

Smart lock

Fsoft IoT challenge 2022
Team Optimization



Overview

- Topic: Smart door lock with wireless unlocking and additional features for prevention of COVID-19.
- Features:
 - Remote locking and unlocking from smartphone through Bluetooth.
 - Fever detection through sensing entering person's body temperature.
 - Person counting, limiting maximum number of people in the room.
 - Automatic light switching only when there are people in the room.
- System used: Silicon Labs BGM220 Bluetooth explorer kit.

Components used

Lock servo

Tower Pro SG09

- Operating voltage: $3 \div 6$ V.
- Operating current: 550 mA.
- Connections: power (black & red), PWM signal (yellow).
- Control method: pulse width modulation
 - Frequency: 50 Hz
 - Pulse width: $0,5 \div 2,4$ ms corresponding to two extremes.
- Control implementation on mainboard: Silicon Labs' PWM driver through GPIO pin.
- Usage: door latch actuator for locking and unlocking.



Components used

Proximity sensor

E3F-DS10C4

- Operating voltage: $5 \div 36$ V.
- Operating current: 300 mA.
- Detection range: 30 cm.
- Connections: power (blue & brown), signal (black).
- Sensing method: sending and detecting reflected infrared light at close range.
- Signaling method: high when no object in front present, low when present.
- Reception implementation on mainboard: reading through an input GPIO pin.
- Usage: detector for people passing through the door.

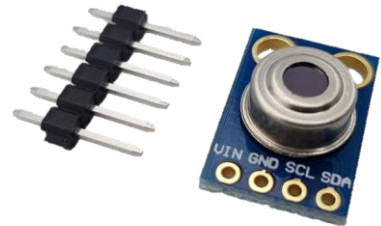


Components used

Temperature sensor

MLX90614

- Operating voltage: 5 V.
- Operating current: 1,3 mA.
- Connections: power (2 pins), I²C (2 pins).
- Sensing method: detect infrared radiation from objects to determine temperature.
- Signaling method: I²C.
- Reception implementation on mainboard: periodic temperature reading requests through two I²C pins.
- Usage: sensor for body temperatures of people entering the room to detect fever.



The temperature sensor needs to have a high accuracy so as to reasonably accurately determine whether a person is having fever or not when entering the room.

Components used

OLED screen

- Operating voltage: $2,2 \div 5,5$ V.
- Operating current: 8 mA.
- Resolution: 128 . 64.
- Connections: power (2 pins), I²C (2 pins).
- Control method: I²C.
- Control implementation on mainboard: sending commands and data through two I²C pins.
- Usage: display for status and user interface messages.



Components used

Buzzer

Prebuilt module with driving components

- Operating voltage: $3,3 \div 5$ V.
- Connections: power (2 pins), signal pin.
- Control method: raise signal pin high to activate the buzzer.
- Control implementation on mainboard: push, pull an output GPIO pin with pulsing for various sound signal styles.
- Usage: sound signal for system events.



Components used

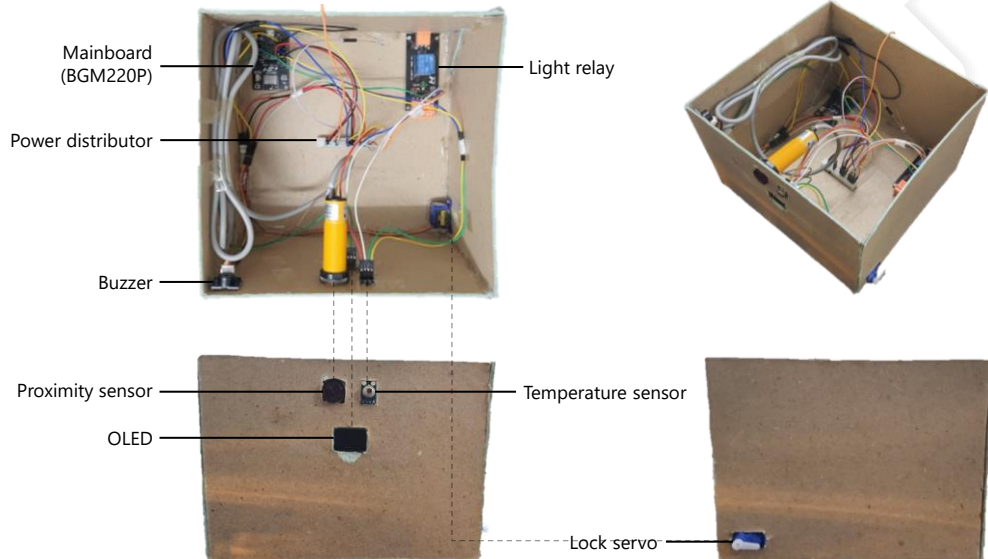
Light relay

RL1-0510

- Operating voltage: 5 V.
- Connections: logic power (2 pins), relay power (2 pins), signal pin, switch contacts (3 pins).
- Control method: raise signal pin high to close the normally-open gate and open the normally-closed gate.
- Control implementation from mainboard: push, pull an output GPIO pin.
- Usage: controller for room lighting, only illuminate when there are people in the room.



