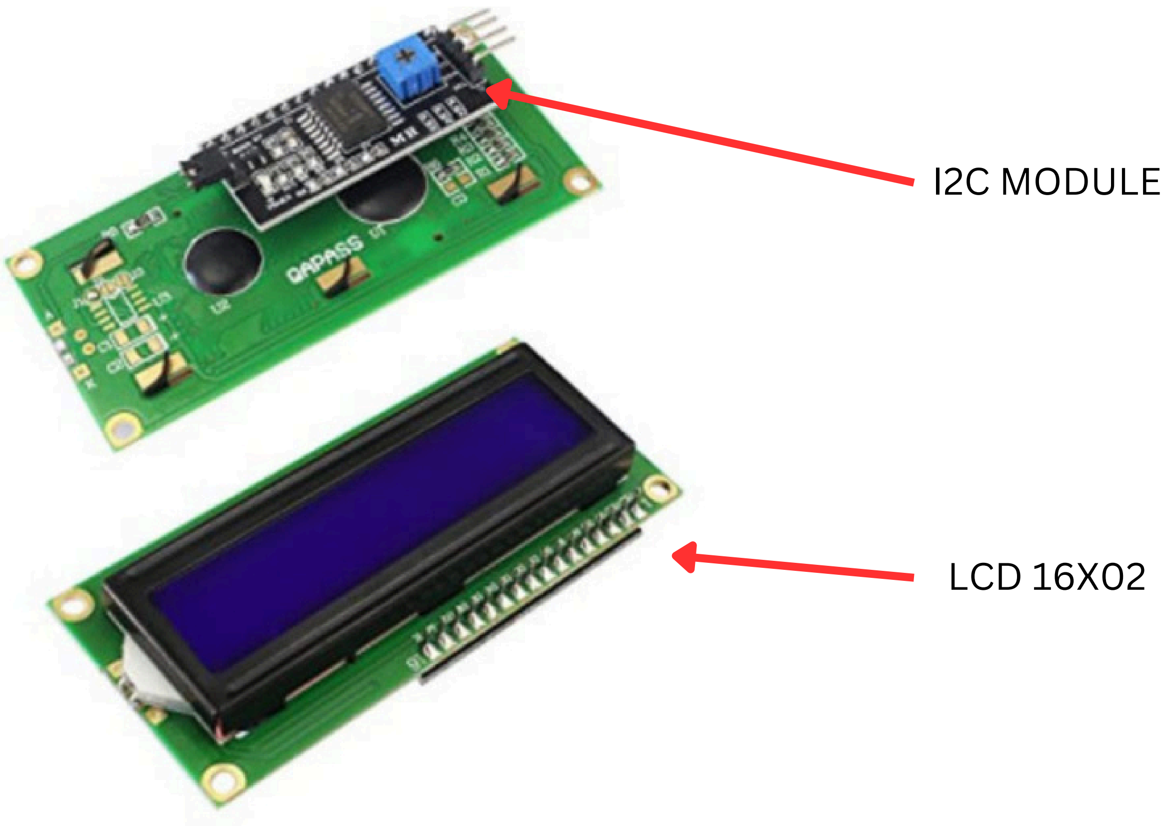
- Used for debugging and displaying sensor output on a serial terminal.



6 LCD 16x02 with I2C Interface:

The USB to TTL converter allows serial communication between the STM32 board and a laptop.

- Used for debugging and displaying sensor output on a serial terminal.



3.TECHNOLOGY USED

UART (Universal Asynchronous Receiver-Transmitter):

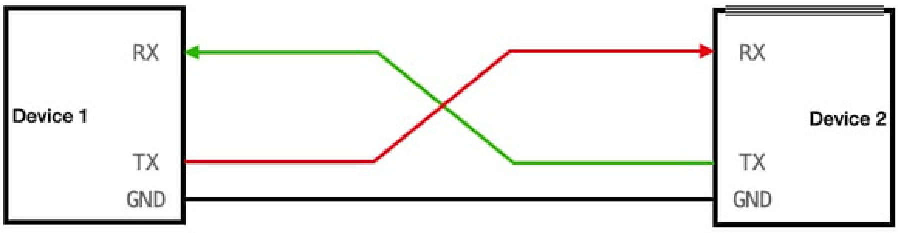
The USB to TTL converter allows serial communication between the STM32 board and a laptop. Used for debugging and displaying sensor output on a serial terminal.

How does UART work?:

- UART uses two wires to transmit and receive data.
- The transmitting UART converts parallel data to serial data, and the receiving UART converts serial data back to parallel data.
- UART uses a packet mode of transmission, with each packet containing a start bit, data frame, parity bit, and stop bits.
- The speed of data transfer is called the baud rate, and both the transmitting and receiving UARTs must operate at the same baud rate.

