PROJECT PROPOSAL

IOT-ENABLED INDOOR FLOOD ENTRY MONITORING AND ALERTING SYSTEM FOR RESIDENTIAL SAFETY

EC6020: EMBEDDED SYSTEMS DESIGN

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TITLE

IoT-Enabled Indoor Flood Entry Monitoring and Alerting System for Residential Safety.

INTRODUCTION

Indoor flooding is a serious and often unexpected problem in residential buildings, especially during periods of heavy rainfall. In many situations, flooding does not occur suddenly during the daytime but develops silently over several hours, particularly at night when occupants are asleep or unaware of the situation.

In one such incident, after a night of continuous rainfall, the intensity of the rain was not clearly noticed. However, upon waking up in the morning, the entire room was found to be filled with water. Important items such as documents, electronic devices, and personal belongings were completely wet and damaged before any preventive action could be taken. This experience clearly highlights the lack of early warning mechanisms for indoor flood entry.

Existing flood detection methods mainly rely on manual observation or simple water contact sensors, which either detect flooding too late or generate false alerts due to splashes and moisture. Therefore, there is a strong need for a reliable system that can detect rising indoor water levels early and notify users in real time.

To address this problem, this project proposes a dual-sensor, wireless indoor flood monitoring and alert system using a water level sensor, a non-contact ultrasonic sensor**,** ATmega328-based local processing**,** RF wireless communication, and an ESP01 IoT gateway to provide timely alerts through a mobile application.

DESIGN OVERVIEW

1. SYSTEM ARCHITECTURE

The proposed system follows a two-node architecture consisting of a sensor node and a gateway node.

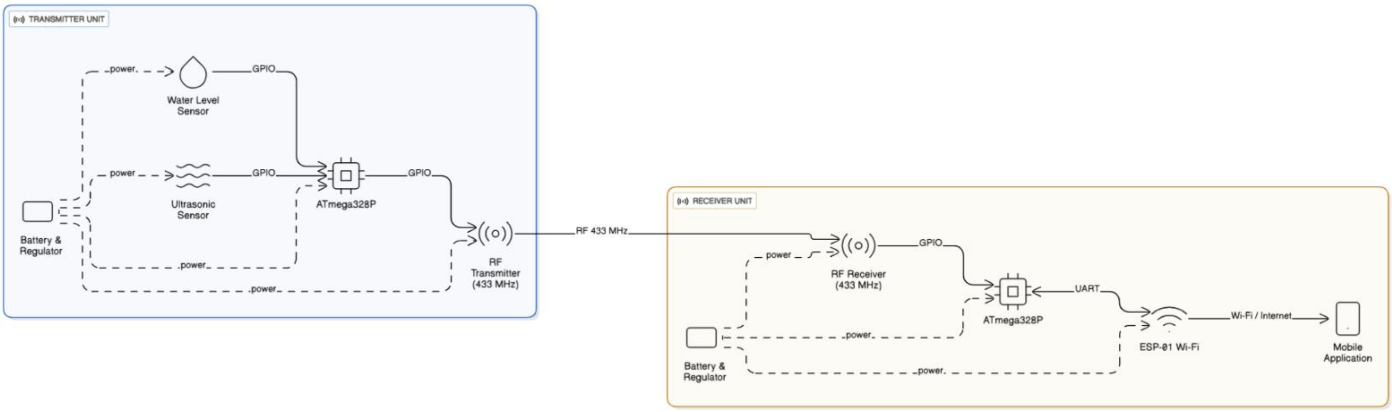
Sensor Node (Processing Unit):

- Water Level Sensor: Confirms the presence of water.
- Ultrasonic Sensor: Measures water height without contact.
- ATmega328: Processes sensor data and confirms flood conditions.
- 16 MHz Crystal Oscillator: Provides accurate clock timing for the microcontroller.
- AMS1117 Voltage Regulator: Supplies stable operating voltage to the circuit.
- RF Transmitter: Sends flood alerts wirelessly.

