Department Of Information Technology And Communication

Diploma In Information Technology

(Digital Technology)

DFT50114: INTEGRATED PROJECT

SAFEZONE

(SafeZone) IOT Based Smoke Detector

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TABLE OF CONTENT

1.0 ABSTRACT

The "safezone" project aims to develop a two-level smoke alarm system to prevent fires and reduce potential casualties and property damage at Politeknik Sultan Idris Shah. The first level detects small amounts of smoke and alerts the administrator, allowing for early intervention to prevent further damage. The second level detects heavy smoke and immediately alerts nearby users while notifying the "FELO" residential college committee. The significance of the system lies in its ability to address the issue of student smoking and associated fire hazards by ensuring early detection and response, prompt notification to the warden, and an effective fire alert system using buzzer and telegram notifications. Gathering components, connecting them, installing required libraries, writing the Arduino sketch, uploading it, and testing the prototype are all part of the methodology.

2.0 PROJECT PLAN

2.1 Problem Statement

1. Early Recognition

i. Existing smoke alarms frequently neglect to distinguish limited quantities of smoke in the beginning phases of a fire.

ii. Postponed caution and reaction time builds the gamble of fire spreading quickly.

2. False Alarms

i. Many smoke alarms are inclined to false alarms brought about by cooking smoke or high humidity

ii. Continuous false alarms can prompt carelessness and dismissal for certifiable fire cautions.

3. Old Device

i. Existing smoke alarms lack of detecting smoke

ii. Postponed notice can delaying and hindering firefighter efforts

4. Openness and Inclusivity

i. Smoke alarms ought to be available and simple to use for all people, incorporating those with inabilities or exceptional requirements.

ii. Existing plans may not take special care of assorted client necessities, influencing equivalent fire wellbeing measures.

To address these difficulties, a hearty and solid smoke recognition framework is required that can recognize smoke early, limit false alarms and give comprehensive UIs. Such a smoke alarm would essentially further develop fire counteraction measures and upgrade by and large fire security.

2.2 **Objective**

1. To Early Smoke Recognition
2. To Decrease Phony problems
3. To Mix with Crisis Administrations
4. To Comprehensive UI.

2.3 Scope

User Scope:

Primary Users: Students of the building where the smoke detector system is located.

Secondary Users: Wardens responsible for monitoring the system, responding to alerts, and ensuring residents' safety.

User Requirements:

Ability to Initiate Evacuation: The system should enable users to initiate evacuation procedures in response to smoke alerts.

Investigation of Smoke Source: Users should have the capability to investigate the source of smoke alerts for appropriate action.

Contact Emergency Services: The system should allow users to quickly contact emergency services when needed.

Addressing Vaping and Smoking Risks: Specific procedures should be implemented to reduce risks posed by students vaping and smoking in the building.

System Scope:

Hardware Components: The smoke detector system requires smoke detectors, sensors, alarms, and communication devices for proper functioning.

Software for Data Processing: Software is necessary to process sensor data, detect smoke levels, and enable critical alerts.

Network Integration: The system should be linked to a network or communication infrastructure for sending alerts and notifications.

Integration with Building Systems: Integration with other building systems, such as ventilation and fire suppression, ensures better overall safety measures and coordination.

Testing and Maintenance: Regular testing and maintenance are essential to ensure proper functionality, accurate readings, and safety compliance.

By considering these user and system scopes, the smoke detector project can be designed to meet the specific needs of building residents and enhance fire safety measures effectively.

2.4 Literature Review

The literature review aims to provide a comprehensive overview of current research on fire detection and response using smoke detector systems. It focuses on four key aspects: integration of fire sprinklers, estimation of smoke and heat percentages, use of Telegram Bot technology for notifications, and integration of heat and smoke sensors.

1. **Heat and Smoke Sensors:** Integrating both heat and smoke sensors enhances the accuracy and reliability of fire detection. Heat sensors can detect rapid temperature changes, while smoke sensors identify smoke particles, allowing the system to detect fires more effectively.
2. **Calculating Heat and Smoke Percentages:** Algorithms are used to analyze sensor data and calculate the percentages of smoke and heat. This calculation is crucial for determining the severity of a fire, distinguishing between low and high levels of smoke and heat.
3. **Telegram Bot Technology:** The use of Telegram Bot technology enables efficient and practical notifications. Specific individuals, such as wardens, receive alerts when low levels of smoke and heat are detected. This immediate notification facilitates prompt intervention and response.

Overall, the literature review highlights the importance of integrating heat and smoke sensors, calculating smoke and heat percentages, utilizing Telegram Bot technology for notifications, and combining the system with fire sprinklers. These components working together result in a dependable and effective smoke detector system for fire detection and response.

2.5 Methodology

1. System Design and Hardware Setup:

i. Select heat and smoke sensors capable of detecting potential fires as well as smoke from student cigarette smoking.
ii. Create and assemble the hardware components, which include heat and smoke sensors, a microcontroller board, buzzer and Telegram bot.
iii. To ensure compatibility and operation, ensure that the components are properly connected and wired.

2- Sensor Integration and Data Collection:

i. Integrate the heat and smoke sensors with the microcontroller board to enable real-time data collection.
ii. Develop the algorithms required to analyse sensor data and determine the percentages of smoke and heat.
iii. Install a data collection system to monitor the heat and smoke levels in the space.

