Group Members

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Project Description

We will build a puzzle box that requires the user to interact with it in novel ways to unlock and reveal the prize inside. The box will have a GPS, a knock detector piezo sensor, a gyroscope, and a photo resistor hidden inside. Markings on the outside of the box will guide the user to interact with the various inputs to solve puzzles. A buzzer inside the box and LED indicators will provide active feedback to the user. There will be four puzzles, once all the puzzles are solved a solenoid will unlock the box from inside.

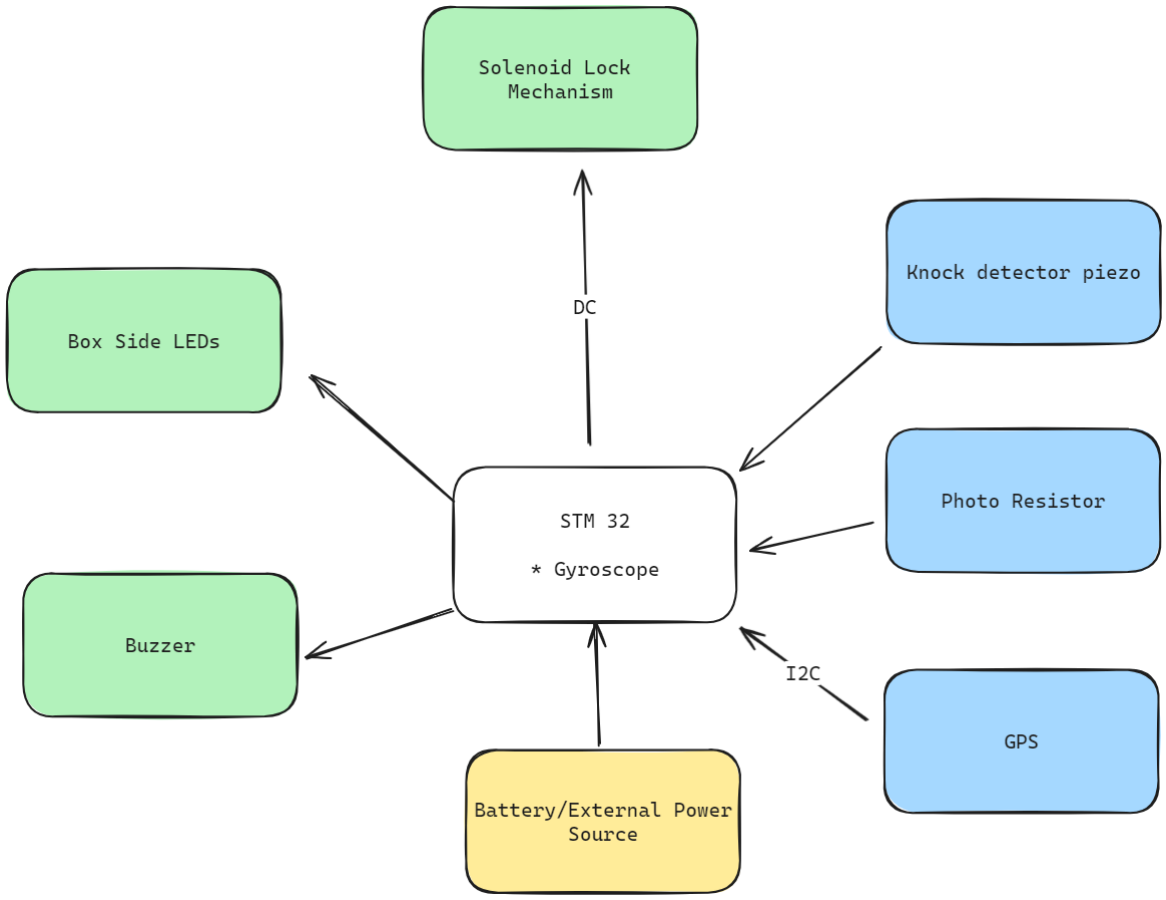
Puzzle ideas include tilting the box to a certain orientation, moving the box a specific distance, knocking on the box in a specific pattern, and shining a light through a small hole in the box.

Motivation

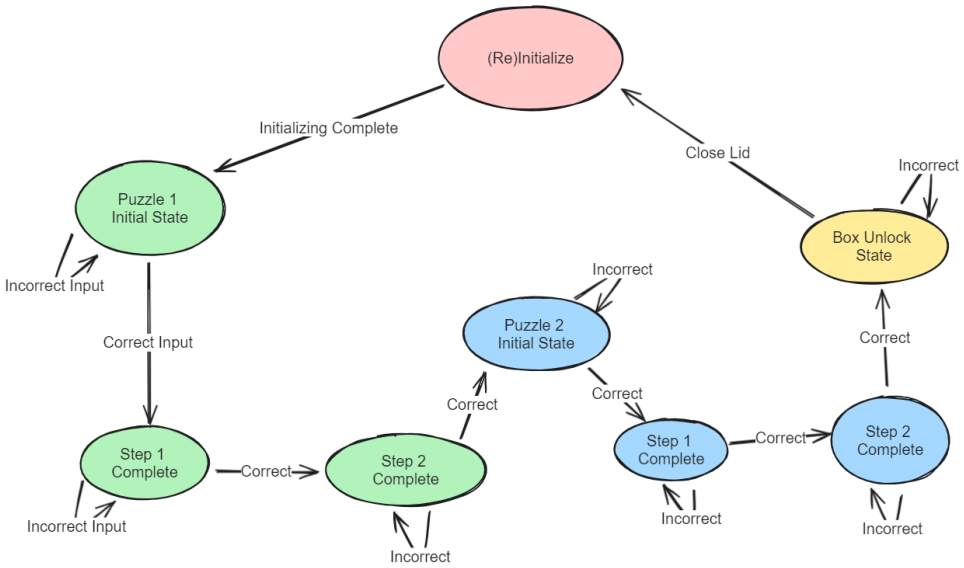
We chose this project idea because it seemed like a very flexible way to get experience with a lot of different sensors and actuators. We also thought it would be a creative and unique concept to explore, combining both embedded systems and game design. We have selected unconventional user interfaces that use technology to challenge the user to think creatively to solve puzzles.

