

Backpack Anti-Theft Device

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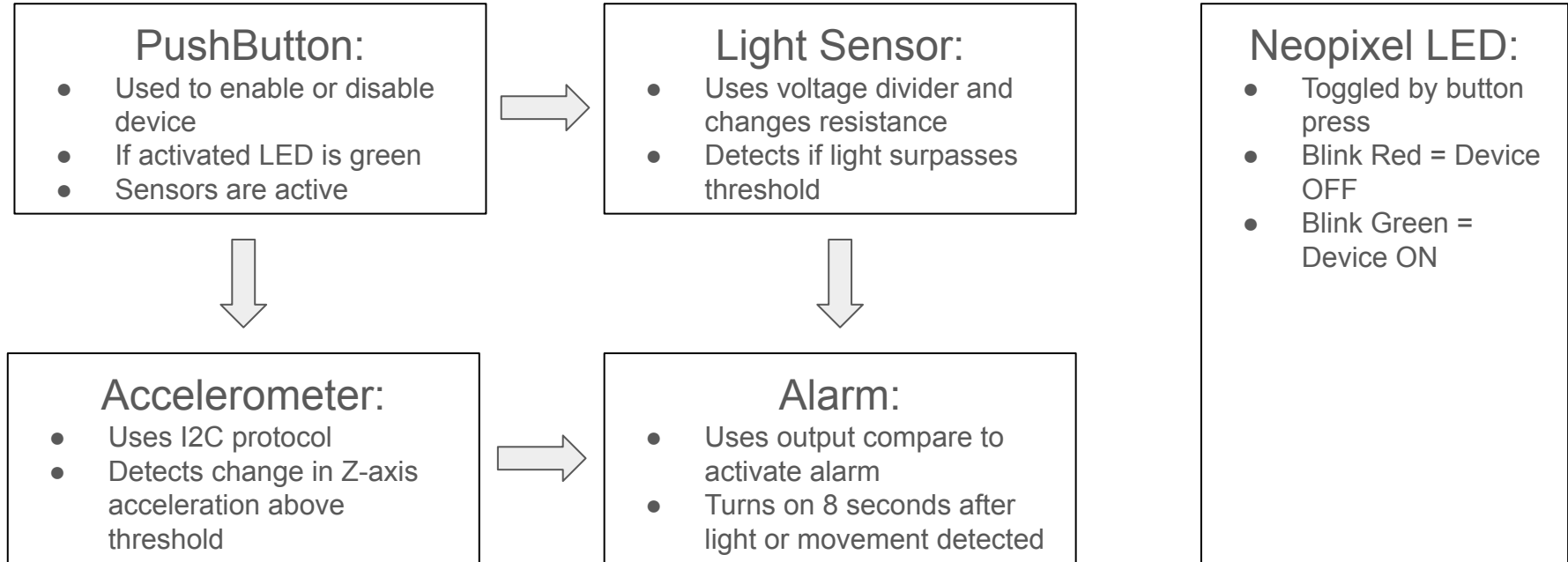