3- Determining Smoke Severity and Trigger Actions:

i. Set smoke and heat percentage thresholds to classify smoke severity as light or heavy.
ii. Implement the necessary circuitry in the microcontroller board to determine the severity level based on the calculated smoke and heat percentages.
iii. When the temperature and smoke levels are low, configure the Telegram bot to send a message to the warden informing them of the presence of smoke caused by student smoking.

4- Testing and Validation:

i. Perform extensive testing to ensure the dependability and functionality of the smoke detector system.

ii. To perform smoke detection testing, simulate a variety of scenarios, such as student smoking and potential fire situations.

iii. Check the accuracy of smoke and heat detection, the estimation of smoke percentages, and the execution of the required steps.

iv. Improve system performance by making the necessary changes and improvements in light of the testing results.

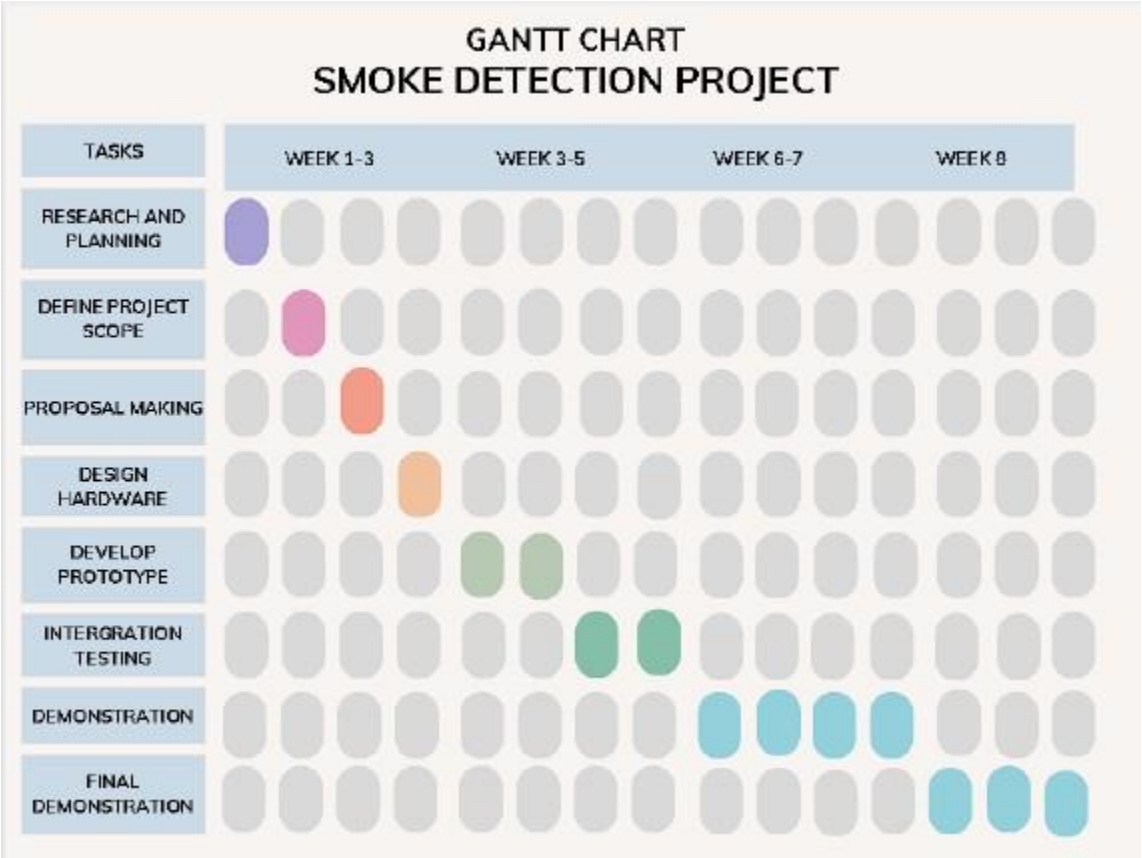
5- Deployment and upkeep:

i. Install the smoke detector system in areas where there is a high likelihood of student smoking, which can cause fires.

ii. Conduct routine maintenance checks, such as sensor calibration, power supply and system updates, to ensure that all components are functioning properly.

iii. Give the warden instructions on how to use the system, including reaction methods and maintenance procedures.

2.6 Gantt Chart



COST PLANNING

BIL	ITEM	UNIT PRICE (RM)	QUANTITY	PRICE (RM)
1	ESP32	35.00	1 unit	35.00
2	Male to Female Wire Jumper	2.50	1 set	2.50
	Female to Female Wire Jumper	2.50	1 set	2.50
	Male to Male Wire Jumper	2.50	1 set	2.50
3	Donut Board 7cmX9cm	3.50	2 unit	7.00
4	Buzzer	2.60	1 unit	2.60
5	MQ2 Gas Sensor	20.00	2 unit	40.00
6	DHT 11 Temperature and Humidity Sensor	20.00	1 unit	20.00
7	12C LCD Display 16X2mm	20.00	1 unit	20.00
8	Donut Board 9cmX15cm	4.90	2 unit	9.80
9	Pin Header Female 1X40 2.54mm 12mm	1.50	3 unit	4.50
10	Soldering Iron	100.00	1 unit	100.00
11	Soldering Wire	20.00	1 roll	20.00
TOTAL				**RM266.40**

3.0 Requirements Specification

3.1 Functional Requirement

Smoke Discovery: The shrewd smoke alarm ought to recognize smoke and potential fire perils with dependable and delicate systems for early recognition.

