MERU UNIVERSITY OF SCIENCE & TECHNOLOGY

IOT-BASED AIR QUALITY MONITORING SYSTEM PROPOSAL PRESETATION

Joshua Wambua

EG209/109705/22

BTech. Electrical and Electronic Engineering

BACKGROUND OF THE STUDY

❖Air pollution is a growing public health and environmental concern worldwide.

❖Urbanization and industrial activities increase emission of harmful gases and particulate matter.

❖Pollutants such as CO, LPG, PM2.5 and PM10 cause serious health problems.

❖Gas leaks in domestic environments pose risks of fire, explosions, and poisoning.

❖Existing air quality monitoring systems are centralized and expensive.

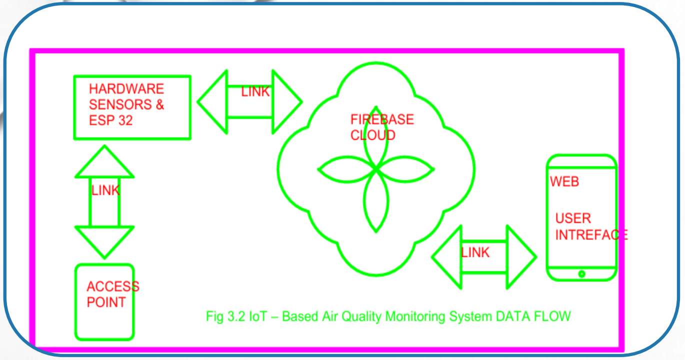
❖Households lack access to real-time, localized air quality information.

❖Advances in IoT enable low-cost, real-time monitoring solutions.

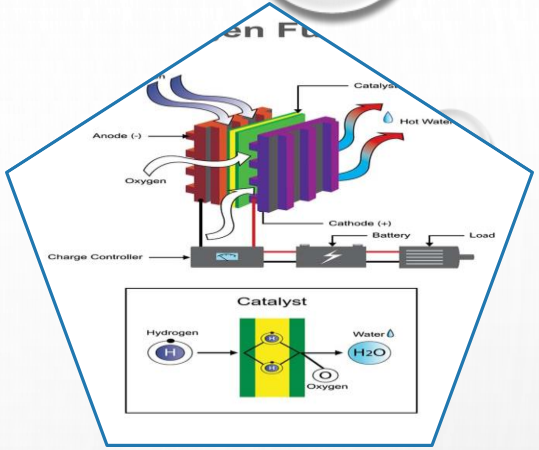
❖This project proposes an IoT-based system for continuous monitoring and early warning.

PROBLEM STATEMENT

- ❖Air pollution and gas leaks often go undetected in homes and small premises.
- ❖Existing air quality monitoring systems are expensive and inaccessible to individuals.
- ❖Lack of real-time, localized monitoring increases health and safety risks.



OBJECTIVES

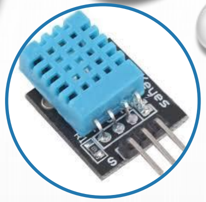


- **MAIN OBJECTIVE**

- TO DESIGN A SCALABLE IOT-BASED AIR QUALITY MONITORING SYSTEM WITH REAL-TIME DETECTION, PREDICTION, ALERTS, AND ACTUATION.

- **SPECIFIC OBJECTIVES**

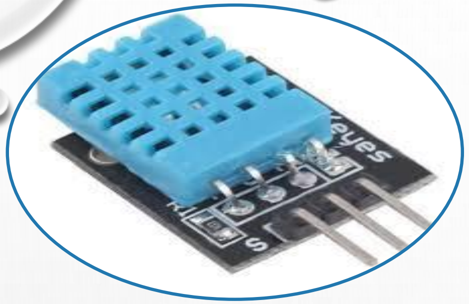
1. MONITOR PARTICULATE MATTER AND HAZARDOUS GASES IN REAL TIME.
2. MEASURE TEMPERATURE AND HUMIDITY.
3. ENABLE REMOTE MONITORING VIA A CLOUD-BASED WEB APPLICATION.
4. PROVIDE INSTANT ALERTS WHEN UNSAFE LEVELS ARE DETECTED.
5. IMPLEMENT A SAFETY RESPONSE SYSTEM.