Purpose of Application

- 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

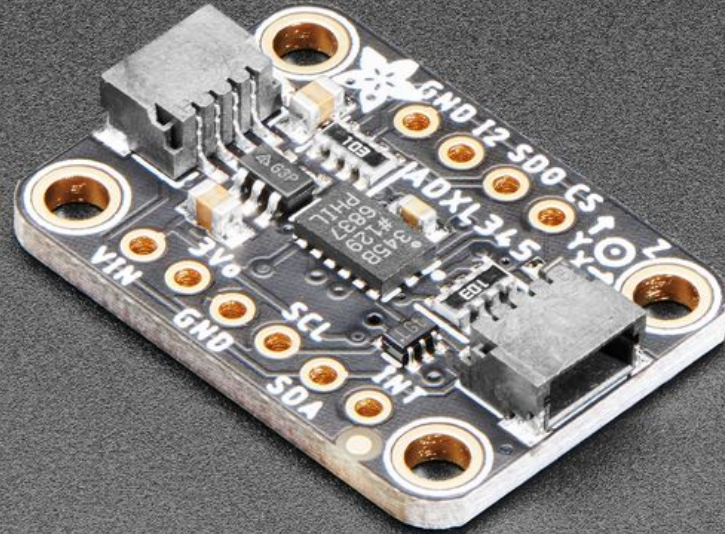


Architectural Overview



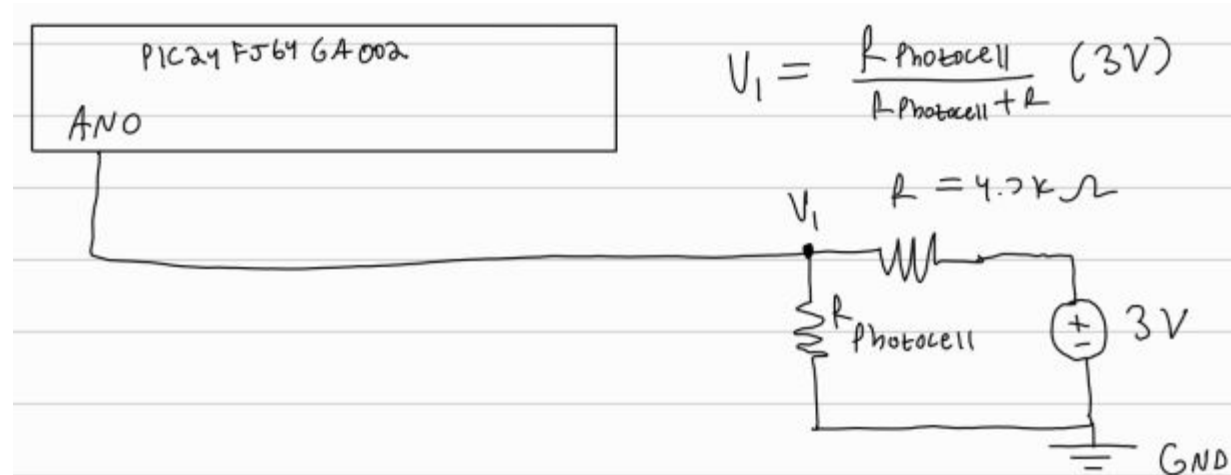
Architectural Overview - LIS3DH Accelerometer

- 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



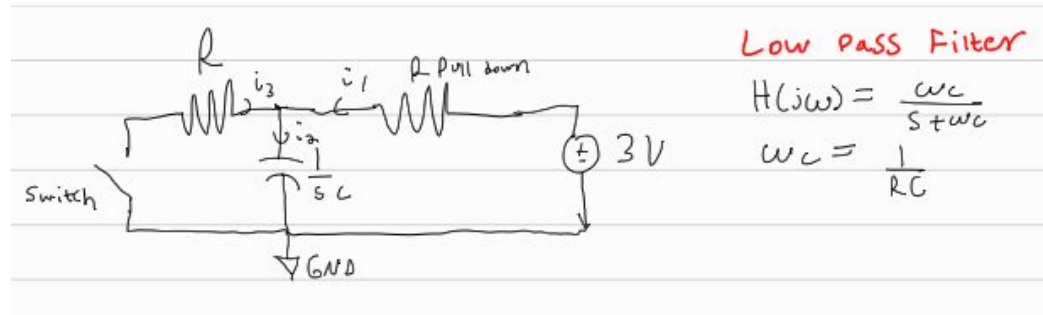
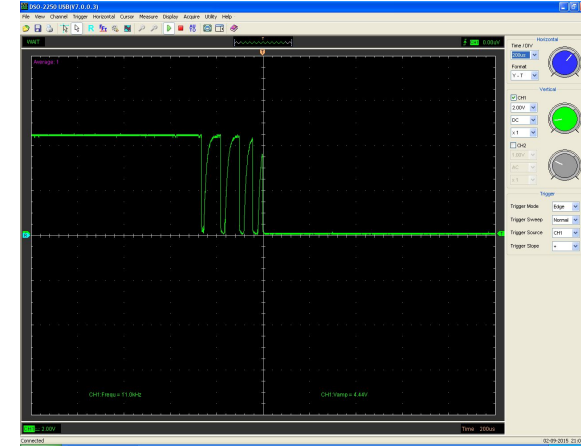
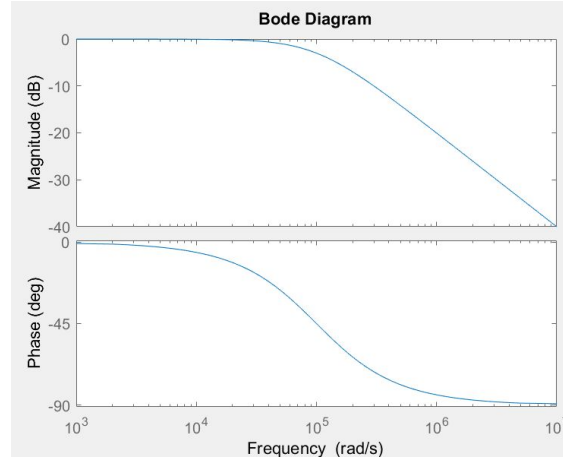
Architectural Overview - Photocell Light Sensor

- 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



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 $0.1\mu\text{F}$ capacitor were used, corresponding to a corner frequency of 10kHz , debouncing by filtering out changes in voltage that are $<0.01\text{ms}$ long



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 X, Y, or Z axis
 - Potential solution would be converting the acceleration into a change in position for each 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

Sources:

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Image Sources:

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[3] *ADXL345 - Triple-Axis Accelerometer (+-2g/4g/8g/16g) w/ I2C/SPI - STEMMA QT / Qwiic*. Available: <https://www.adafruit.com/product/1231>

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