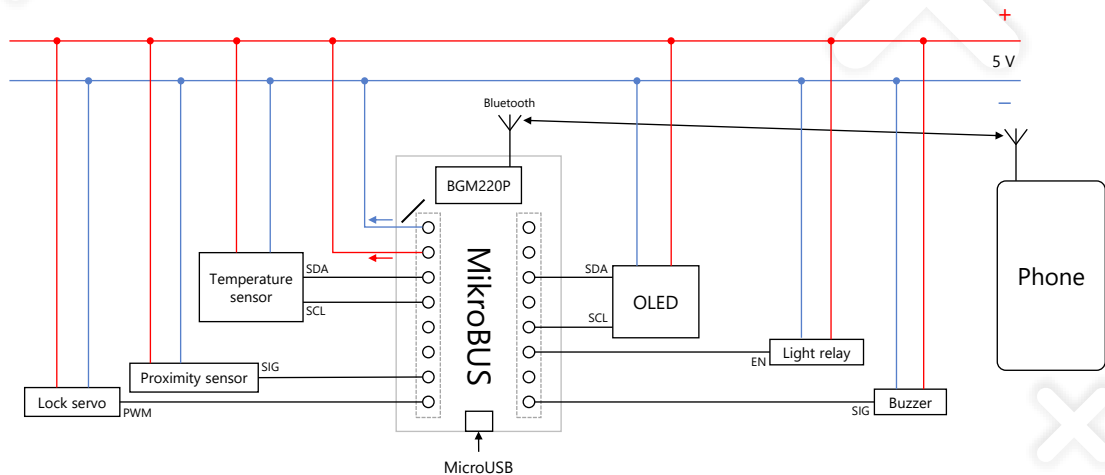
Prototype



The prototype's housing is made of cardboard, with components mounted through tight-fitting, taping or screwing. Wires are bundled and taped for better appearance and easier management.

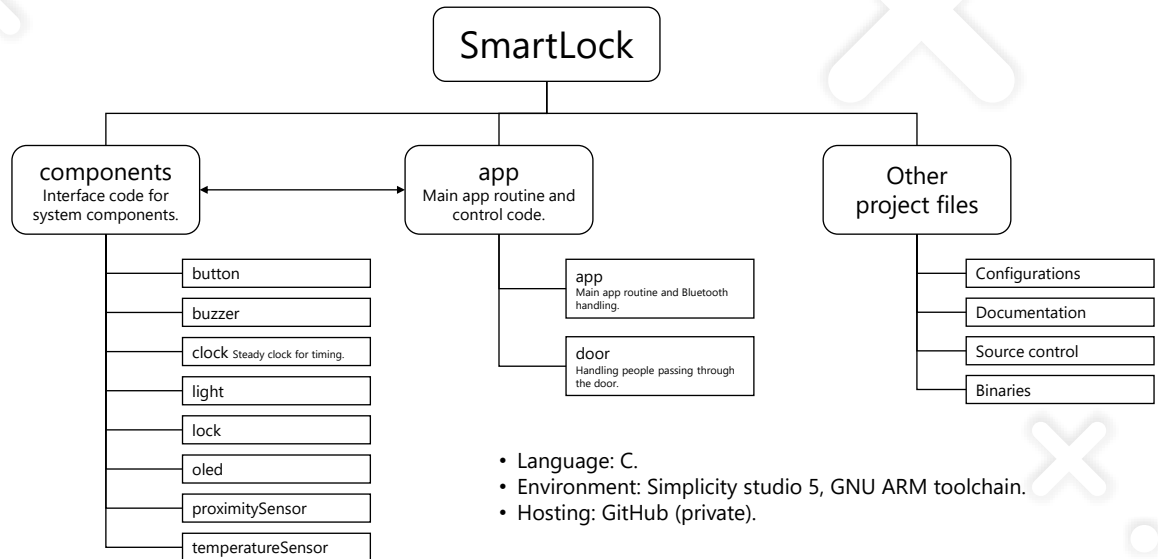
The lock servo is left bare, in application it should be connected to the door's latch or the servo can be replaced by a dedicated door security device which is then commanded by the mainboard.