Role/Used in:

- Used for serial communication between STM32 and:
- Ultrasonic Sensor (to receive distance data).
- ESP8266 (to send data to Thingspeak dashboard).
- USB to TTL (for debugging and displaying data on a laptop).



I2C (Inter-Integrated Circuit):

I2C (Inter-Integrated Circuit) is a serial communication protocol that allows devices to communicate with each other over a two-wire bus. It is used to connect peripheral integrated circuits (ICs) to microcontrollers and processors.

How does I2C work?:

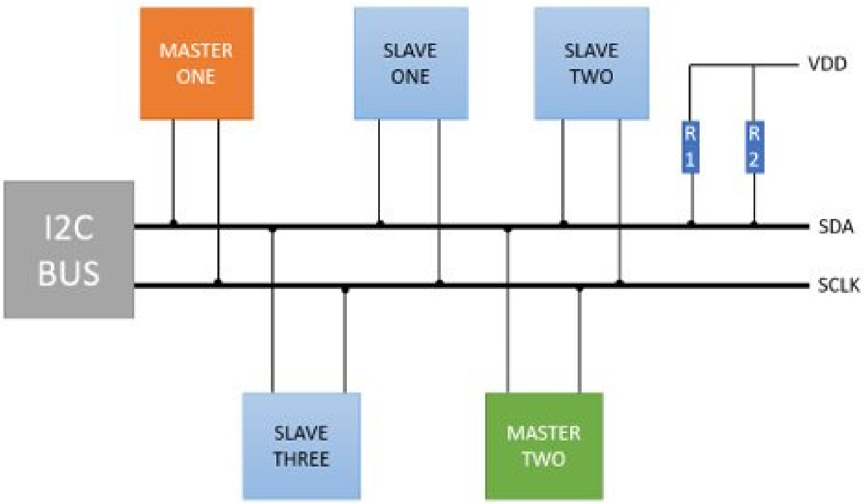
- A master device controls the I2C bus and communicates with slave devices.
- Each device on the bus has a unique address.
- A slave device can't transmit data unless it is addressed by the master.
- The master sends a byte packet of data to the slave.
- The slave compares the address to its own address.
- If the addresses match, the slave returns an ACK bit.
- If the addresses don't match, the slave leaves the SDA line high.

I2C modes:

- Standard-Mode (Sm) with a bit rate up to 100 kbit/s
- Fast-Mode (Fm) with a bit rate up to 400 kbit/s
- Fast-Mode Plus (Fm+) with a bit rate up to 1 Mbit/s

ROLE/USED IN :

- Used for LCD 16x02 communication.
- Reduces the number of connections by using only two wires (SDA, SCL).
- Allows efficient data display for real-time monitoring.



GPIO (General Purpose Input/Output):

GPIO stands for General Purpose Input/Output. It's a type of pin on an electronic circuit board that can be used to send and receive digital signals.

How does GPIO work?:

- GPIOs are uncommitted pins that can be configured as inputs or outputs.
- They can be used to control LEDs, motors, and other devices.
- GPIOs can also be used to detect switches, temperature, and light.
- GPIOs can be programmed by the user.
- GPIOs can be configured in many combinations, such as 4 input and 4 output, or 7 input and 1 output.

GPIO applications :

- GPIOs can be used to communicate with the CPU.
- GPIOs can be used to drive outside operations based on CPU instructions.
- GPIOs can be used to read input values.
- GPIOs can be used as interrupt lines.

ROLE/USED IN :