Caution Framework: It ought to have an implicit caution framework that discharges a boisterous and unmistakable sound to caution occupants in the quarters or encompassing regions when smoke or fire is distinguished.

Constant Warnings: The savvy smoke alarm ought to send ongoing notices to property holders or assigned clients through Telegram

Availability and Incorporation: The savvy smoke alarm ought to be IoT-empowered and viable with other brilliant home gadgets and frameworks, permitting coordination with home robotization stages and shrewd center points.

Self-observing and Symptomatic: It ought to have self-observing abilities to perform customary checks and ready clients of battery exhaustion or sensor glitches.

Controller: Clients ought to have the option to remotely control the shrewd smoke alarm through a versatile application or web interface for furnishing/incapacitating, really taking a look at sensor status, and changing settings.

Battery Reinforcement: The shrewd smoke alarm ought to have a solid battery reinforcement to guarantee consistent activity during blackouts.

Low Battery Alert: It ought to send low battery cautions to clients ahead of time, showing the requirement for battery substitution.

Interconnectivity: In multi-room or multi-story residences, shrewd smoke alarms ought to interconnect remotely to set off cautions in everything interconnected locators when smoke is recognized.

Information Logging and Detailing: The brilliant smoke alarm ought to keep a log of smoke discovery occasions with timestamps and caution triggers, permitting clients to get to verifiable information and get intermittent reports.

Easy to use Connection point: The shrewd smoke alarm ought to have a natural UI on the gadget and going with versatile application or web-based interface for simple arrangement, setup, and the executives.

By consolidating these improved on utilitarian prerequisites, the savvy smoke alarm can give progressed smoke recognition capacities while offering comfort and easy to understand highlights to upgrade wellbeing in residences.

3.2 Non-Functional Requirements

Dependability: The savvy smoke alarms ought to be reliable and precise in identifying smoke or fire perils, guaranteeing the wellbeing of residence occupants.

Execution: Quick reaction times are vital to caution occupants during fire crises in dorms rapidly.

Security: The framework ought to focus on the assurance of student's protection and information, utilizing secure correspondence and information transmission strategies.

Versatility: The shrewd smoke alarm framework ought to be equipped for scaling to cover a developing grounds or extra dorms.

Power Productivity: Guaranteeing proficient power utilization is fundamental, especially during blackouts or when occupants might neglect to immediately supplant batteries.

Similarity: The shrewd smoke alarms ought to be viable with different gadgets and stages utilized nearby, supporting different correspondence conventions and working frameworks.

Client Openness: Giving available UIs and supporting different dialects guarantees all occupants can associate with and figure out the framework.

Ecological Contemplations: The framework ought to consent to natural guidelines, reflecting capable assembling and removal rehearses.

Upkeep and Backing: Solid client assistance and customary updates are fundamental to keeping up with ideal usefulness of the brilliant smoke alarms.

Convenience: Simple establishment and a stylishly satisfying plan upgrade ease of use and reasonableness for quarters use.

Integrating these non-practical necessities into the shrewd smoke alarm's plan and execution would guarantee that the framework meets wellbeing, security, and client experience assumptions for quarters occupants and the grounds local area.

3.3 Hardware And Software Requirements

Hardware Requirement	Description
ESP32 Board	Esp32-based development board
DHT11 Temperature and Humidity Sensor	Sensor to detect heat level
MQ2 Gas Sensor	Sensor to detect smoke and gas
Buzzer	For audio alerts
Jumper Wires	Wires to connecting components
USB Cable	Standard USB Cable to connecting board to Laptop
Power Source	USB Power Adapter or battery for standalone usage

Software Requirement	Description
Arduino IDE	For programming for upload the code into ESP32 Board
Telegram	Application to receive notification from ESP32 Board

3.4 System Configuration

i. **Microcontroller:** As the central processing unit, use the ESP32 to manage sensor data, control the alarm, and communicate with other devices.
ii. **Smoke Detection Sensors:** Include high-quality smoke detection sensors to detect smoke particles and identify fire hazards.
iii. **Communication Module:** Use the ESP32's built-in Wi-Fi and Bluetooth capabilities to connect to the internet, communicate with the cloud, and interact with nearby devices.
iv. Provide both primary power via an electrical outlet and a reliable backup power source (batteries) to ensure continuous operation during power outages.
v. **Alarm System:** Install a loud and clear alarm system with a speaker or buzzer to notify dormitory residents when there is smoke or fire. Include a test button for performing routine functionality checks.
vi. **User Interface:** Create a user-friendly interface on the ESP32 with buttons or touch-sensitive controls for manual operations such as testing the alarm or silencing the detector. LEDs can be used to display status information.
vii. Develop a mobile app for iOS and Android to allow remote interactions with the smart smoke detector. Provide users with the ability to receive real-time notifications, manage settings, and view historical data.
viii. **Firmware:** Create reliable firmware for the ESP32 microcontroller to handle sensor data processing, alarm control, communication protocols, and system functions.

