Backpack Anti-Theft Device

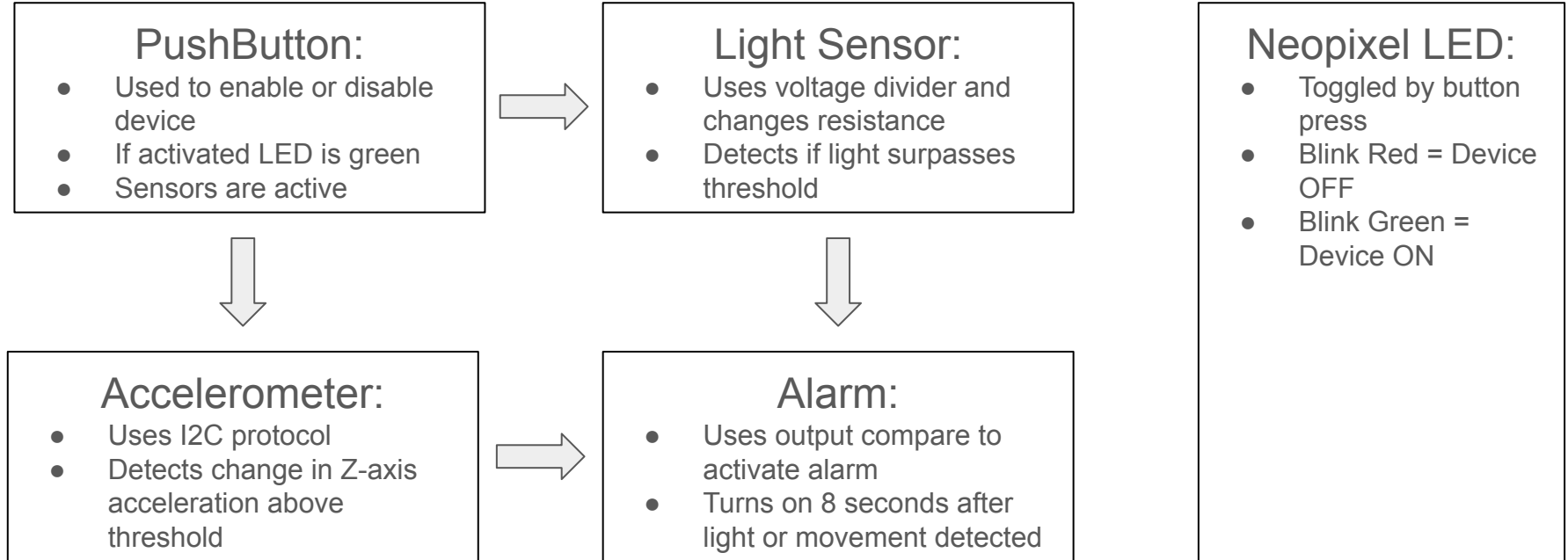Ryan Fowler, Sharmarke Ahmed

Purpose of Application

- The Backpack Anti-Theft Device is meant to watch your belongings while they are left unattended
- Allows a bag or backpack to be left alone so that you don't need to always lug it around when stepping away for a minute
- Utilizes an accelerometer to detect if your whole backpack is stolen
- Utilizes a light sensor to detect if your backpack is opened
- Once enabled, if the backpack moves or is stolen, a loud alarm will go off until turned off
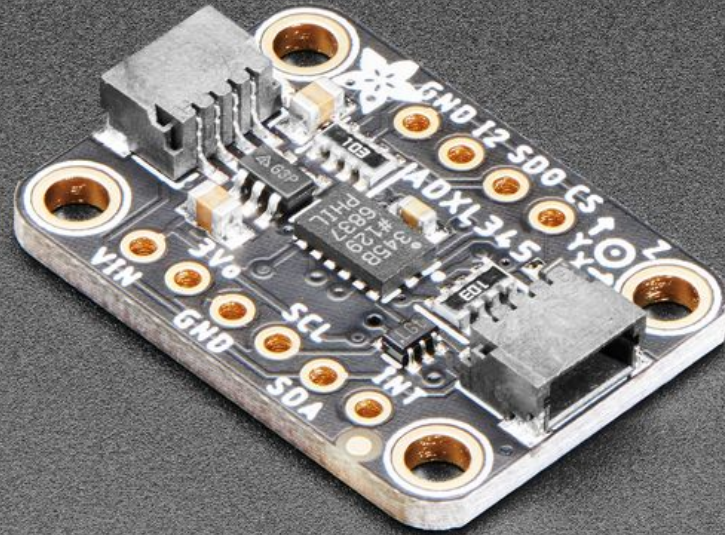
Architectural Overview