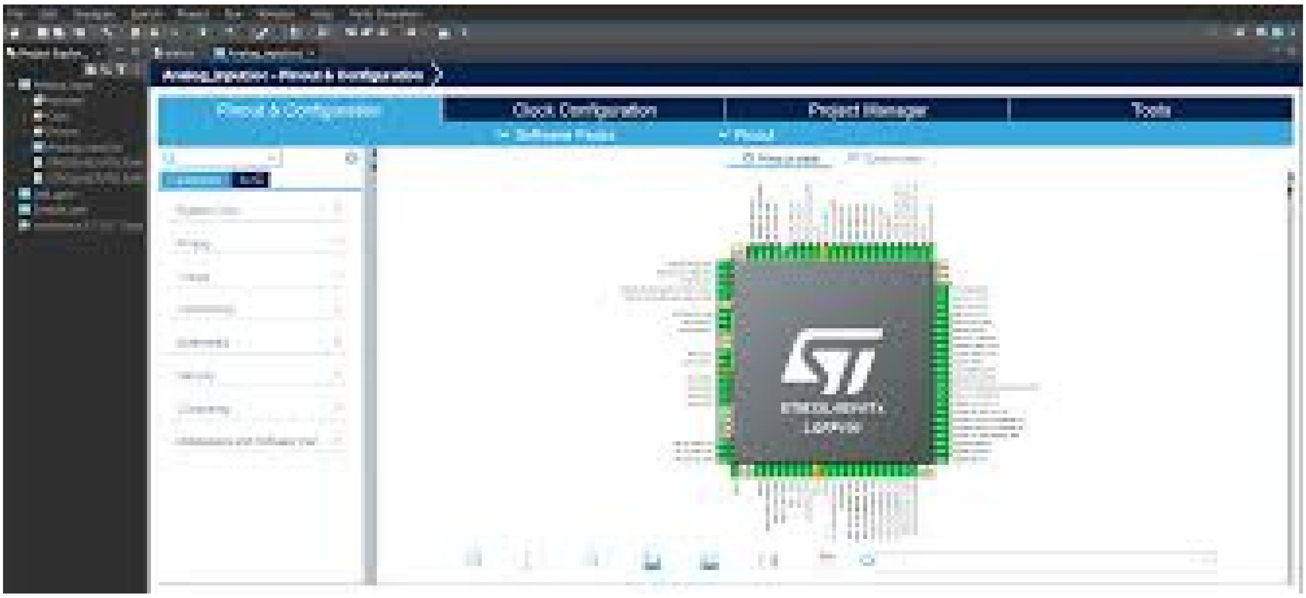
Used to interface:

- PIR Sensor (to detect motion and trigger alerts).
- Buzzer and LED (to provide security alerts when motion is detected).
- Configured as digital inputs for PIR and digital outputs for buzzer & LED.

4.SOFTWARE REQUIREMENTS:

STM CUBEIDE :

STM32CubeIDE is an advanced C/C++ development platform with IP configuration, code generation, code compilation, and debug features for STM32 microcontrollers. It is based on the ECLIPSE™/CDT framework and GCC toolchain for the development, and GDB for the debugging.



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

5.CURCUIT CONNECTION:

Component	STM32F407 Pin	Communication
Ultrasonic Sensor (HC-SR04)	UART (Tx, Rx)	Serial (UART)
PIR Sensor	GPIO	Digital Input
ESP8266 Wi-Fi Module	UART (Tx, Rx)	Serial (UART)
USB to TTL Converter	UART (Tx, Rx)	Serial (UART)
LCD 16x02	I2C (SCL, SDA)	I2C Protocol
Buzzer & LED	GPIO	Digital Output

6.STEPS OF IMPLEMENTATION:

Step 1: Setting Up STM32F407

- Configure UART, I2C, and GPIO pins using STM32CubeMX.
- Initialize peripherals and clocks in STM32.

Step 2: Interfacing Ultrasonic Sensor

- Connect Trigger and Echo pins to STM32.
- Configure UART to reStep 1: Setting Up STM32F407
- Configure UART, I2C, and GPIO pins using STM32CubeMX.
- Initialize peripherals and clocks in STM32
- Convert signal time to distance in cm.

Step 3: Interfacing PIR Sensor

- Connect PIR output pin to STM32 GPIO.
- Configure GPIO interrupt to detect motion changes.

Step 4: Displaying Data on LCD

- Use I2C communication to send data from STM32 to LCD.
- Display distance and motion status.

Step 5: Sending Data to ESP8266

- Configure UART communication between STM32 and ESP8266.
- Transmit distance and motion detection alerts

Step 6: Uploading Data to Thingspeak Dashboard

- Connect ESP8266 to Wi-Fi network.
- Send sensor data to Thingspeak API.
- Display real-time updates on the dashboard.

7.Applications:

- **Industrial Safety Monitoring** – Prevents unauthorized access to restricted areas.
- **Smart Parking Systems** – Monitors parking space availability using ultrasonic sensors.
- **Wildlife Monitoring**GIVE truders.
- **Smart Agriculture** – Monitors livestock movement and security.

8.FUTURE SCOPE:

- Integration with AI & ML: Use AI algorithms to classify movements and detect threats more accurately.
- Battery-Powered Operation: Implement a low-power mode for energy-efficient monitoring.
- Cloud-Based Alert System: Send email/SMS notifications for security alerts.
- Mobile App Integration: Develop an Android/iOS app for real-time monitoring.

9.CONCLUSION:

This project successfully demonstrates a real-time security and monitoring system using STM32, IoT, and various sensors. The system continuously tracks object movement, detects motion, and transmits real-time data to the Thingspeak cloud dashboard. With potential enhancements like AI-based detection and mobile app integration, the system can be further developed into a commercial security solution