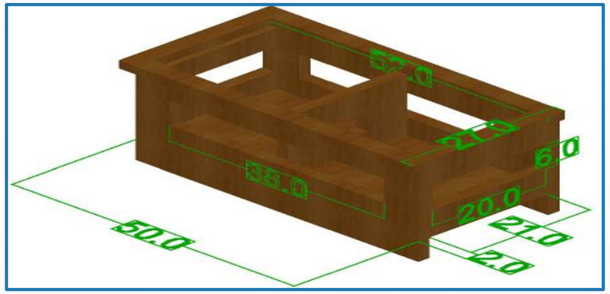


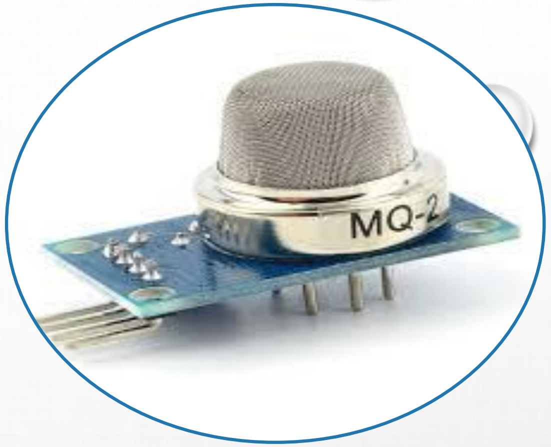
LITERATURE REVIEW

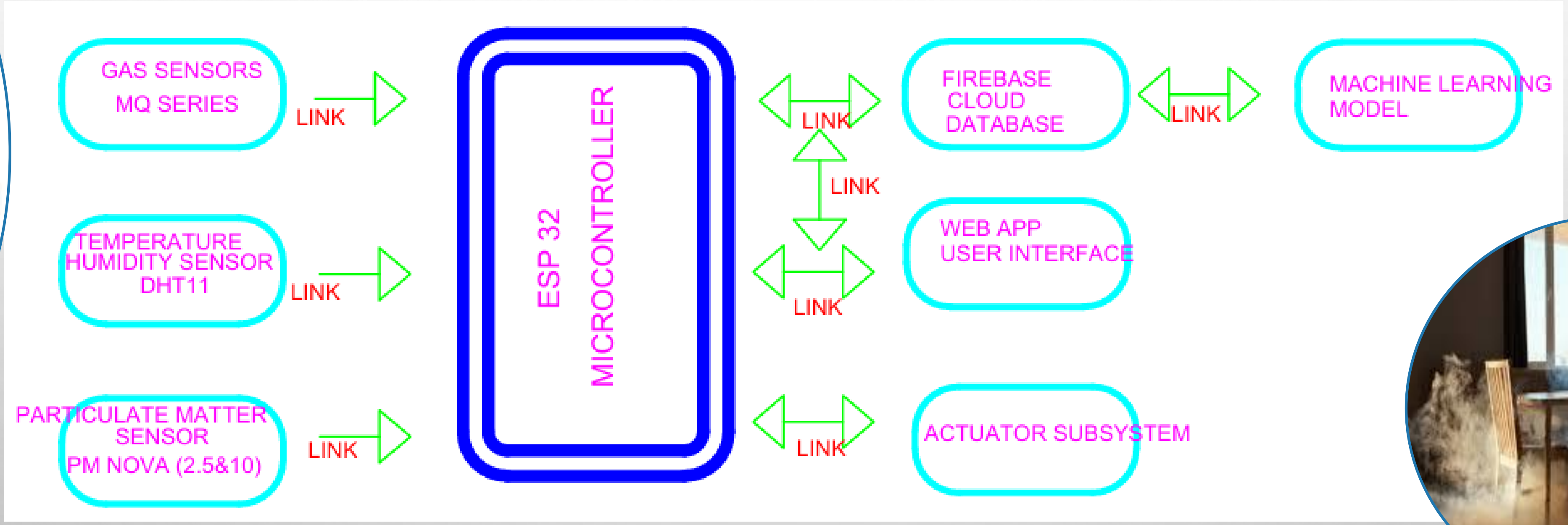
Author & Year	Focus Area	Key Findings	Identified Gap
Bagkis et al. (2025)	Low-cost sensor networks	Scalable but accuracy issues	Limited household deployment
Concas et al. (2021)	Sensor calibration	Accuracy affected by drift	Need ML calibration
Garcia et al. (2025)	IoT & AI monitoring	Real-time analytics possible	Limited safety response
Gatari et al. (2018)	Kenyan PM monitoring	Reliable low-cost sensors	Sparse local coverage
Ramesh et al. (2024)	IoT monitoring	Real-time data & alerts	Limited prediction capability