By meeting these hardware and software requirements, the smart smoke detector can improve dormitory residents' safety and security by providing reliable smoke detection and effective communication features.

3.5 Security Requirements

Implement strong authentication mechanisms to ensure that only authorised users can access and control the device using valid credentials (username and password).

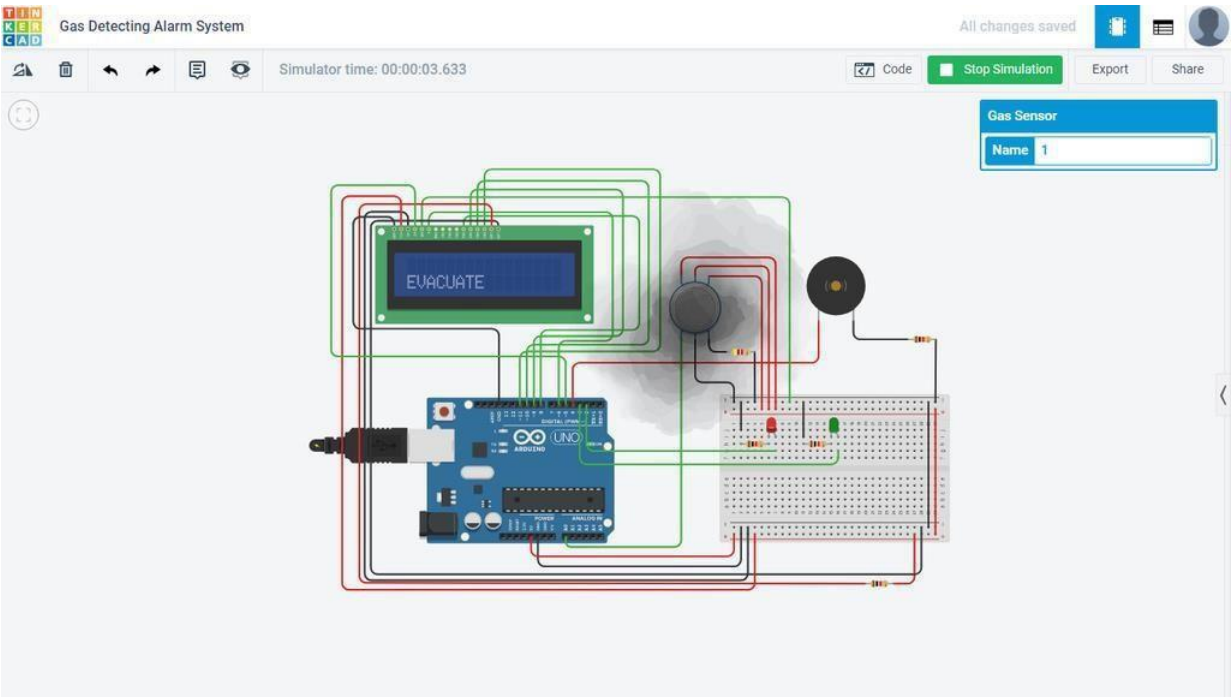
i. **Secure Communication:** Use secure protocols (TLS/SSL) to encrypt all communication between the smart smoke detector, mobile app, and cloud server to protect data from unauthorised interception and tampering.
ii. **Data Security:** Keep user data secure and in accordance with data protection regulations. Define your privacy policies for data collection, processing, and use.
iii. **Secure Firmware:** Make sure the firmware is securely stored and not tampered with. Implement secure boot mechanisms to allow the device to run only verified and authentic firmware.
iv. **Physical Tampering Protection:** Build the hardware to resist physical tampering and unauthorised access to sensitive components and access points.
v. **Protection against Denial of Service (DoS) attacks:** Prevent DoS attacks to ensure the smart smoke detector remains operational during sustained attack attempts.
vi. **Intrusion Detection and Prevention:** Use real-time mechanisms to detect and respond to potential security breaches or malicious activity.
vii. **Regular Security Updates:** Distribute firmware updates on a regular basis to address security vulnerabilities and protect against emerging threats.
viii. **Backup and Recovery:** Implement dependable backup and recovery procedures to ensure data integrity in the event of data loss or system failure.
ix. **Secure Mobile App:** Use secure coding practises when developing the mobile app to avoid vulnerabilities such as SQL injection, cross-site scripting, and data leakage.

