# CMPT433 Project: GatekeeperInsights Write up

System Explanation:
Our project aims to develop a system for monitoring and analyzing customer traffic at the entrances of stores. By integrating hardware and software, this system enhances the shopping experience and provides store owners with daily customer traffic data.

The system uses a combination of motion sensors and laser-photocell setups to detect customer entries and exits. When a customer enters, the motion sensor triggers and the count increases by one. For exits, the laser and photocell detect when a person passes through, decreasing the count accordingly. We employ UDP to send this data in real-time to a web interface, which displays the current number of people inside, as well as the total count of entries for the day. This data is stored in the IndexedDB of the BeagleBone Green (BBG) web browser.

For **data analysis**, we record the maximum number of people per minute, average it over an hour, and then compute a daily average from these hourly values. Our web dashboard offers visualizations of weekly and daily averages, and hourly maxima. Due to limited data collection during our demo, random numbers were used to simulate the display.
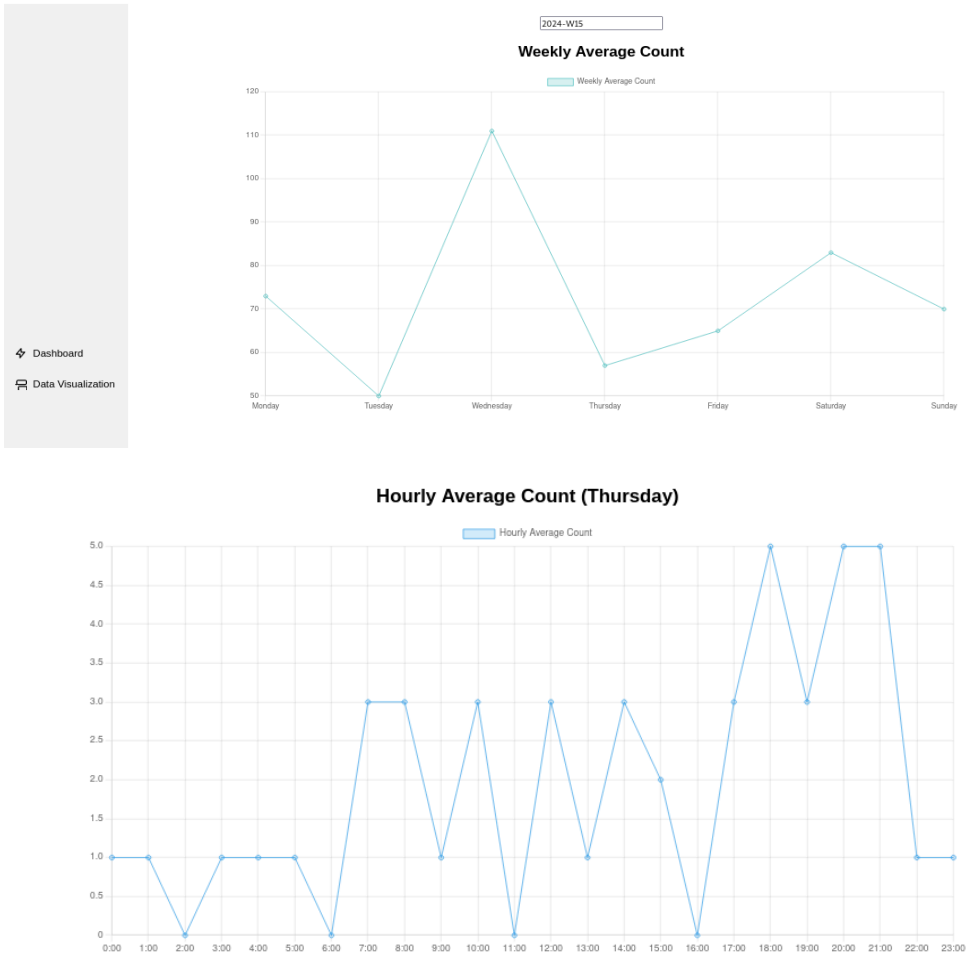
During operation, users can interact with the system via a **web dashboard** to:
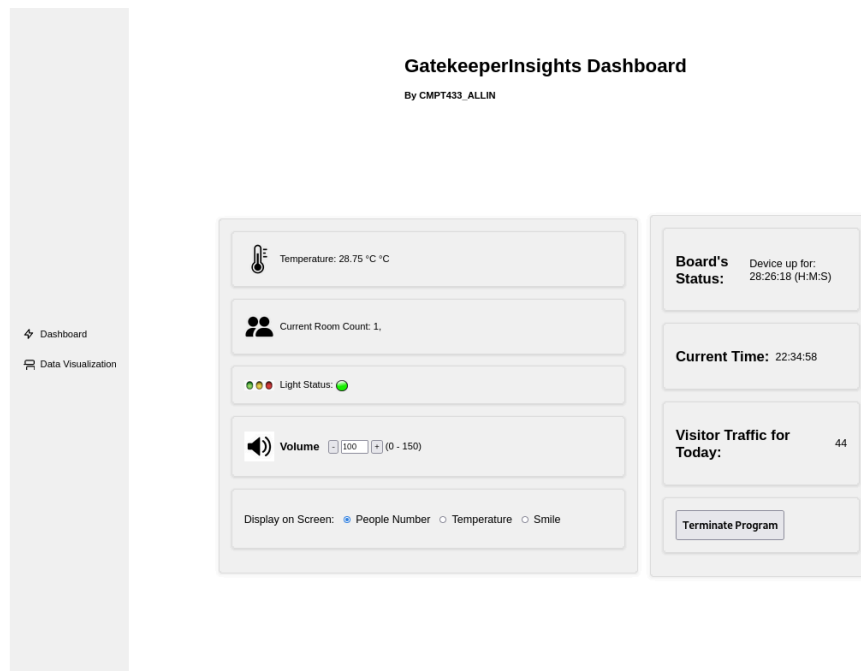
1. Switch display modes between People Count, Temperature, and Smile.
2. Adjust the volume of audio feedback.
3. Check system uptime and the current number of people inside.
4. Refresh daily entry counts at midnight.
5. Display the current time in GMT-7 and ambient temperature.
6. Indicate room occupancy with green, yellow, and red lights for under 4, between 4 to 8, and over 8 people respectively.
7. Terminate the program.

