

Smart Home Security System– Final Implementation

Group - 6
Tue/Thu - Batch

Abstract

The "Smart Home Security System," designed for single homeowners, combines motion sensors for intrusion detection, RFID technology for automatic door access control, and water sensors for leak detection. The fundamental hardware is the BeagleBone Black, which includes LED indications, a steady power source, and SD card storage. FreeRTOS, C programming, and custom home security software are examples of software. We prioritise comfort and security by providing scheduled intrusion detection, automated door locking/unlocking, and real-time monitoring. This project provides modern security and automation capabilities to homeowners, boosting their peace of mind.

Presented by Group 6

Project Overview

Designed to provide single homeowners with a complete automation and security system that takes into account their own lifestyle needs, the "Smart Home Security System" is a personalized solution. This technology is designed to make the life of single homeowners easier while improving the security of their homes. The functionalities are as follows:

01

Intrusion Detection
using PIR Motion
Sensors

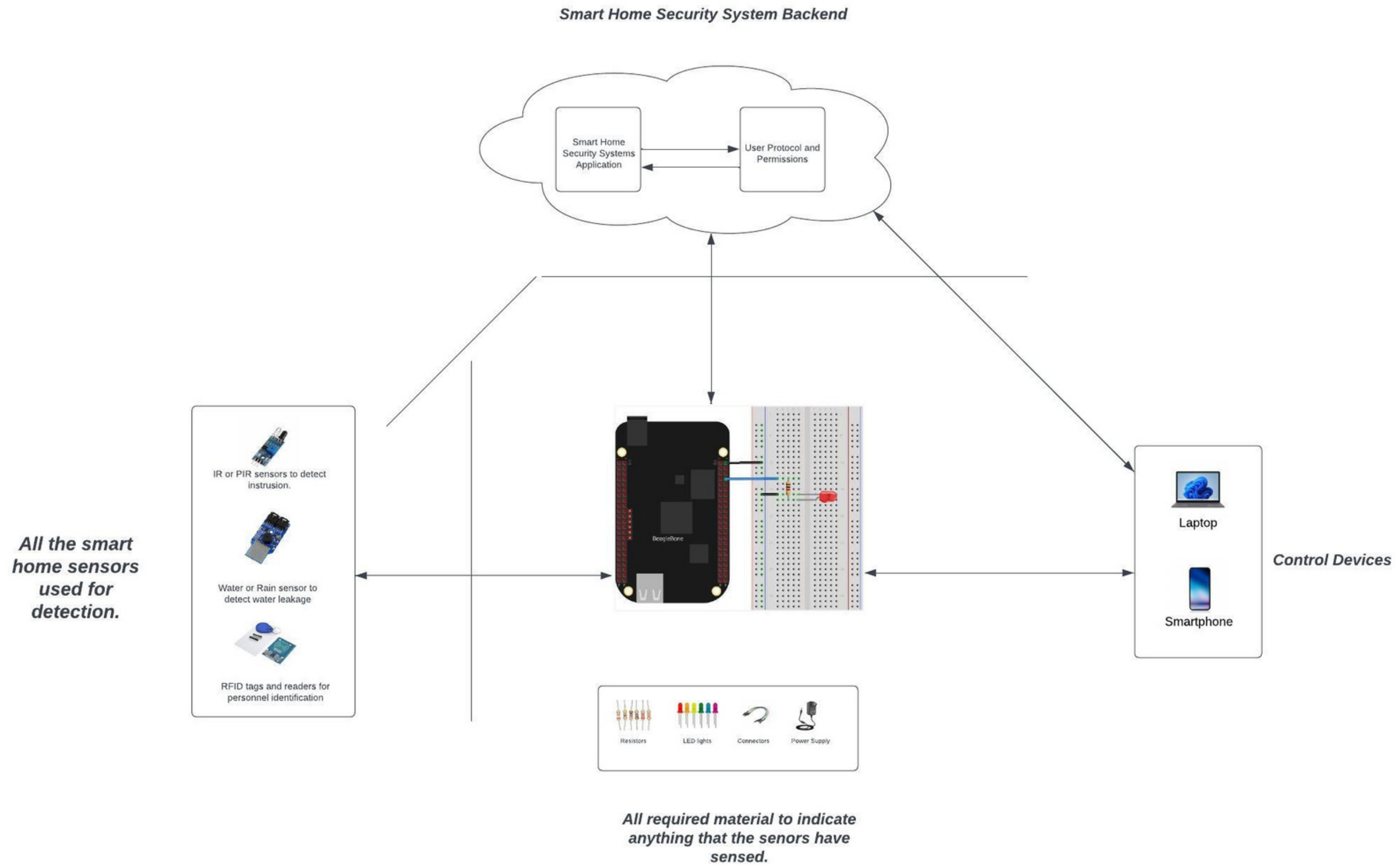
02

Locking/Unlocking of
Doors