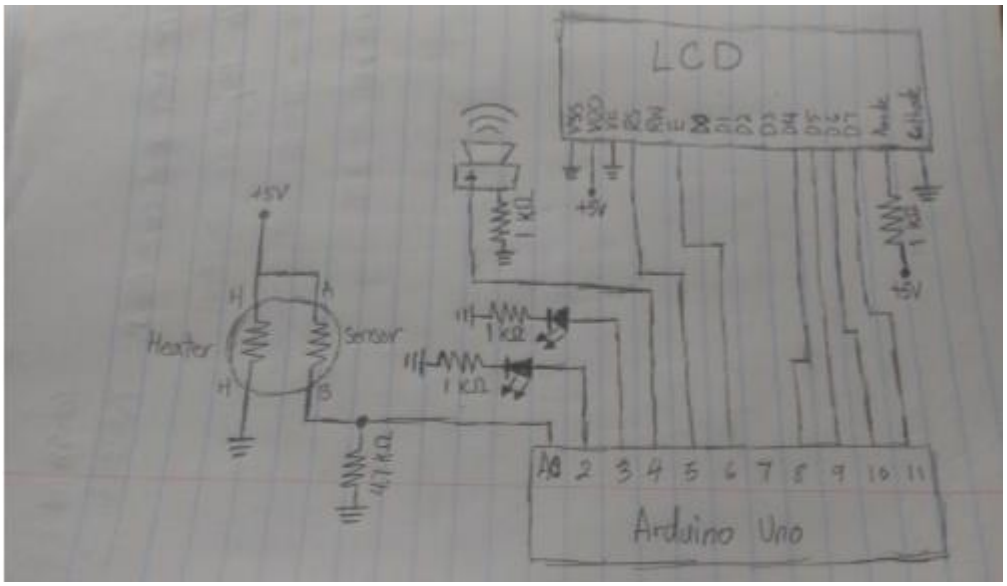
By incorporating these security requirements, the smart smoke detector system can provide a high level of protection against potential threats, ensuring dormitory residents' safety and privacy.