Interactive hardware enhancements include:
1. NeoPixel Behavior:
   ● Color Shifts for Capacity Indication: The NeoPixel starts with a green light indicating low occupancy (fewer than 4 people). As occupancy reaches 4, it shifts to yellow, and at 8, it turns red, providing a clear visual cue about the room's capacity status.
   ● Entry and Exit Alerts: Additionally, the NeoPixel flashes blue or teal lights to indicate when someone enters or exits, enhancing awareness without requiring direct attention.
2. Audio Feedback:
   ● Music During Entry and Exit: Specific tunes play whenever someone enters or exits the store, creating a welcoming or parting gesture that enhances the customer experience.
3. Joystick Control:
   ● Interactive Display Control: Users can manipulate the joystick to switch between different display modes on the Mini 8x8 Yellow-Green LED Matrix—TEMP for temperature, PPL for people count, and a smiley for

general mood. Pressing the joystick to the right will halt the system, offering a simple manual control for emergencies or end of day operations.

4. Displays for Information:
    ● 14-Seg Display via I2C: This display shows the number of people in the room under PPL mode and the current temperature under TEMP mode, using data from a connected temperature sensor. The display is left blank in SMILE mode.
    ● Potentiometer - A2D: This allows users to adjust the blinking speed of the NeoPixel, providing a customizable interaction that can be tailored to the ambient environment or specific user preferences.
    ● Grove 4-Digit Display: Shows the current time in GMT-7, which is crucial for managing store operations and aligning them with local time.

5. BBG (BeagleBone Green) and LED Feedback:
    ● Central Processing and Control: The BBG coordinates all the input and output signals from the sensors, displays, and other hardware, ensuring seamless operation and data integrity.
    ● Mode-Specific LED Feedback: Each time the joystick is pressed to switch modes, the BBG LEDs blink at a specific frequency, providing a tactile and visual feedback that confirms the change.