Gateway Node (Communication and Alert Unit):

- RF Receiver: Receives wireless flood alert.
- ATmega328: Validates received RF data.
- 16 MHz Crystal Oscillator: Ensures stable timing for data processing.
- AMS1117 Voltage Regulator: Maintains reliable power supply for the receiver unit.
- Mobile Application: Notifies the user in real time about indoor flooding.
- ESP01: Sends alerts to the mobile application via Wi-Fi.

This architecture separates sensing, decision-making, wireless communication, and IoT connectivity, improving reliability and scalability.



<u>FIGURE 01: HIGH LEVEL SYSTEM ARCHITECTURE DIAGRAM OF THE INDOOR FLOOD MONITORING AND ALERT SYSTEM.</u>

2. PROTOCOLS

1. **Custom / Raw RF Signaling :**
   Used to wirelessly transmit flood alert signals from the sensor-node ATmega328 to the gateway-node ATmega328 over a short distance.

2. **GPIO-Based Signaling :**
   Used to interface the water level sensor and ultrasonic sensor with the ATmega328 for reading water presence and water level data.

3. **SPI (Serial Peripheral Interface) :**
   Used for high-speed communication between the ATmega328 and the RF transmitter/receiver modules.

4. **UART (Universal Asynchronous Receiver Transmitter) :**
   Used to transfer validated flood alert data from the gateway ATmega328 to the ESP01 module.

5. **Wireless LAN Protocol :**
   Used by the ESP32 to connect the system to the internet for remote monitoring and alert delivery.

6. **HTTP (Hypertext Transfer Protocol) :**
   Used to send flood alert information from the ESP01 to the web server or cloud platform.

7. **AJAX (Asynchronous JavaScript and XML) :**
   Used in the mobile or web application to fetch and update flood alert data in real time without refreshing the page.

3. CIRCUIT DESIGN

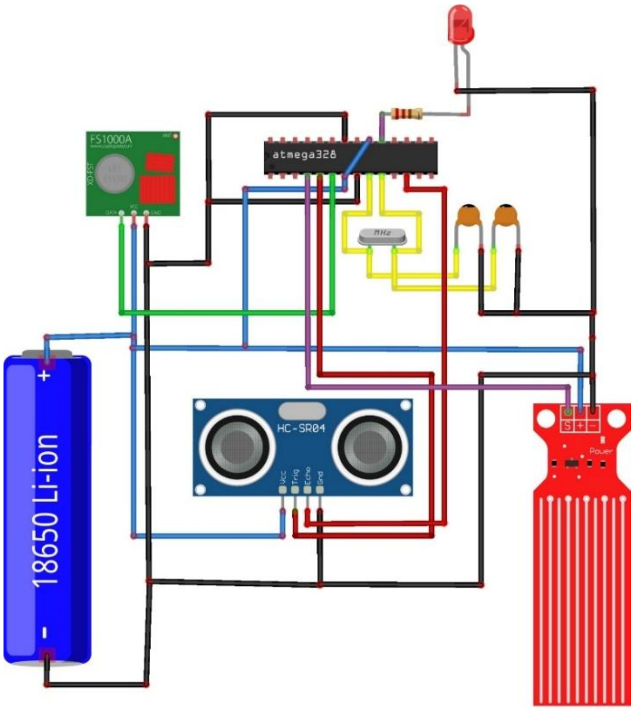


FIGURE 02: TRANSMITTED SIDE OF THE INDOOR FLOOD MONITORING AND ALERT SYSTEM.

