IOT PROJECT

"Development of a healthcare/wellbeing platform in the context of smart home"

Mobile Platform - G3

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Introduction:

Introducing our revolutionary IoT healthcare platform designed to enhance the well-being and safety of individuals. Our platform leverages cutting-edge technology to monitor and analyze vital health parameters, including GPS tracking, step counting, and fall detection.

By seamlessly integrating these features into a single system, the platform provides comprehensive insights and real-time data to empower users and their healthcare providers in making informed decisions. With our platform, healthcare experts and users can effortlessly track patients' daily activities, ensuring they stay active, safe and within a confined area of safety. Furthermore, our advanced fall detection capability adds an extra layer of security, instantly notifying emergency contacts or healthcare professionals in the event of an unexpected fall. Experience the future of healthcare monitoring with our IoT platform, enabling a proactive and connected approach to personal health and safety.

Use case:

This healthcare IoT platform can have use cases in and outside the healthcare domain as seen below.

- GPS Tracking:

- Elderly Care: Monitor the location of elderly individuals or patients under care allowing health experts to ensure their safety and provide timely assistance if they wander or get lost.

- Step Counter:

- Activity Monitoring: Measure daily step count to encourage physical activity and promote a healthier lifestyle.
- Rehabilitation Programs: Assist in tracking and evaluating the progress of patients undergoing physical therapy or post-surgery recovery.

- Fall Detection:

- Elderly Safety: Detect falls in real-time and automatically alert health experts. Prompt response can be crucial in providing immediate assistance and reducing the risk of serious injuries for elderly individuals or patients living alone.
- Workplace Safety: Enhance occupational safety by monitoring employees in physically demanding industries prone to accidents or falls. The fall detection feature can promptly notify supervisors or safety personnel, enabling timely response and reducing the severity of injuries.

These are just a few examples of how the GPS tracking, step counter, and fall detection sensors can be utilized within the IoT health platform. The versatility of the platform allows for customization and adaptation to various healthcare scenarios and user needs.

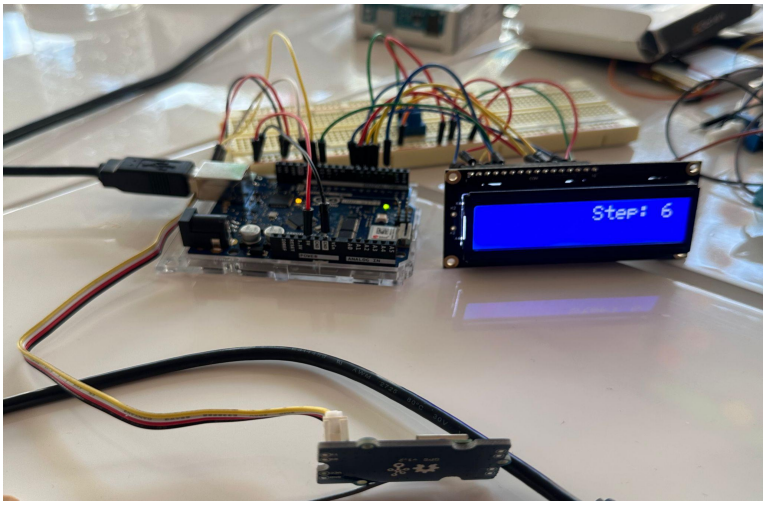
Technical Solution:

Sensors

1. **Step counting data**: the step counter works by detecting a magnitude of acceleration in any direction by extracting an acceleration in dimension from the IMU built-in with the arduino board (x,y,z) and put in the equations below to compute the magnitude of acceleration.