4.0 Final Design

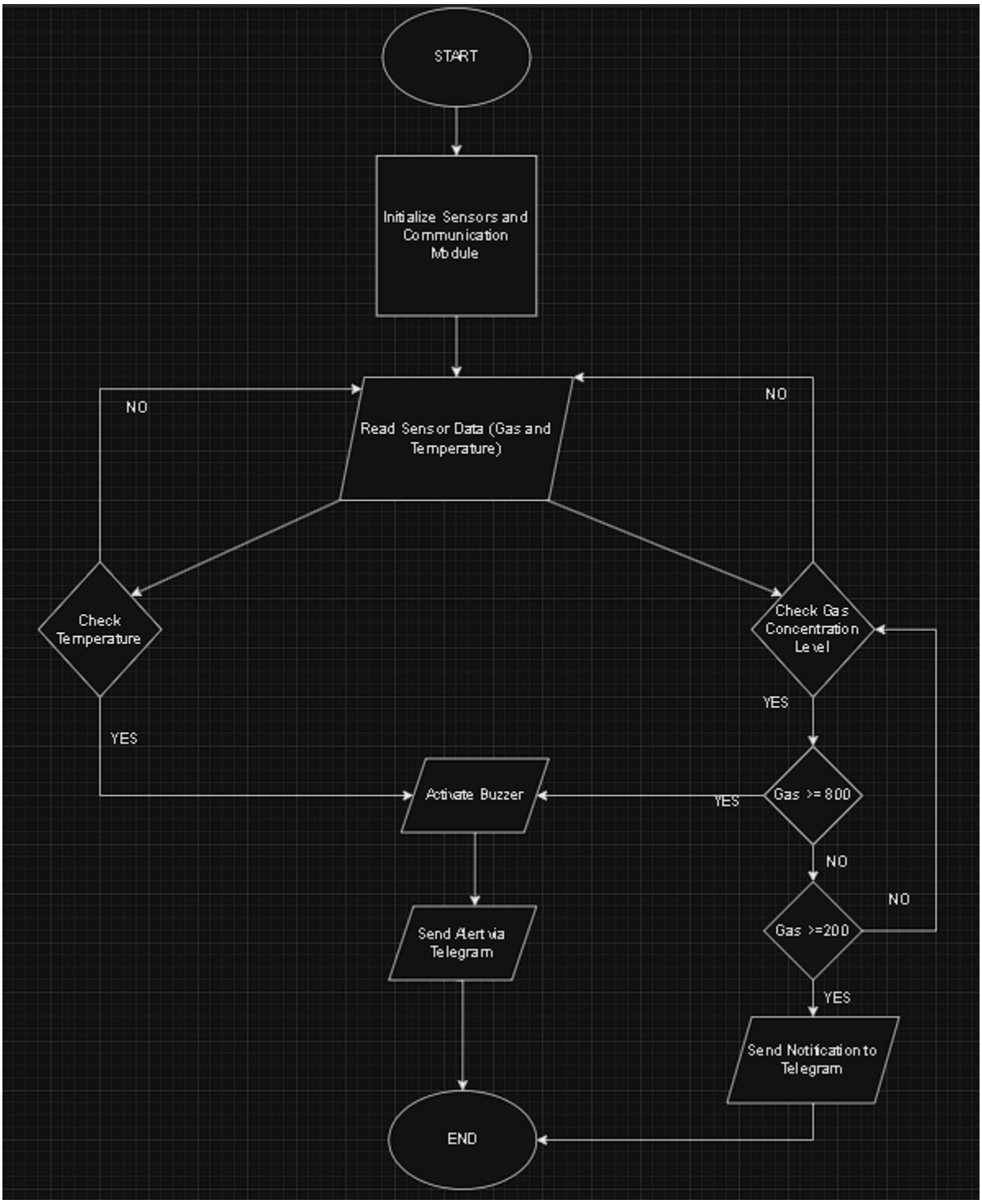
4.1 Logical Design

Schematic Diagram Circuit

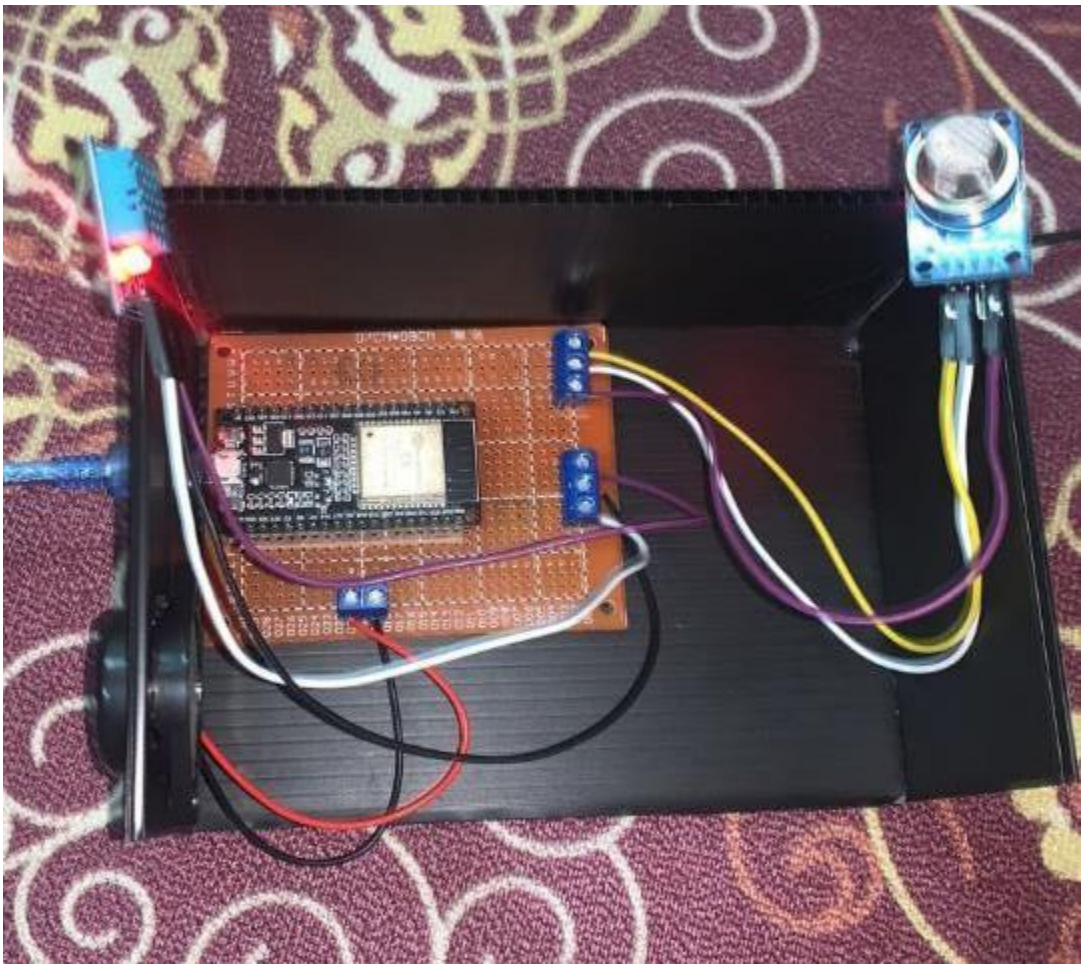



LCD
+5V
+5V
+5V
1kΩ
1kΩ
Heater
Sensor
H
A
H
B
47kΩ
A0 2 3 4 5 6 7 8 9 10 11
Arduino Uno

FLOW CHART


START
Initialize Sensors and Communication Module
Read Sensor Data (Gas and Temperature)
NO
NO
Check Temperature
Check Gas Concentration Level
YES
YES
Activate Buzzer
YES
Gas >= 800
NO
NO
Gas >=200
Send Alert via Telegram
YES
Send Notification to Telegram
END

4.2 Physical Design



4.3 Experimental Concept

The experimental concept for the smart smoke detector involves testing and evaluating the performance of the device in a controlled environment to validate its functionalities and assess its effectiveness in detecting smoke and potential fire hazards. The goal of the experiment is to gather data and insights that can be used to optimize and refine the smart smoke detector's design and algorithms.

Experiment Outline:

Test Setup:

Set up a controlled test environment that simulates real-life scenarios in a dormitory, including a smoke chamber or controlled fire source.

Ensure safety measures are in place to prevent any risks to personnel or property.

Calibration and Baseline:

Calibrate the smart smoke detector's sensors to establish a baseline for smoke detection sensitivity and accuracy.

Conduct initial tests to ensure the detector's alarm activation and notification systems are functioning correctly.

Smoke Detection Performance:

Introduce controlled amounts of smoke into the test environment and measure the smart smoke detector's response time and accuracy in detecting the smoke.

Vary the density and types of smoke particles to assess the detector's ability to differentiate between smoke and other airborne particles.

False Alarm Testing:

Introduce common sources of false alarms, such as cooking smoke, steam, or dust, to assess the detector's ability to distinguish between real smoke and false triggers.

Measure the false alarm rate and adjust the algorithm's sensitivity if needed.

Alarm Sound and Notification:

Evaluate the loudness and audibility of the alarm sound in different dormitory settings to ensure it can effectively alert residents.

Network Connectivity and Reliability:

Test the smart smoke detector's connection to the internet and cloud server to ensure stable and uninterrupted communication.

