

# RESEARCH PAPER

## **Project ID:**

**Project Title:** Implementation of Safe and Isolated Drainage System with Real-Time Alerts using ESP8266

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## **a. Introduction**

Drainage systems play a crucial role in sanitation, public health, and environmental safety. Open or blocked drains cause flooding, foul odor, mosquito breeding, and can spread waterborne diseases. Traditional systems often fail to provide timely alerts about blockages or open/unsafe drainage covers.

This project will aim to design and test a **smart, safe, and isolated drainage system** using ESP8266 microcontroller and sensors. The system will continuously monitor drainage cover status (open/closed) and detect blockages. If any abnormal condition occurs, an alert will be sent to authorities or users via IoT-based notification.

## **b. Selection of Problem and Background Information**

Unattended or improperly closed drains are a major cause of accidents and public health hazards in many urban areas. Blockages lead to waterlogging, contamination, and infrastructure damage. Manual inspection is inefficient and prone to delays.

By integrating low-cost IoT-based monitoring, it will be possible to implement a safer and more reliable drainage monitoring system that can improve both safety and maintenance efficiency.

### **c. Objective**

**Research Problem / Question:** How can IoT-enabled sensing using ESP8266 help in detecting drainage blockages and unsafe open covers to improve public safety and reduce maintenance delays?

#### **What will be found out:**

- Accuracy of blockage detection using water level/flow sensors.
- Reliability of open/close cover detection using magnetic/limit switches.
- Efficiency of alert notifications via IoT (Wi-Fi / SMS).

#### **Variables:**

- Independent Variables: Type of blockage (partial/complete), drainage cover status (open/closed).
- Dependent Variables: Alert response time, detection accuracy, false alarm rate.
- Controlled Variables: Sensor placement, ESP8266 firmware, drainage dimensions.

**Control in the Study:** A conventional system without sensors (manual inspection) will be used as the control method for comparison.

### **d. Hypothesis**

If ESP8266-based sensors are used to monitor drainage conditions, then blockages and unsafe openings will be detected earlier, and real-time alerts will reduce accidents and delays in corrective action compared with manual inspection.

### **e. Procedure**

**Design of Study:** A prototype drainage unit will be built with ESP8266, water- level/flow sensors, and magnetic switches. Data will be transmitted to a mobile app or cloud dashboard. Alerts will be triggered for abnormal events.

## Materials Required:

- ESP8266 microcontroller (with Wi-Fi).
- Ultrasonic sensor or water flow sensor (to detect blockage/water rise).
- Magnetic reed switch or limit switch (to detect open/closed cover).
- Power supply (battery/adapter).
- Buzzer/LED for local alert.
- Mobile app or cloud dashboard for notifications.
- Small drainage model setup.

## Stepwise Procedure:

1. Assemble ESP8266 with flow/water level sensor inside drainage model.
2. Place magnetic switch on drainage cover to detect open/closed status.
3. Program ESP8266 to read sensor values and transmit alerts via Wi-Fi.
4. Simulate blockage by placing obstacles in the drain model and record detection.
5. Simulate open cover events and measure alert response time.
6. Collect data on detection accuracy, false alarms, and delay times.

## Proposed Data Tables:

**Table A: Blockage Detection Trials**

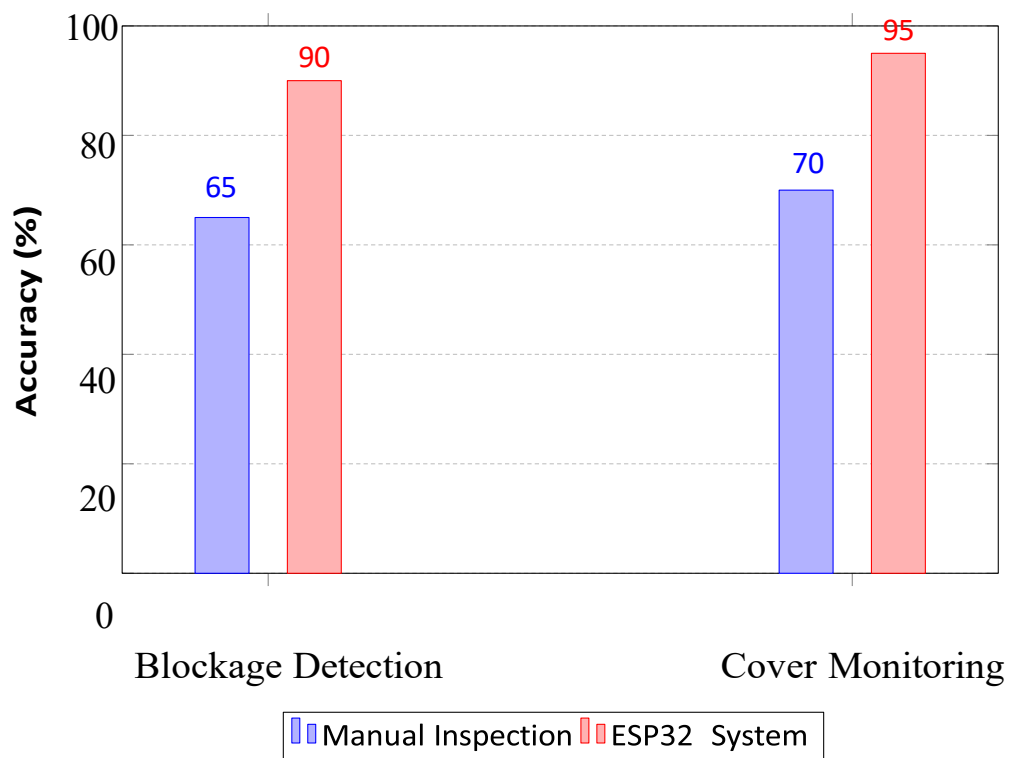
Trial No.	Blockage Type	Ground Truth	System Detection	Correct / Incorrect
1	No Blockage	Clear	Clear	Correct
2	Partial Blockage	Blocked	Blocked	Correct
3	Full Blockage	Blocked	Clear	Incorrect

**Table B: Cover Status Monitoring**

Trial No.	Cover Status (Ground Truth)	System Detection	Alert Sent
1	Closed	Closed	No
2	Open	Open	Yes
3	Half-Closed	Open	Yes

**Graphical Representation**

**Accuracy Comparison – Manual Inspection vs ESP32-based Smart Drainage System**



## **f. Risk and Safety**

- Low-voltage ESP8266 circuit ensures electrical safety.
- Testing will be carried out on a scaled-down drainage model, not actual sewage.
- Alerts will be simulated via Wi-Fi/mobile app only.

## **g. Data Analysis**

- Detection accuracy will be calculated as percentage of correct alerts.
- False alarm rate will be analyzed for both blockage and cover detection.
- Response time from event occurrence to alert notification will be measured.
- Graphs will be plotted for accuracy comparison (system vs manual inspection).

## **REFERENCE**

1. Espressif Systems. *ESP8266 Technical Reference Manual*.
2. Singh, R. et al. "IoT-based smart drainage monitoring systems." *International Journal of IoT and Applications*.
3. Open-source IoT libraries documentation for Arduino/ESP8266.