METHODOLOGY





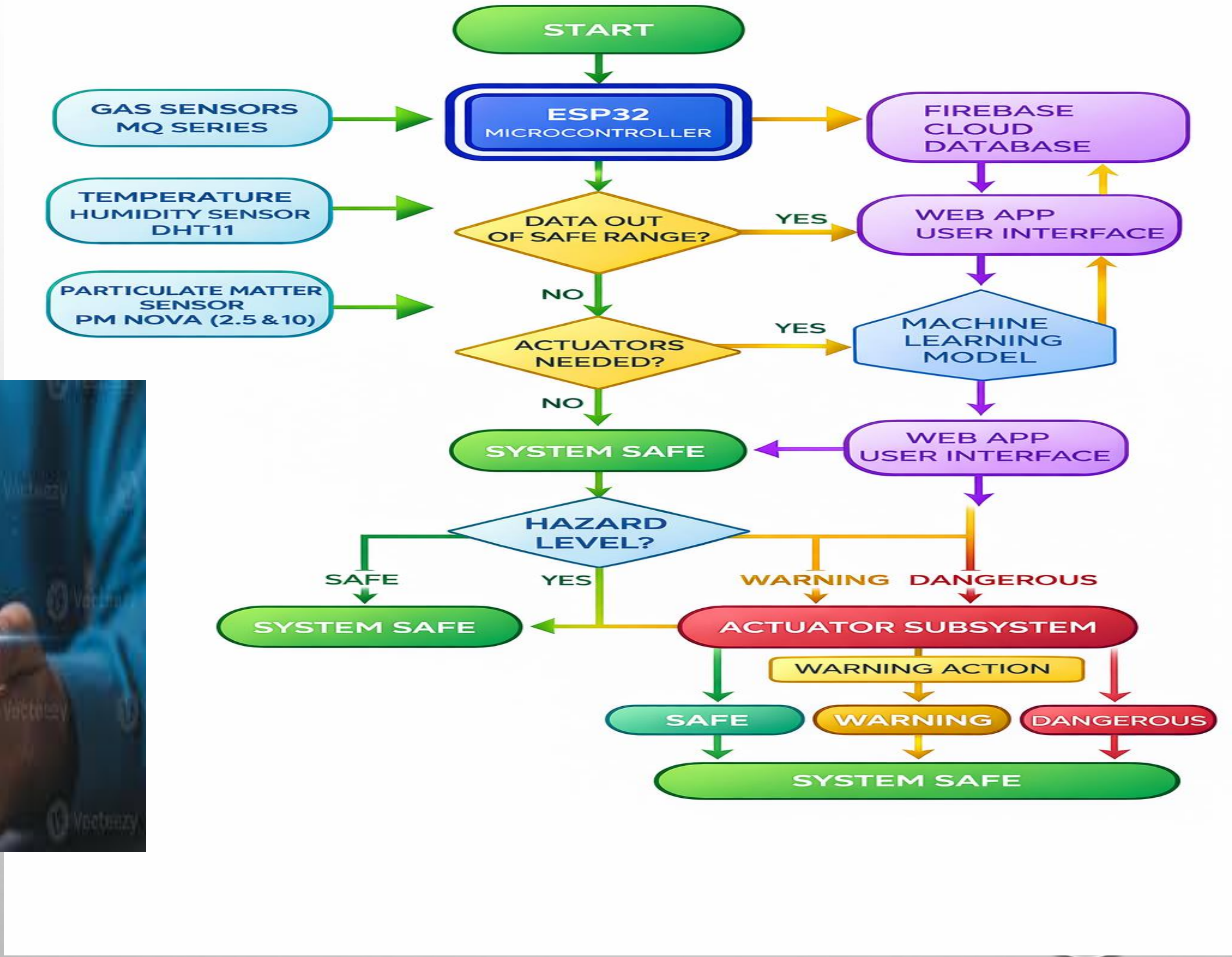




METHODOLOGY-SYSTEM OPERATION

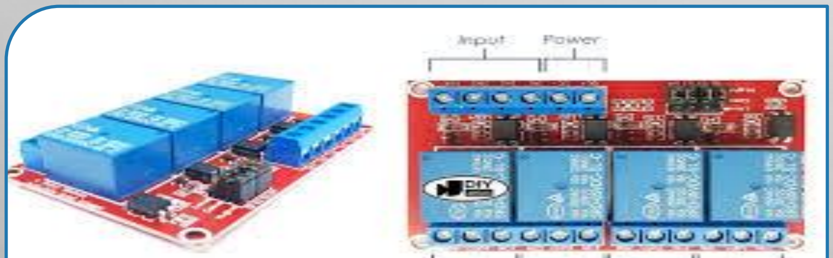
- ❖SENSORS CONTINUOUSLY MEASURE AIR POLLUTANTS AND ENVIRONMENTAL PARAMETERS.
- ❖ESP32 PROCESSES AND EVALUATES SENSOR DATA LOCALLY.
- ❖UNSAFE CONDITIONS TRIGGER IMMEDIATE ALERTS AND SAFETY ACTIONS.
- ❖DATA IS TRANSMITTED TO FIREBASE VIA WI-FI.
- ❖WEB APPLICATION DISPLAYS REAL-TIME AND HISTORICAL DATA.
- ❖MACHINE LEARNING MODELS PREDICT TRENDS AND DETECT ANOMALIES.

METHODOLOGY-LOGICAL FLOW CHART

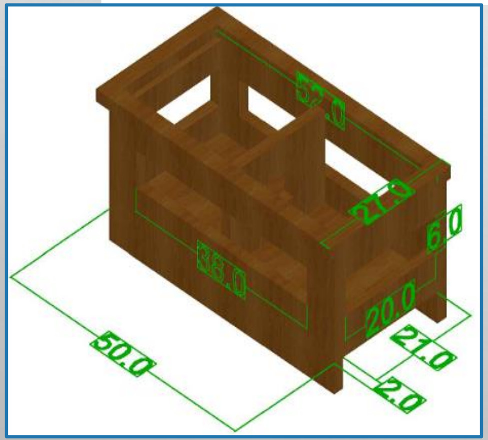


EXPECTED RESULTS

- ❖Real-time monitoring of air pollutants and hazardous gases.
- ❖Early detection of gas leaks and fire risks.
- ❖Automated alerts and notifications.
- ❖Accessible web-based visualization.
- ❖Improved environmental awareness and safety.