PushButton:
- Used to enable or disable device
- If activated LED is green
- Sensors are active

Light Sensor:
- Uses voltage divider and changes resistance
- Detects if light surpasses threshold

Neopixel LED:
- Toggled by button press
- Blink Red = Device OFF
- Blink Green = Device ON

Accelerometer:
- Uses I2C protocol
- Detects change in Z-axis acceleration above threshold

Alarm:
- Uses output compare to activate alarm
- Turns on 8 seconds after light or movement detected

Architectural Overview - LIS3DH Accelerometer

- Communicates via I2C at a baud rate of 100kHz.
- Can obtain acceleration in the x, y, and z-axis.
- movementDetected() function returns 1 if acceleration in the x, y, or z axis is above a certain threshold.
- Electric tape placed on ON light of accelerometer as to not interfere with light sensor

Architectural Overview - Photocell Light Sensor

- The amount of light exposure determines its resistance.
- Resistance is from 3k to 11k ohms
- Put in series with 4.7k ohm resistor
- Uses Analog to Digital conversion to read voltage across divider

PIC24 FJ64 GA002

ANO

$$V_1 = \frac{R_{photocell}}{R_{photocell} + R}(3V)$$

V_1

$R = 4.7k\,\Omega$

$R_{photocell}$

3V

GND
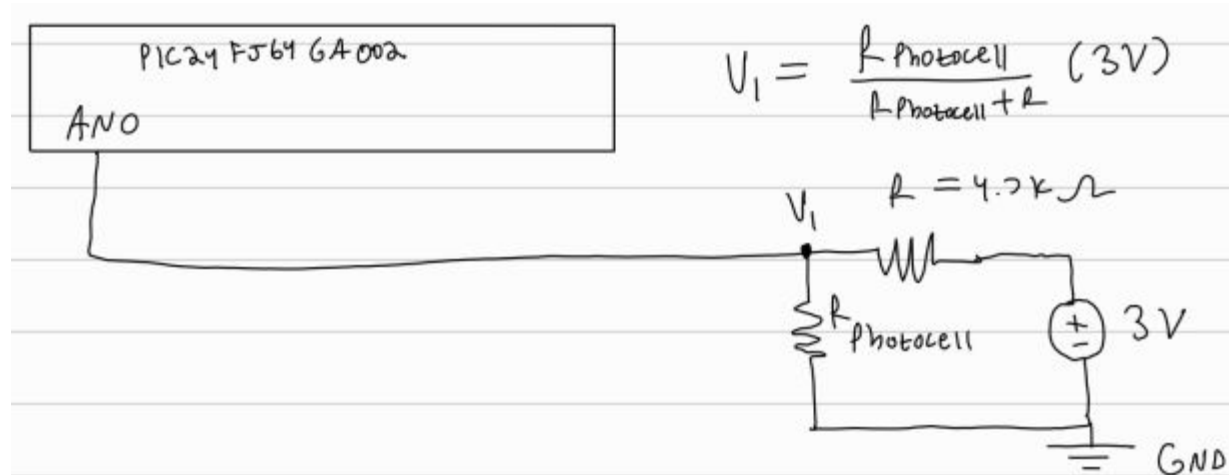
Architectural Overview - PushButton

- Pin RP15 is connected to a button and a pull down resistor connected to 3V.
- When the button is pressed, the switch is closed, short circuiting the pull down resistor. Change Notification interrupt is used with pin RP15 to capture button presses
- RC Circuit used to filter bouncing. A 100Ω resistor and a 0.1µF capacitor were used, corresponding to a corner frequency of 10kHz, debouncing by filtering out changes in voltage that are <0.01ms long