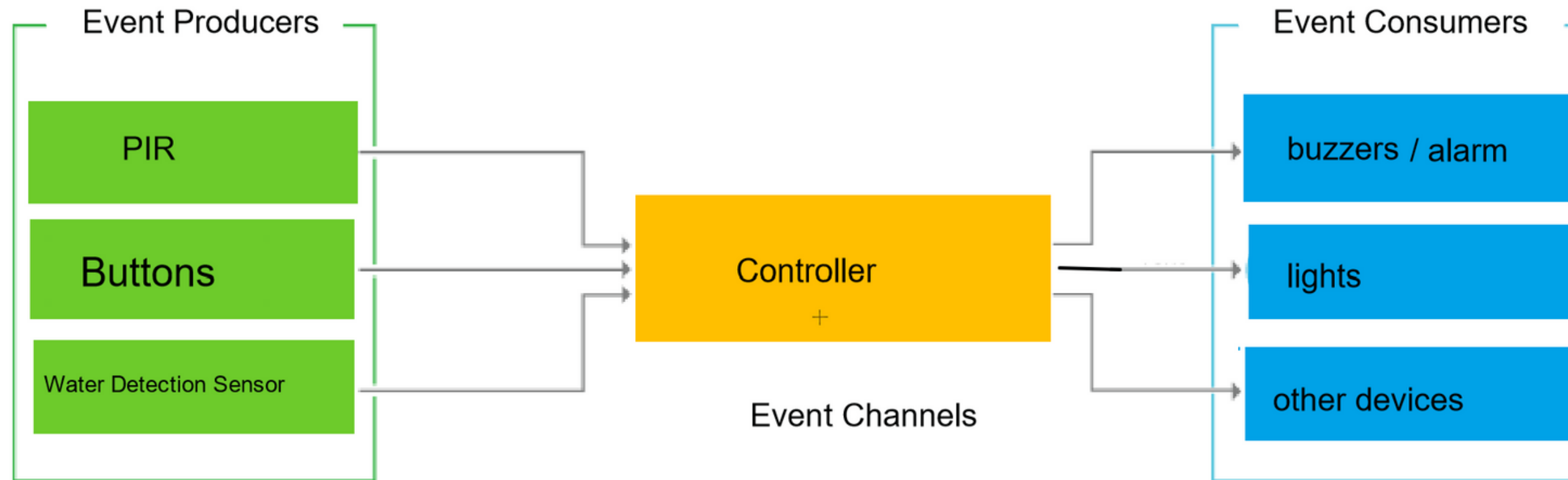
03

Water Leakage Detection

Hardware Architecture



Software Architecture



We have followed an Event-Driven Architecture for our system. The above diagram describes the flow of our architecture.

Design Decisions

The Design decisions taken are as follows:

- BeagleBone Black serves as embedded system
- C Language has been employed for embedded system programming
- PIR motion sensors for intrusion detection
- Water/Rain Sensors for water leakage detection
- Buttons for a unique locking pattern for personnel identification
- Buzzer and Red LED light for alerts - These are used by the PIR sensor and the water detection sensor.

Intrusion Detection using PIR Motion Sensors

- PIR sensors are strategically placed within a pet-free house, inconspicuously located at various points.
- Doors can be locked by the user, activating the Intrusion Detection System.
- In the active mode, any motion detected by the PIR sensor is treated as an intrusion, triggering the alarm.
- A single PIR sensor is used in the prototype, scalable for future implementations.
- Operating in Single Trigger mode.
- Time Delay set to the minimum for ease of modification in the C code.
- Sensitivity adjusted to the minimum for initial testing purposes.