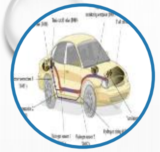


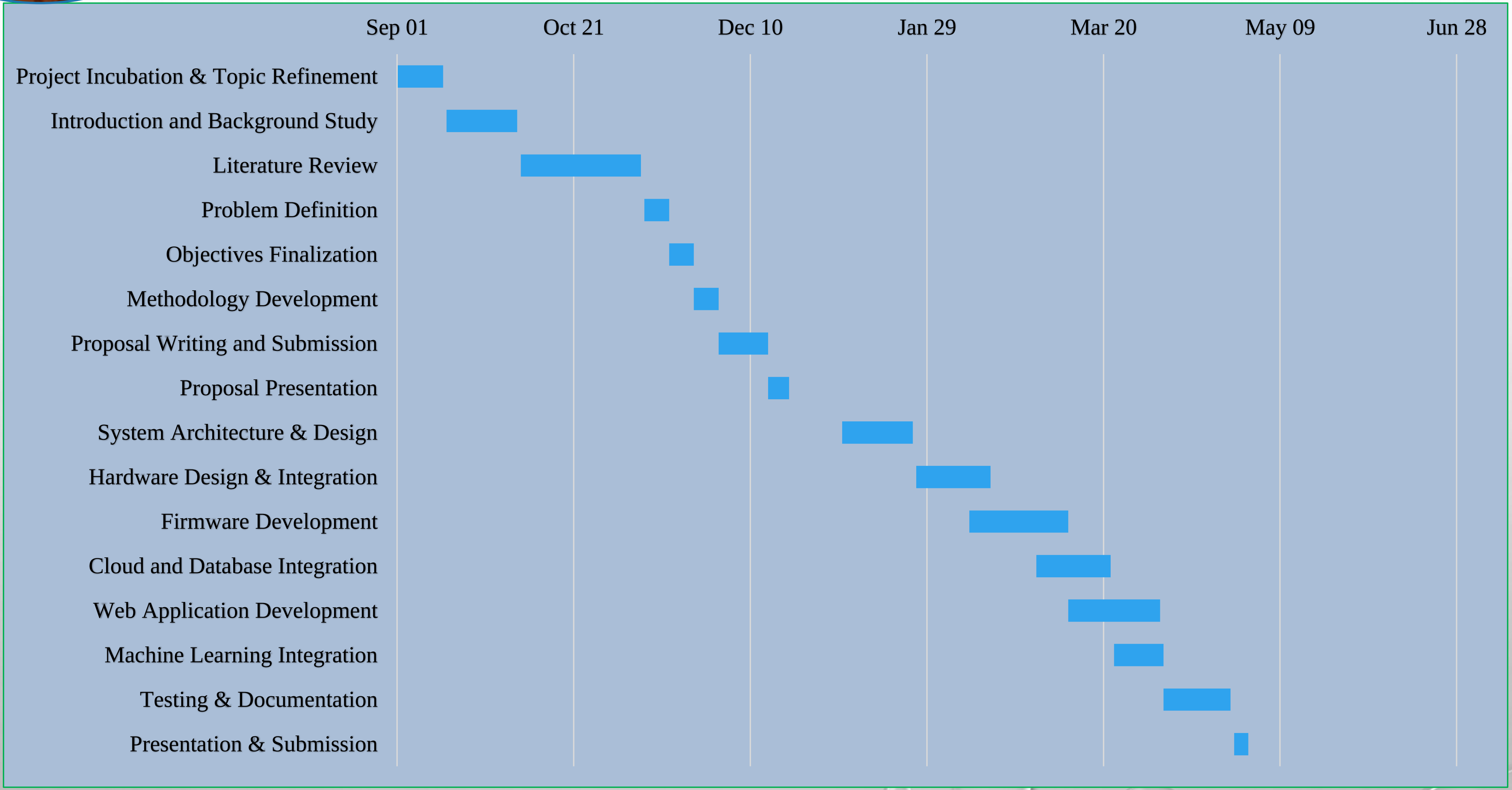
WORK PLAN



Activity	Start Date	End Date	Days
Project Incubation & Topic Refinement	01-Sep-2025	14-Sep-2025	13
Introduction and Background Study	15-Sep-2025	05-Oct-2025	20
Literature Review	06-Oct-2025	09-Nov-2025	34
Problem Definition	10-Nov-2025	16-Nov-2025	7
Objectives Finalization	17-Nov-2025	23-Nov-2025	7
Methodology Development	24-Nov-2025	30-Nov-2025	7
Proposal Writing and Submission	01-Dec-2025	14-Dec-2025	14
Proposal Presentation	15-Dec-2025	21-Dec-2025	6
System Architecture & Design	05-Jan-2026	25-Jan-2026	20
Hardware Design & Integration	26-Jan-2026	16-Feb-2026	21
Firmware Development	10-Feb-2026	10-Mar-2026	28
Cloud and Database Integration	01-Mar-2026	22-Mar-2026	21
Web Application Development	10-Mar-2026	05-Apr-2026	26
Machine Learning Integration	23-Mar-2026	05-Apr-2026	14
Testing & Documentation	06-Apr-2026	25-Apr-2026	19
Presentation & Submission	26-Apr-2026	30-Apr-2026	4