Low Pass Filter

$$H(j\omega) = \frac{\omega_c}{s + \omega_c}$$

$$\omega_c = \frac{1}{RC}$$
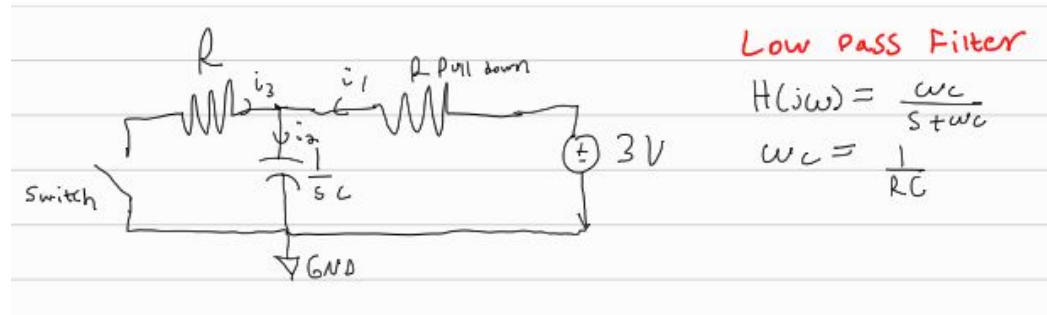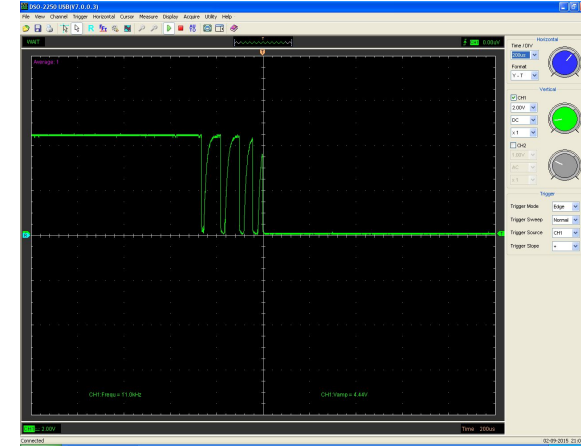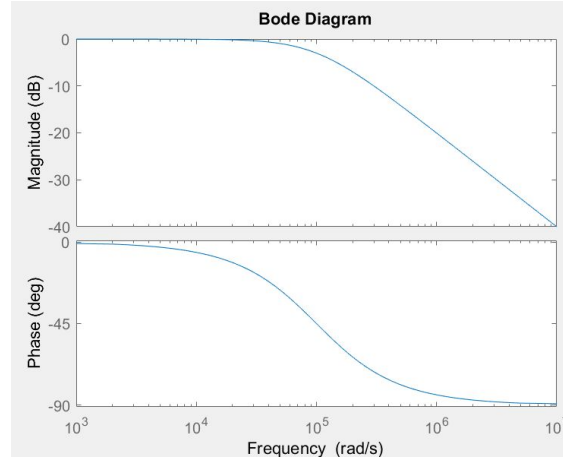
Architectural Overview - Alarm

- Uses a piezoelectric buzzer, which generates a high pitched tone at 3V
- Output compare used to have the alarm buzz at a given input frequency

Individual Contributions

Sharmarke:

- Developed Accelerometer, PushButton, Neopixel and Alarm libraries, worked on the logic on the main code.

Ryan:

- Developed light sensor library, main code logic, slides, and contributed to making button asynchronous, made frequency selector for alarm

Description of Libraries and Public Functions

- Button:
  - Include "PushButton.h"
  - Call function "initPushButton" to initialize and "isButtonPressed" to detect press
- Light Sensor:
  - Include "LightSensor.h"
  - Call function "initLightSensor" to initialize AD conversion and "lightDetected" to check if light is ed in the backpack
- Alarm:
  - Include "Alarm.h"
  - Call function "initAlarm" to initialize, "turnOffAlarm" to turn off, and "turnOnAlarm" to turn on
- Accelerometer:
  - Include "Accelerometer.h"
  - Call function "initAccelerometer" to initialize, and "movementDetected" to detect motion
- LED:
  - Include "Neopixel.h"
  - Call function "initNeopixel" to initialize, "blinkRed" to blink red (for indicating that the device is turned off, and "blinkGreen" to indicate that the device was turned on.

Shortfalls

- Must be present in environment of constant acceleration (or none)
  - This is so it can detect changes in acceleration
  - Would likely not work on train, airplane, bus, ect.
- Can be set off by tremors in Z axis
  - Potential solution would be converting the acceleration into a change in position on z-axis
  - Alarm would set off at certain height
- Not easily concealable
  - If criminal opens pack they would easily spot it
  - If development continued it would be made more inconspicuous
  - In future would use PCB board to avoid wires being seen
- Alarm must be outside backpack
  - If left inside sound is muffled
  - If put on outside it is more conspicuous to people stealing it
  - In future would use louder alarm that is concealed

Conclusion

- Purpose: Backpack Anti-Theft device will monitor the status of your backpack while it is left alone, keeping thieves from stealing your backpack!
- Allows the user to not have to carry their backpack with them at all times

References

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