Intrusion Detection using PIR Motion Sensors

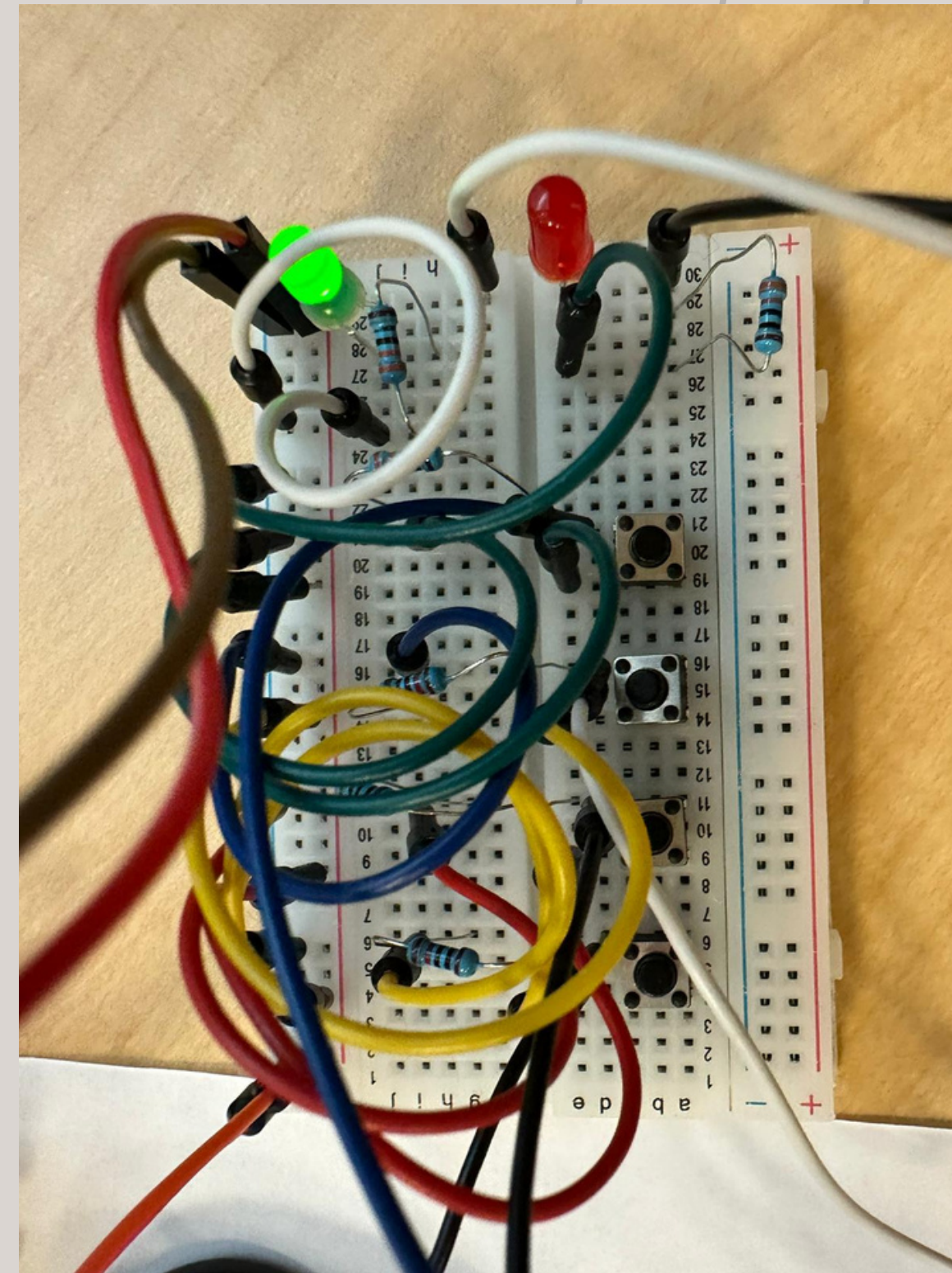
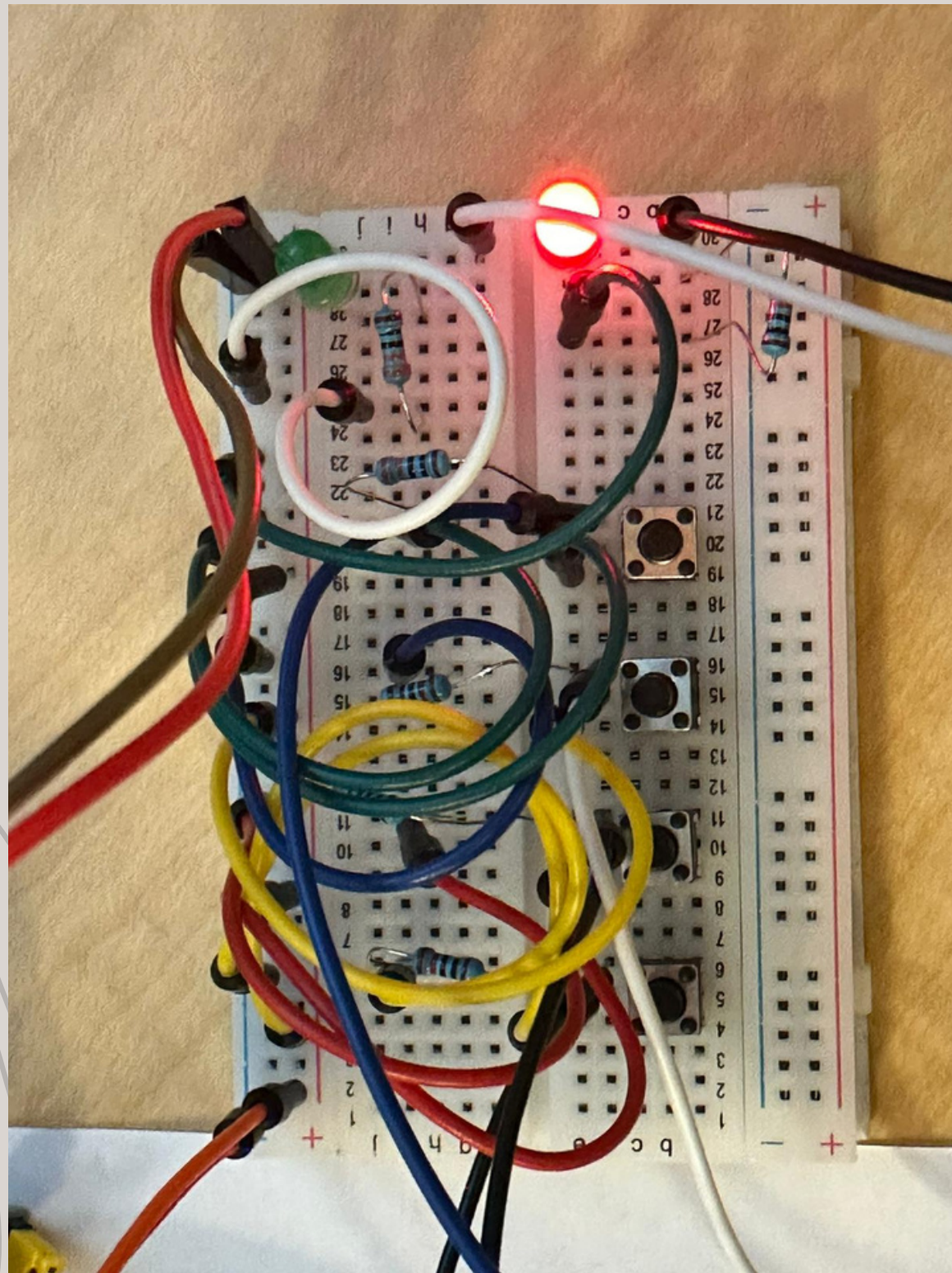
The PIR sensor having a Detection range of up to 7 meters and the Detection angle of 110 degrees, any small motion in its field would easily trigger the sensor. This made working with the sensor difficult for prototyping. Hence the sensitivity is set to the minimum possible value for the prototype and can be adjusted at any time to a practical value when implemented in a real setting.