Wiring diagram

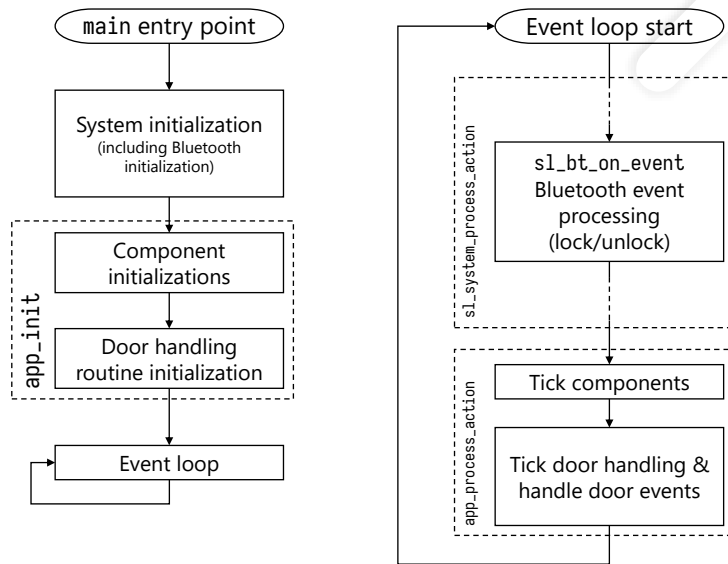


The whole system's power comes from the MicroUSB port plugged to the mainboard, then it is sent through two 5 V power pins on the mainboard to a power distributor for the system components to utilize.