Evaluate the system's ability to recover from network disruptions or outages.

Power Management:

Measure the smart smoke detector's power consumption in various operational modes to optimize battery life and power efficiency.

Assess the effectiveness of the backup power source during power outages.

User Interaction and Usability:

Conduct user testing sessions to evaluate the user interface's ease of use, clarity of instructions, and overall user experience.

Gather feedback from users to identify potential improvements in the mobile app and physical controls.

Data Collection and Analysis:

Collect and analyze data from the experiments, including sensor readings, alarm triggers, notification delivery times, and user feedback.

Use statistical analysis to draw conclusions about the smart smoke detector's performance and identify areas for enhancement.

Iterative Design:

Based on the experiment results, make necessary adjustments and improvements to the smart smoke detector's hardware, firmware, and software components.

Iterate through testing and refinement until the device meets the desired performance and safety standards.

5.0 Test Description and Result

5.1 Unit Testing Plan

UNIT TESTING PLAN (UTP)						
NO	**TEST CASE NAME**	TEST PROCEDURE	PRECONDITION	EXPECTED RESULT	TESTER	RESULT(PASS/FAIL)
1	**Gas Detection**	Introduce controlled gas (e.g., LPG or methane) near the MQ2 gas sensor. Observe the sensor's response and output values.	MQ2 gas sensor installed and connected to esp 32	The MQ2 gas sensor detects the gas presence and provides accurate readings of the gas concentration.	Zainoor Naim bin Zainoor Rumaizi	pass
2	**False Alarm**	Introduce other substances like alcohol vapor or smoke near the MQ2 sensor. Observe the sensor's response and output values	MQ2 gas sensor, ESP32, DHT11, and buzzer installed and powered on.	The MQ2 sensor does not trigger an alarm, indicating its specificity to the target gas (e.g., LPG or methane) and preventing false alarms.	Azmeen Syahmi bin Md Fairuz	pass
3	**Temperature Reading**	Measure the ambient temperature using the DHT11 temperature sensor. Verify the accuracy of temperature readings.	DHT11 temperature sensor, ESP32, and buzzer installed and powered on.	The DHT11 sensor provides accurate temperature readings, and the buzzer remains inactive during this test.	Mohd Danial Iman bin Badrol Hisham	pass
4	**Alarm Sound**	Activate the alarm system of the gas detector manually. Evaluate the loudness and audibility of the buzzer alarm sound.	MQ2 gas sensor, ESP32, DHT11, and buzzer installed, powered on, and alarm activated.	The buzzer produces a distinct and audible sound, ensuring users can hear and respond to the gas detection or temperature alert.	Ahmad Amirul bin Najmi Fuad	pass
5	**Telegram Bot Alerts**	Simulate gas detection and temperature changes and observe real-time alerts through the Telegram Bot.	MQ2 gas sensor, DHT11, ESP32, buzzer, and Telegram Bot integrated and connected	Immediate notifications are sent through the Telegram Bot, providing users with real-time information	Muhd Farouk bin Mahmud	pass

				about the detected gas and temperature.		
6	**Backup Power**	Disconnect the primary power source and observe the device's functionality with backup power (e.g., batteries).	MQ2 gas sensor, ESP32, DHT11, buzzer, and backup power source installed and set up.	The gas sensor, DHT11, buzzer, and ESP32 continue to operate using the backup power source during power outages.	Muhd Hadi bin Suparman	pass
7	**User Interface**	Interact with the gas detector's physical controls and Telegram Bot commands. Verify ease of use and clarity of instructions.	MQ2 gas sensor, ESP32, DHT11, buzzer, and Telegram Bot integrated and connected.	Users can easily interact with the device using Telegram Bot commands, enabling manual operations and access to gas concentration and temperature information.	Arif Hakimi bin Ramli	pass

5.2 Integration Testing Plan

UNIT TESTING PLAN (UTP)						
NO	**TEST CASE NAME**	**TEST PROCEDURE**	**PRECONDITION**	**EXPECTED RESULT**	**TESTER**	**RESULT(PASS/FAIL)**
1	**Telegram Bot Integration**	Integrate the Telegram Bot with the smart gas detector system. Send test commands and receive responses from the bot.	MQ2 gas sensor, DHT11, ESP32, buzzer, Telegram Bot, and internet connectivity set up.	The Telegram Bot successfully integrates with the smart gas detector. It can receive commands to query gas concentration and temperature, and it sends real-time alerts to users when gas is detected or when temperature thresholds are exceeded.	Muhd Farouk bin Mahmud	pass
2	**Sensor Data Communication**	Ensure that the gas sensor and DHT11 temperature sensor data is accurately communicated to the ESP32 and processed correctly. Verify the sensor data's integrity and consistency.	MQ2 gas sensor, DHT11, ESP32, buzzer, and data communication channels set up.	The ESP32 correctly receives data from the gas sensor and DHT11 temperature sensor. The gas concentration and temperature readings are accurate, and they trigger the appropriate actions, such as activating the buzzer and sending alerts via Telegram Bot.	Zainoor Naim bin Zainoor Rumaizi	pass
3	**Alarm System Activation**	Test the integration between the gas sensor, buzzer, and ESP32 to verify that the alarm system is activated when gas is detected.	MQ2 gas sensor, DHT11, ESP32, buzzer, and alarm system set up.	When the gas sensor detects gas above a certain threshold, the buzzer is triggered by the ESP32 to produce an audible alarm sound. The alarm is promptly activated, providing an	Ahmad Amirul bin Najmi Fuad	pass