Each element of our system is designed to interact naturally with users, making technology feel more intuitive and less intrusive. This not only enhances the customer's shopping experience but also helps the store management to efficiently monitor and control the flow of people, thereby optimizing the store's operational dynamics.
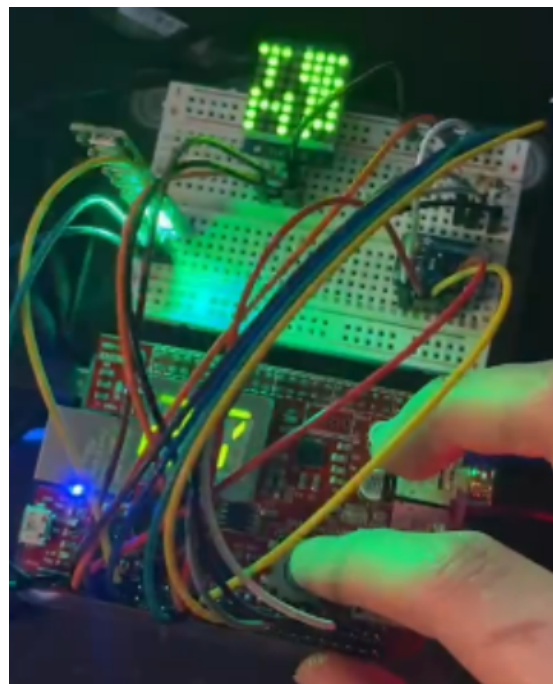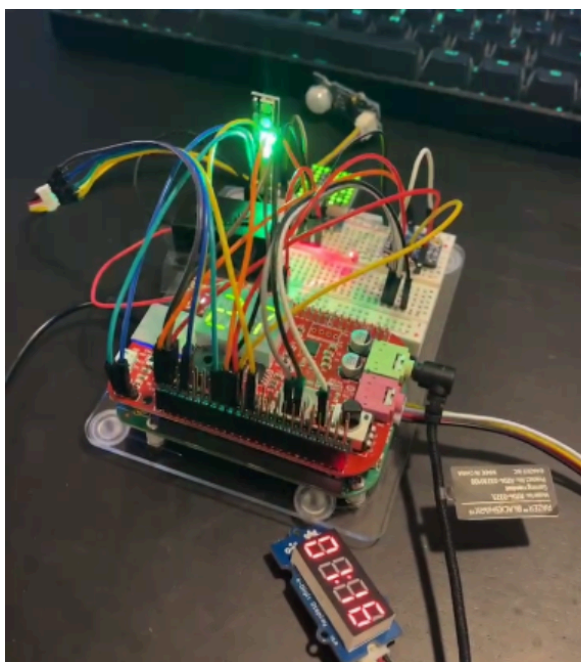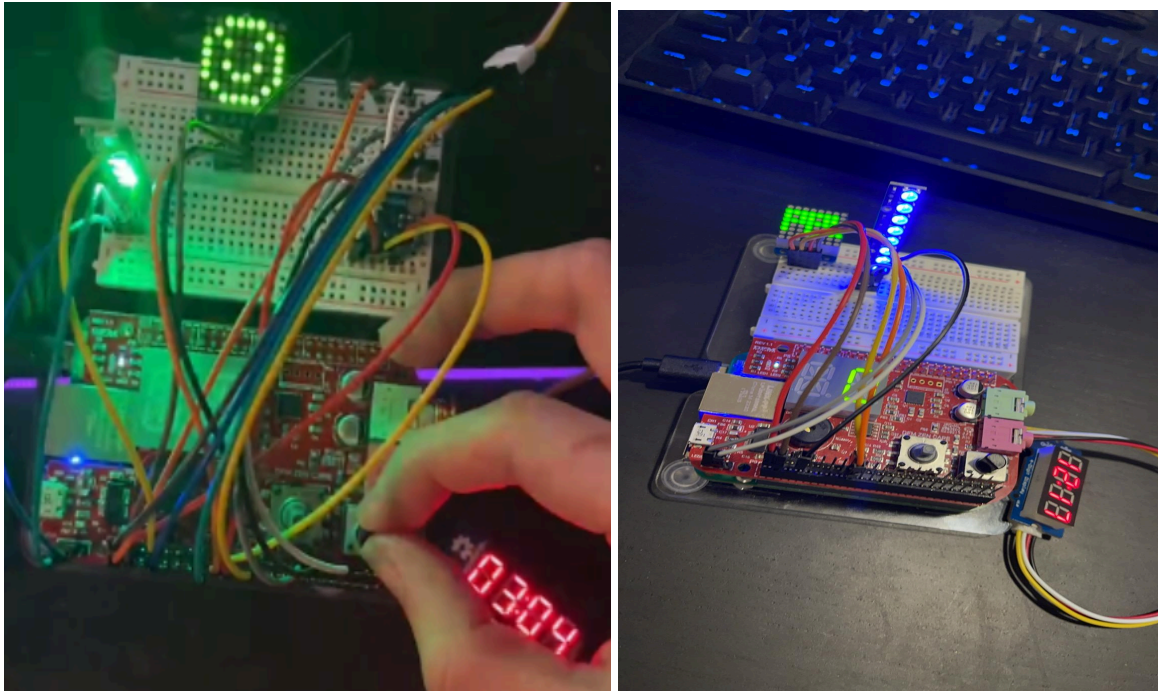
Challenges faced include inaccurate temperature measurements and occasional unexpected errors. The combination of motion sensors and the laser-photocell setup is not always precise, as the sensors are highly sensitive and the height of the laser setup is fixed, making them suitable only for stores with designated entry and exit gates. Additionally, due to time constraints, the database contains only test data. However, with ongoing data collection, the system's effectiveness and data accuracy are expected to improve.