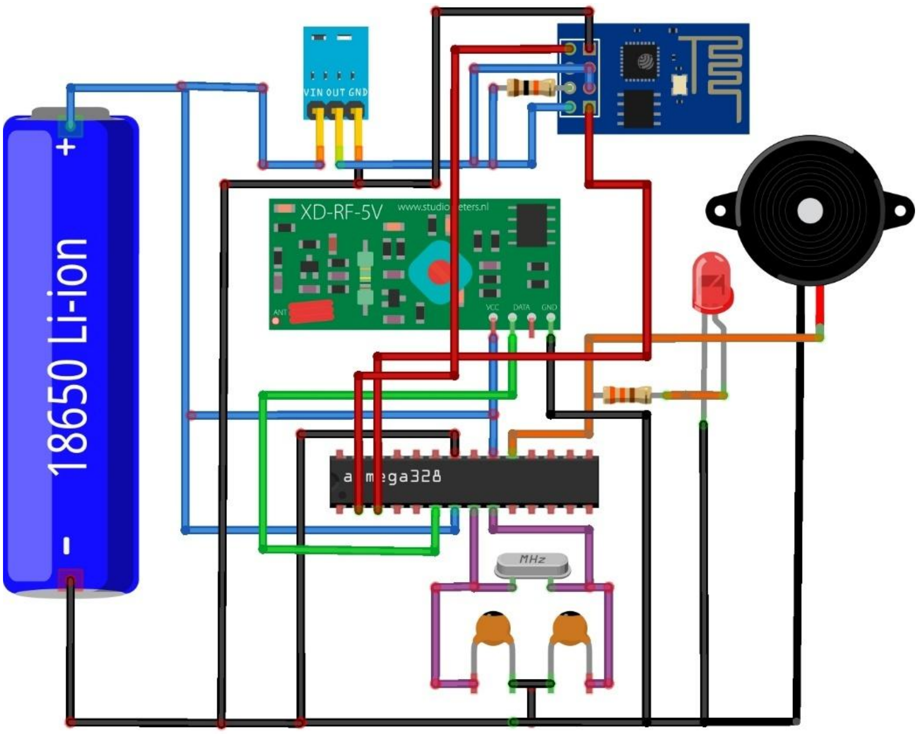


FIGURE 03: RECIEVER SIDE OF THE INDOOR FLOOD MONITORING AND ALERT SYSTEM.

TECHNOLOGIES

Hardware Components

- Ultrasonic Sensor (HC-SR04)
- Water Level Sensor Module
- ATmega328 Microcontroller (2 units)
- RF Transmitter and Receiver Modules
- ESP-01 Wi-Fi Module (ESP8266)
- Buzzer
- LED
- Lithium iron Battery
- 16MHz Oscillator
- AMS 1117 Voltage regulator

Software Technologies

- Arduino IDE
- Embedded C / C++
- ESP8266 Wi-Fi Libraries
- IoT Platform
- Mobile Application Dashboard
- Ubuntu

INNOVATION

The proposed system is innovative due to the following features:

1. **Dual-Sensor Validation**
   Water presence is confirmed using a water level sensor, while water height is measured using an ultrasonic sensor, reducing false alerts.

2. **Non-Contact Water Level Measurement**
   Ultrasonic sensing avoids direct contact with water, increasing durability and accuracy.

3. **Event-Driven RF Communication**
   Wireless transmission occurs only when a flood condition is confirmed, minimizing RF noise and power consumption.

4. **Low-Cost, Non-Development-Board Design**
   The system avoids development boards and uses bare microcontrollers and discrete RF modules for a low-cost, power-efficient, and hardware-oriented design.

BUDGET

Component	Quantity	Unit Cost (LKR)	Total Cost (LKR)
ATmega328P Microcontroller	2	750	1,500
RF Transmitter & Receiver Module (433 MHz)	1	280	280
ESP-01 Wi-Fi Module (ESP8266)	1	550	550
Water Level Sensor	1	100	100
Ultrasonic Sensor (HC-SR04)	1	240	240
AMS1117 Voltage Regulator	1	60	60
Capacitor (22 pF)	4	5	20
16 MHz Crystal Oscillator	2	35	70
LED	2	5	10
Resistors	3	5	15
Lithium-Ion Battery	2	350	700
Total Estimated Cost			**Rs. 3,545.00**

Table 1: Required Components & Cost Estimation

TIMELINE

Activity	Weeks										
	4	5	6	7	8	9	10	11	12	13	14
Research and requirement analysis											
System architecture design and planning											
Circuit design and component procurement											
Hardware assembly and initial firmware development											
Sensor integration and communication protocol implementation											
IoT integration and cloud communication setup											
Mobile/Web application development											
App and hardware integration											
System testing and user interface refinement											
Final integration, documentation, and project submission											

Table 2: Timeline for Project