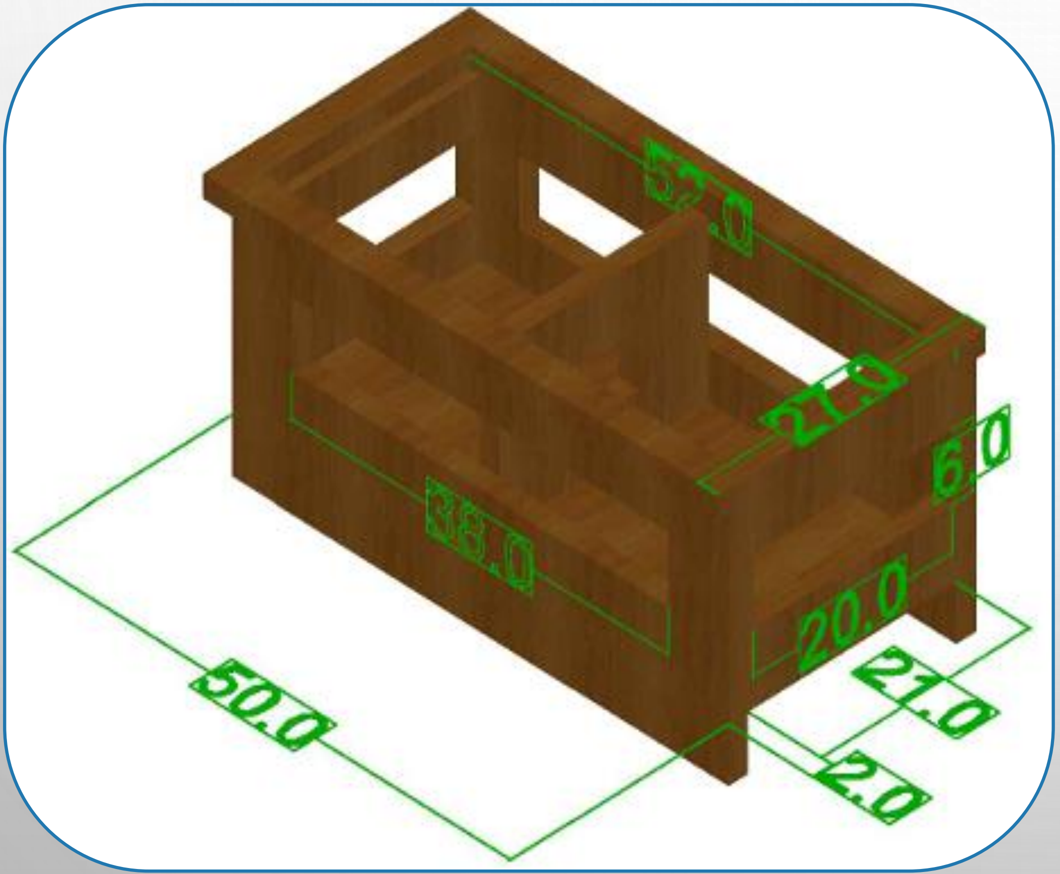
GANTT CHART





Sep 01
Oct 21
Dec 10
Jan 29
Mar 20
May 09
Jun 28
Project Incubation & Topic Refinement
Introduction and Background Study
Literature Review
Problem Definition
Objectives Finalization
Methodology Development
Proposal Writing and Submission
Proposal Presentation
System Architecture & Design
Hardware Design & Integration
Firmware Development
Cloud and Database Integration
Web Application Development
Machine Learning Integration
Testing & Documentation
Presentation & Submission

BUDGET



COMPONENTS	COST
SENSORS	4400
MICROCONTOLLER	1500
POWER SUPPLY UNIT	5900
Miscellaneous	560
CONNECTIVITY	4500
ENCLOSURE	1000
TOTAL	17860

KEY REFERENCES

- ❖ Bagkis et al., *npj Climate and Atmospheric Science*, 2025.
- ❖ Concas et al., *ACM TOSN*, 2021.
- ❖ Garcia et al., *Artificial Intelligence Review*, 2025.
- ❖ Gatari et al., *Atmospheric Chemistry and Physics*, 2018.
- ❖ Ramesh et al., *ICCES*, 2024.
- ❖ Tastan, *Sensors*, 2025.


Thank You