				immediate warning to users.		
4	**Telegram Bot Commands**	Send various commands to the Telegram Bot to interact with the smart gas detector system. Test commands such as querying gas concentration, temperature, and testing the alarm.	MQ2 gas sensor, DHT11, ESP32, buzzer, Telegram Bot, and internet connectivity set up.	The Telegram Bot successfully executes the commands and provides the requested information, such as the current gas concentration, temperature, and status of the alarm. The alarm test command triggers the buzzer to produce a test alarm sound.	Azmeen Syahmi bin Md Fairuz	pass
5	**Power Source Switching**	Verify the seamless switch between primary power and backup power (e.g., batteries) when the primary power source is disconnected. Test the device's functionality during the power source transition	MQ2 gas sensor, DHT11, ESP32, buzzer, primary power source, and backup power source set up.	When the primary power source is disconnected, the smart gas detector switches to the backup power source without interruption. The gas sensor, DHT11, buzzer, and ESP32 continue to operate seamlessly during the transition.	Muhd Hadi bin Suparman	pass
6	**Data Logging and Reporting**	est the data logging functionality and ensure that data is correctly stored and accessible. Verify that periodic reports are generated and sent through the Telegram Bot.	MQ2 gas sensor, DHT11, ESP32, buzzer, data logging functionalities, and Telegram Bot set up.	The gas detector system logs and stores gas concentration and temperature data accurately. Periodic reports are generated and sent to users through the Telegram Bot, providing insights into the historical performance of the system.	Arif Hakimi bin Ramli	pass

6.0 Major Finding and Discussion

6.1 The Advantages of the Project

a. **Enhanced Safety:** The smart smoke detector detects smoke early, lowering the risk of injuries and property damage in dorms.
b. **Real-time Notifications:** Even when residents are away, they receive instant alerts on their smartphones, allowing them to respond quickly to potential fire incidents.
c. **User-friendly Interface:** Simple controls and mobile apps encourage regular testing and keep the detector operational at all times.
d. **Power Efficiency and Backup:** Power management and backup support ensure that operations continue even when power is out.
e. Integration with smart home systems improves overall safety and security by interacting with other devices.
f. **Data logging and analysis:** Analysing historical data helps identify patterns and potential risks for better safety protocols.
g. Data security and user privacy are prioritised in the project through encryption and secure communication.
h. **Environmental Impact:** The device's environmentally friendly design reduces its environmental impact.
i. **Scalability and Integration:** The project's scalable design makes future technologies easy to integrate.
j. **Cost-effectiveness:** The long-term benefits outweigh the initial costs of implementation.

Overall, the smart smoke detector project provides a comprehensive safety solution for dormitories and residential settings, ensuring residents live in a safer and smarter environment.

6.2 The Disadvantages of the Project

Due to the integration of smart technology, the initial cost of implementation may be higher.

a. **Dependence on Technology:** Network disruptions or technical failures may cause temporary communication outages.
b. **User Familiarity and Adoption:** It may take some time for some users to adjust to the new interface and features.
c. **Security Risks:** Because smart devices are vulnerable to hacking or unauthorised access, strong security measures are required.
d. **Power Requirements:** Continuous operation requires a power source, and battery depletion may jeopardise functionality.
e. **Maintenance and updates:** For optimal performance, regular maintenance and updates are required.
f. **Compatibility:** Additional testing may be required to ensure compatibility with existing smart home systems.
g. **False Alarms:** Despite best efforts, false alarms can occur as a result of non-fire-related events.
h. **Limited Coverage:** In large or multi-story buildings, comprehensive coverage may necessitate the use of multiple devices.
i. **Internet Connection Dependence:** Real-time notifications rely heavily on a stable internet connection.

By addressing these issues through proper planning, maintenance, and user education, you can maximise the benefits and effectiveness of the smart smoke detector system while minimising potential drawbacks.

7.0 CONCLUSION

Our smoke alarm project aims to develop a two-tier smoke detection system to address the serious consequences of fire incidents. The system will detect smoke and promptly notify warden, followed by effective preventive measures.

The project objectives include creating a smoke alarm system with different detection levels, enabling early intervention for small amounts of smoke and immediate response for significant smoke levels. By combining intensity and smoke sensors, the system will accurately assess the severity of fire conditions.

We will integrate Telegram Bot technology for real-time alerts to the dormitory superintendent, ensuring a swift response and accountability. The system will also initiate emergency calls to the local fire department and activate water sprinklers for effective fire suppression.

The project's significance lies in addressing student smoking and fire risks in educational settings, reducing fire incidents, and promoting a safe environment.

The project methodology involves designing, testing, and implementing the smoke alarm system. The hardware setup, sensor integration, data collection, smoke severity determination, and testing processes ensure the system's functionality and reliability. Regular maintenance and guidelines for the superintendent will ensure continuous operation.

Overall, our smoke alarm project will provide a comprehensive and reliable smoke detection system, advancing fire safety practices and proactive response to smoke and fire incidents.

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