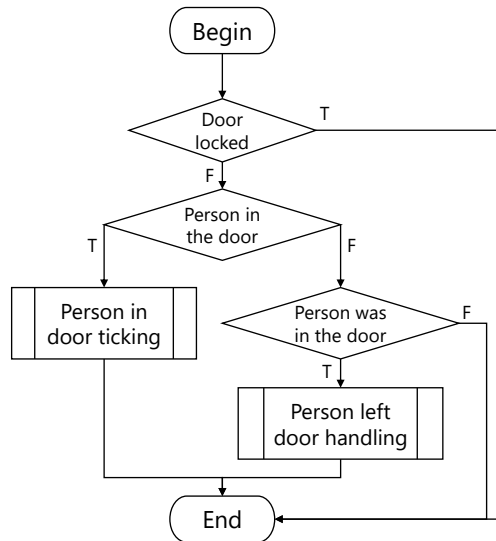
Mainboard codebase overview



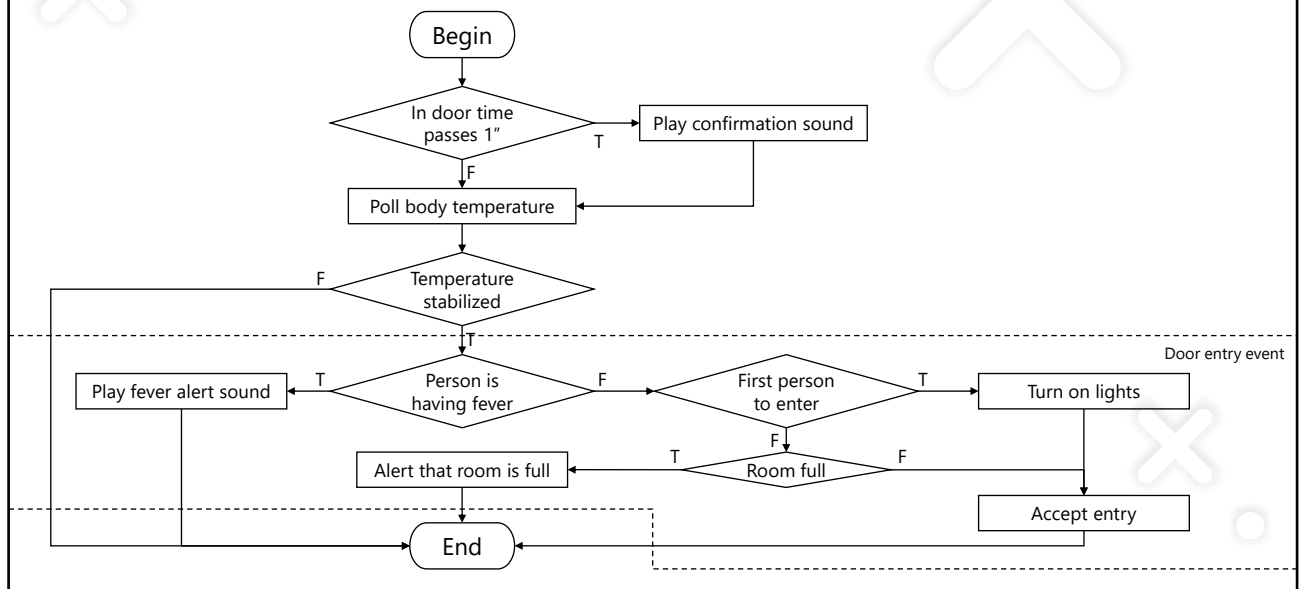
Mainboard code routine



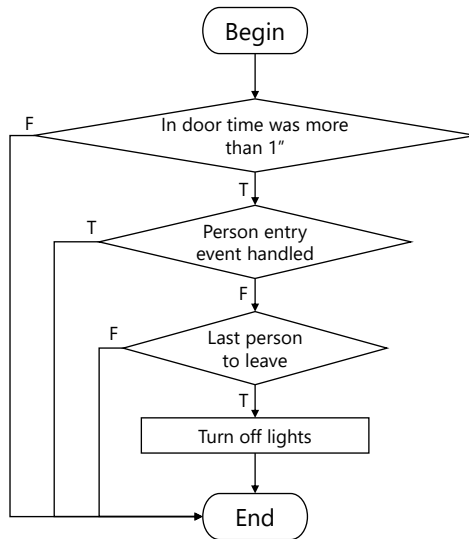
Door handling routine



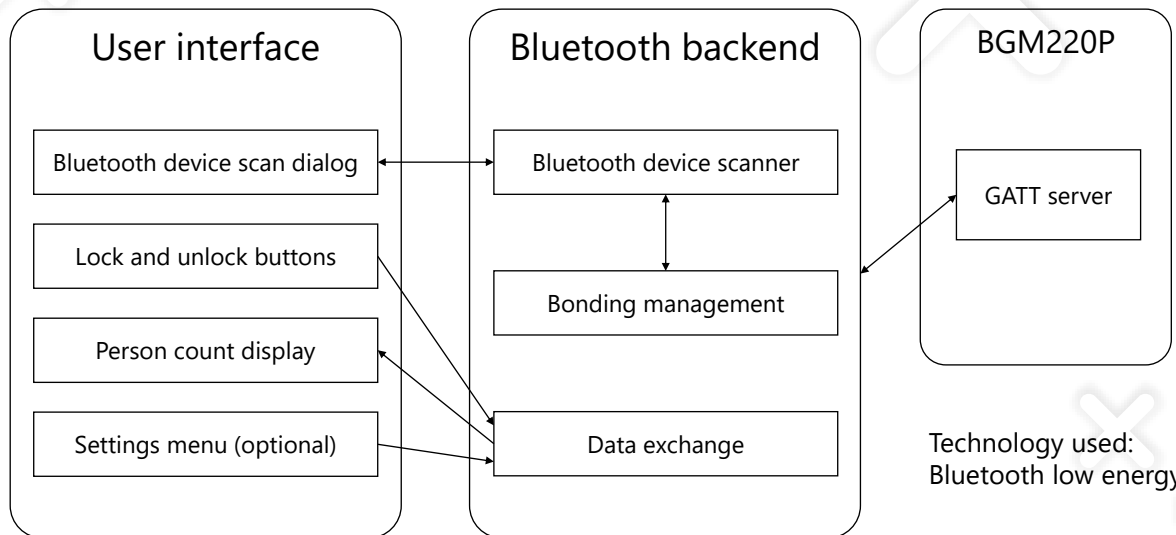
Person in door ticking



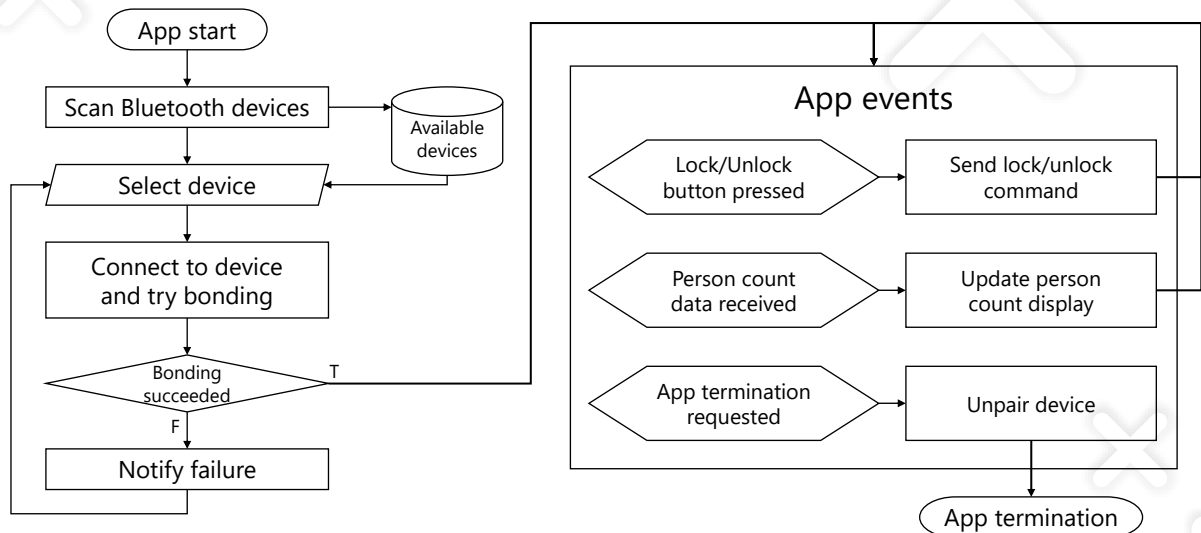
Person left door handling



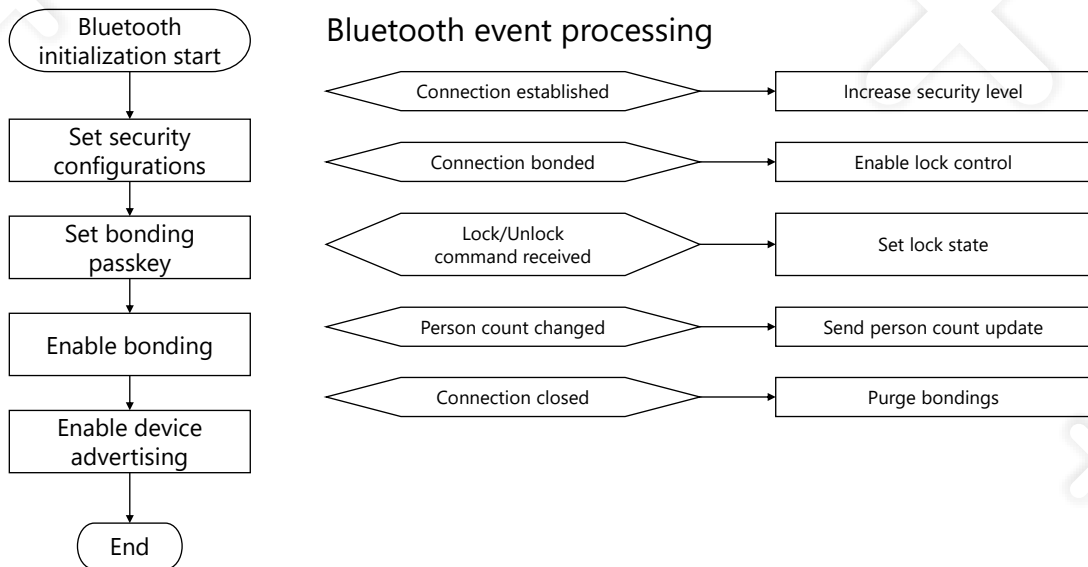
Bluetooth control app overview



Bluetooth control app routine



Mainboard Bluetooth routine



Issues

The phone app needs more features.

- Including admin management, setting authentication password and person limit, statistics reporting.
- Unable to implement due to time constraints.

Person entry/exit detection is not ideal.

- Relies on the person willingly standing still at the door for the required amount of time for reasonably reliable detection.
- May use multiple sensors or a camera; can use a body temperature sensor with better range; ...

No mechanic to prevent entry when entry is rejected.

- Thus relies on the rejected person to not enter anyway.
- Implementation may require specialized mechanisms.

Such mechanism for only allowing entry when approved can be a barrier only allowing one person to pass at a time when allowed (otherwise it's locked).



Thank you
for listening.