Block Diagram

Hardware Components



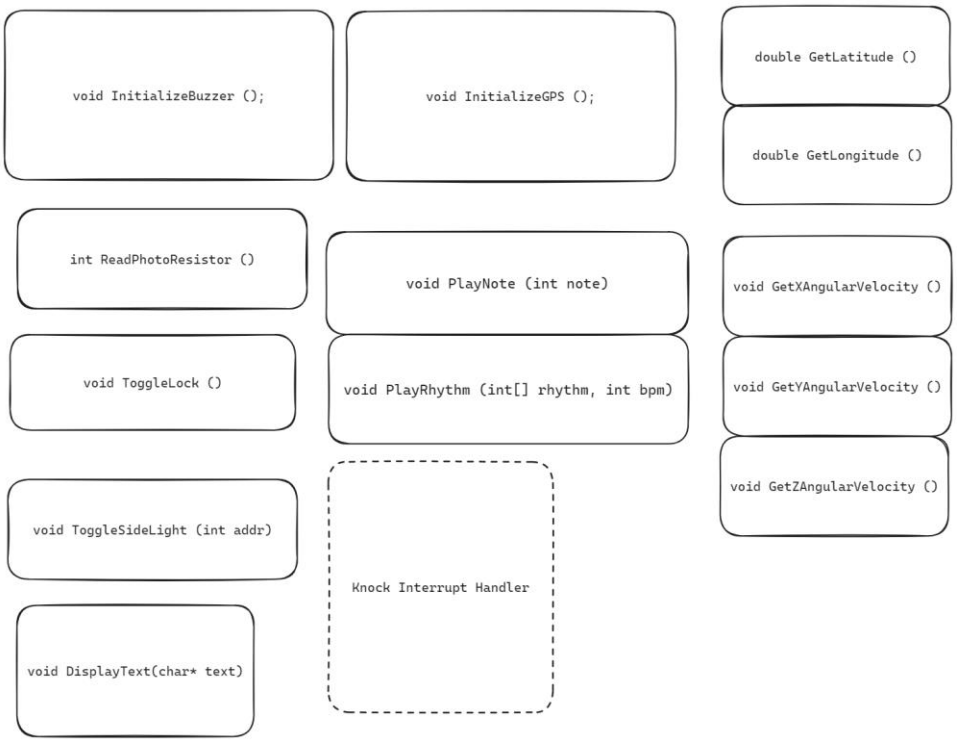
Software State Machine



Note: the state machine diagram shows only *two* puzzles for simplicity, *it can* be extended to include more steps and/or more puzzles.

Note: “Box Unlock State” does not necessarily have an incorrect action, it just ignores further input

Software Units



Milestones

Milestone 1

Primary Goal: Communication with the piezo sensor, and buzzer.

- Buzzer can play a rhythm
- Main loop switch statement for state machine

Secondary Goals:

- Piezo sensor can detect a pattern of taps
- Obtain parts
- Puzzles designed

Milestone 2

Primary Goal: Communication with accelerometer for rotation puzzle.

Main state machine architecture complete.

- Can decide which side is facing down
- We can easily address the side LEDs
- We can randomly turn on an LED

Secondary Goals:

- Box design complete

Tasks:

- Piezo
    - Detect knocks
    - Store knock history
- Buzzer
    - Function to play tone for certain time
    - Play sequence of tones
- Accelerometer
    - Read I2C
    - Function to return which side is down
    -

Milestone 3

Primary Goal: Measurement of the photoresistors

- We can detect light/dark/ambient state on each photo resistors
- We can communicate with 5 Photoresistors
- Can rapidly flash LEDs on one side

Secondary Goals:

- Box assembled

Milestone 4

Primary Goal: Communication with servo to open the lid; Finished puzzle box.

- Can send a lock/unlock signal to the lock mechanism
- Play a fanfare on open
- Can transition to back to play state

Secondary Goals:

- Fully test the project
- Debug/fix any software issues
- Add features if time permits

Discussion of Risk

One of the biggest risks we have identified with this mini project is the physical design aspects of the puzzle box. We have access to a 3D printer for rapid prototyping of the box, however none of us are particularly experienced in 3D modeling. This risk will be mitigated by dedicating time to learning basic 3D modeling in CAD software.

Another risk is that our team does not include an Electrical Engineer, so we may struggle more with some of the hardware design/implementation aspects of the project. This risk is partially mitigated through having two Computer Engineers on the team; however, Computer Engineers are not as experienced in hardware as an Electrical Engineer would be.

Pins

I2C:

SCL: B10

SDA: B11

UART (debug):

TX: PC10

RX: PC11

ADC: A pins

Piezo: C0

Photoresistors: PA1-5 and PA7

DMA BUFFER:

PIEZO - [0]

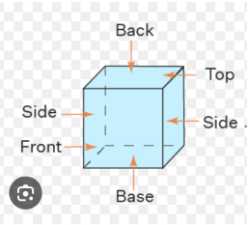
Top Resistor - [1]

Bottom Resistor - [2]

Back Resistor - [3]

Buzzer: PB5

Box-Side LEDs



PA0 -- Top LED

PA1 – Base LED

PA8 – Front LED

PA9 – Back LED

PA10 – Left Side LED

PA15 – Right Side LED

Servo: PB3