Locking and Unlocking of Doors

- We implemented a button-based system for locking and unlocking.
- Utilized 4 buttons (1, 2, 3, 4) and 2 LEDs (Red for lock state, Green for unlock state) to simulate the smart home security system.
- To activate the Smart Home Security System and lock it, the user must press and hold button 1 for a minimum of 5 seconds.
- The system prints "LOCKED" on the terminal, and the Red LED is turned ON while the Green LED remains OFF.
- To deactivate the security system and unlock, the user needs to input a specific button sequence: 1, 3, 4, 2.
- Successfully entering this sequence prints "UNLOCKED" on the screen, and the Green LED is turned ON, while the Red LED is turned OFF.
- Red LED signifies the lock state, and its activation corresponds to the system being locked.
- Green LED indicates the unlock state and is activated when the system is successfully unlocked.

Locking and Unlocking of Doors

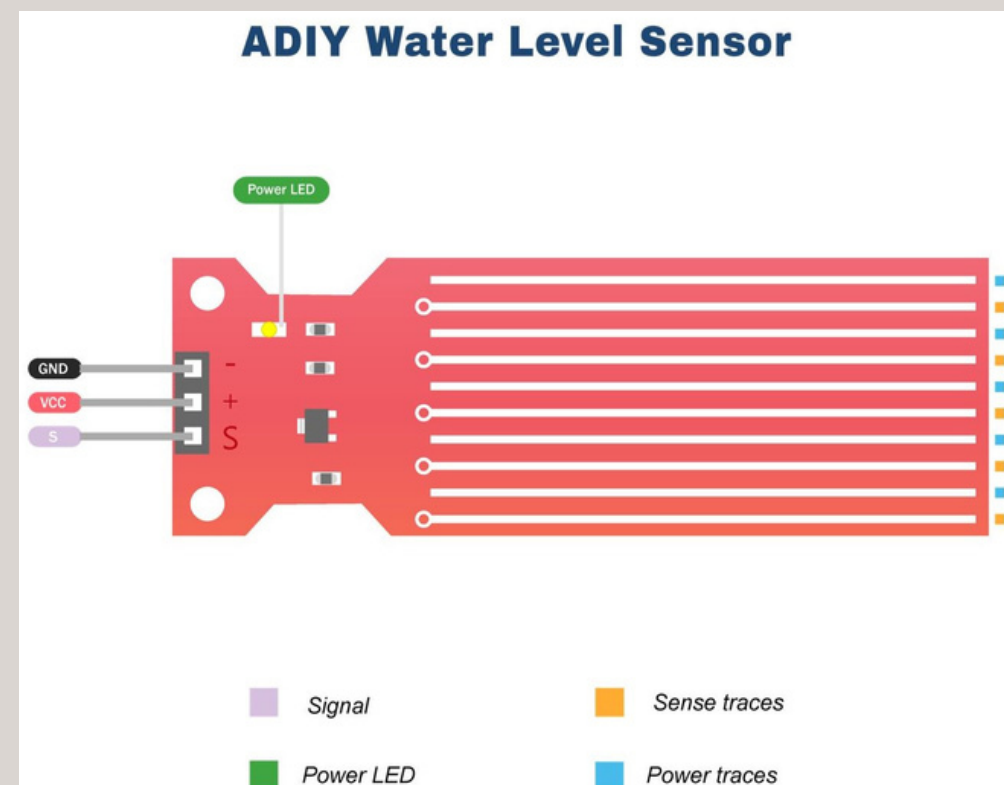


Water Leakage Detection

- The sensor is designed to detect the presence and depth of water.
- The water level sensor can be utilized for various applications, including measuring water levels, monitoring sump pits, detecting rainfall, and identifying leaks.
- The sensor includes a total of ten copper traces and features a Power LED that illuminates when the board is powered.
- We set a threshold for the sensor at 1mm, and if the reading reaches or exceeds this value, we identify it as a water leakage.
- The sensor generates an output voltage that is proportional to the resistance.
- By measuring this voltage, the water level can be determined.

Water Leakage Detection

- We activate a buzzer, trigger a timing mechanism, and illuminate a red light upon detecting water leakage, regardless of whether the system is in a locked or unlocked state.
- The sensor has a simple three-pin configuration:
 - **S (Signal)**: Analog output pin connected to a Beagle Bone analog input.
 - **+ (VCC)**: Power pin, recommended to be supplied with 3.3V to 5V.
 - **- (GND)**: Ground pin.
- The board includes a Power LED that indicates when the sensor is powered.



Planned VS Actual Accomplishments

- The proposed functionalities were successfully implemented as planned, with the exception of one feature that required a minor adjustment.
- Originally, we aimed to create a smart door unlocking system utilizing RFID tags and readers, specifically the MFRC522 Reader operating at 13.56 MHz.
- However, we encountered challenges in interfacing the RFID reader with the BeagleBone Black due to a lack of proper support/packages.
- Consequently, we opted to implement an alternative function using four buttons (labeled 1, 2, 3, and 4) and two LEDs (Red for the lock state and Green for the unlock state).
- This feature allows the system to be locked or unlocked based on a specific button sequence, serving as a reliable substitute for the original RFID-based approach.
- Despite the initial setback, the modified solution effectively achieves the desired functionality.

The background is a light gray color. It features several decorative elements: wavy lines in the top-left and bottom-right corners, and a series of concentric, irregular circles in the top-right corner.

**Thank
You**