Feature table:

Description	Host/Target	Comp	Code	Author(s)	Notes
Web page	T	5	JS/HTML	Xiaohong	Based on As3 sample code, it handles errors and could work smoothly.
IndexedDB	T	2	JS	Xiaohong	Used to store head counts per minute, hour and day. but not cover all real data.
UDP	H,T	5	JS/C	Xiaohong, Lingjie, Lihao	Transmit data base on designed message passing protocol

Temperature Sensor	T	4	C	Haowei, Lingjie	Reading data by I2C, wire hardware to I2C-2, detecting I2C-2, and configuring registers for getting data. When we try to use thread to read data, sometimes the read may fail due to the reconfiguration of the register.
Audio Play Sound	T	5	C	Lihao	Adapted A3 ALSA library as fundamental of sound playing, music plays when motion sensor or laser detected traffic.
Motion Sensor	T	5	C	Lihao	Motion sensor evokes when detecting people walking in the store, people count incremented by 1.
Laser & Photoresistor	T	5	C	Lihao	The laser is shooting directly at the photoresistor, people count gets deducted by 1 when laser beam gets blocked
Joystick	T	5	C	Lingjie	Manually control three modes switching
14-Seg Display	T	5	C	Lingjie	Displays people count and temperature as the mode changes
Mini 8x8 Yellow-Green LED Matrix	T	5	C	Lingjie	Displays "PPL", "TEMP" and smile emoticons as the mode changes
Grove 4-Digit Display	T	5	C	Lingjie	Displays current time. 20% sample code, 80% us
Potentiometer	T	5	C	Lingjie	Rotate the potentiometer to

					control the neo pixel flashing speed
BBG LEDs blink	T	5	C	Lingjie	BBG LEDs blink when joystick pressed up or down
NeoPixel-PRU	T	5	C	Lingjie	Flashing back and forth means that the program is running normally. After the number of people reaches a certain value, the color switches. When it is detected that someone comes in or goes out, all pixels light up.

Extra Hardware & Software Used
1. Chart. js: showing the diagram of data
2. Temperature Sensor (MCP9808)
   - guide from online https://cdn-learn.adafruit.com/downloads/pdf/adafruit-mcp9808-precision-i2c-temperature-sensor-guide.pdf
3. Laser Diode
4. Motion Sensor
5. Mini 8x8 Yellow-Green LED Matrix
   - I2C guide from Brian Fraser https://opencoursehub.cs.sfu.ca/bfraser/grav-cms/cmpt433/guides/files/I2CGuide.pdf
   - Design our own pattern mode and set different values to register
6. Grove 4-Digit Display
   - guide from previous students https://opencoursehub.cs.sfu.ca/bfraser/grav-cms/cmpt433/links/files/2016-student-howtos/Grove4DigitDisplay.pdf
   - Follow the guide instructions to display the current time