$$Magnitude\ of\ acceleration\ = \sqrt{x^2 + y^2 + z^2}$$

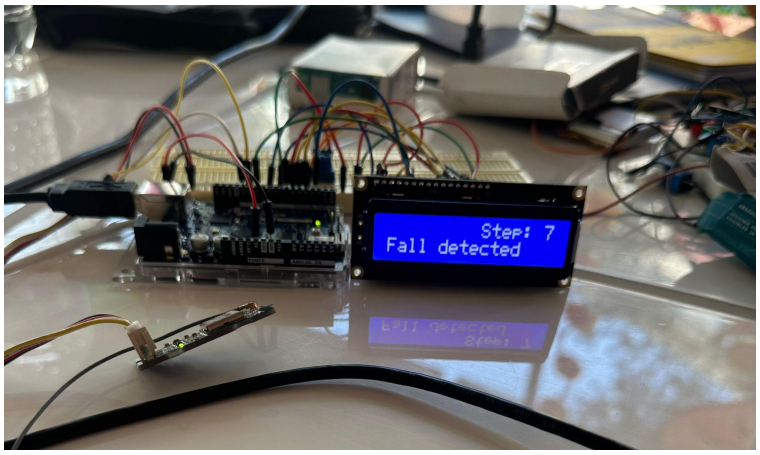
   If the magnitude of acceleration has exceeded a certain threshold the algorithm will detect a step, we also put a delay in the code for more accuracy in counting steps.



The lcd counting a step

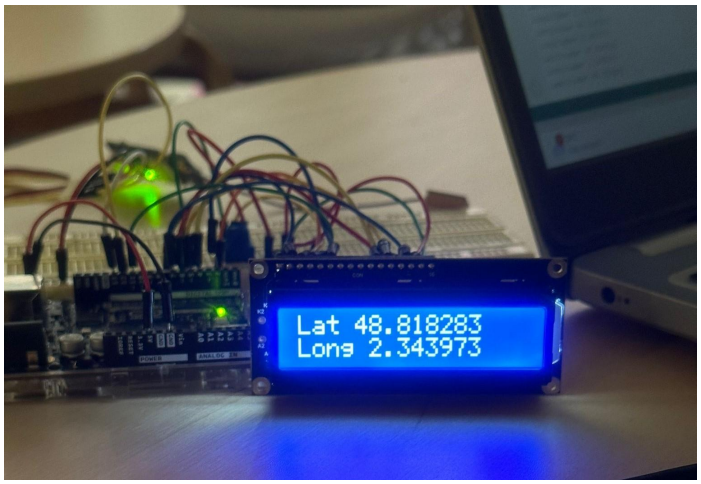
2. **A fall detection data**: The fall detection algorithm use the same magnitude of acceleration data from the step counter, it will detect a potential fall if a magnitude of acceleration reached a certain value and will print a string “Potential fall detected”, if after the detection of

potential fall, the arduino cannot detect any movement from the user the arduino will print “Fall detected” on the lcd and send the fall detection data to the gateway. Otherwise if the arduino still continues to detect a movement similar to walking it will send the false positive status for the fall to the gateway instead.



The lcd after detecting a fall

3. **A gps data**: The algorithm gets the data from the gps sensor module and prints the latitude and longitude data regularly, however, the frequency of the gps data update depends on the processor of the computer system used since most of the resource in the arduino is focus into an IMU reading which makes the fall detection data and step counting data accurate.



Lcd displaying latitude and longitude

USB

1. We are supposed to send data through Bluetooth, But we are getting errors when making a bluetooth connection between arduino and raspberry pi. So, we made a connection through a USB cable (Serial Communication). And we can successfully send data from arduino to raspberry pi. Once we connect the arduino to raspberry pi via USB cable. We have to specify the baud rate and port in the raspberry pi, then we need to write a python code to receive the data.

Gateway

1. We are using raspberry pi 3 model B+ as gateway. It has a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT12. It has more processing power.

2. We have to install raspberry pi os in the sd card by using raspberry pi imager software, while writing the data we have to specify the internet details. After installing, we can insert the sd card in the raspberry pi 3 model B+. We have to give power to the raspberry pi, and then we can configure the raspberry pi via hdmi cable or SSH connection. It has more computation power, it will act as a mini PC.

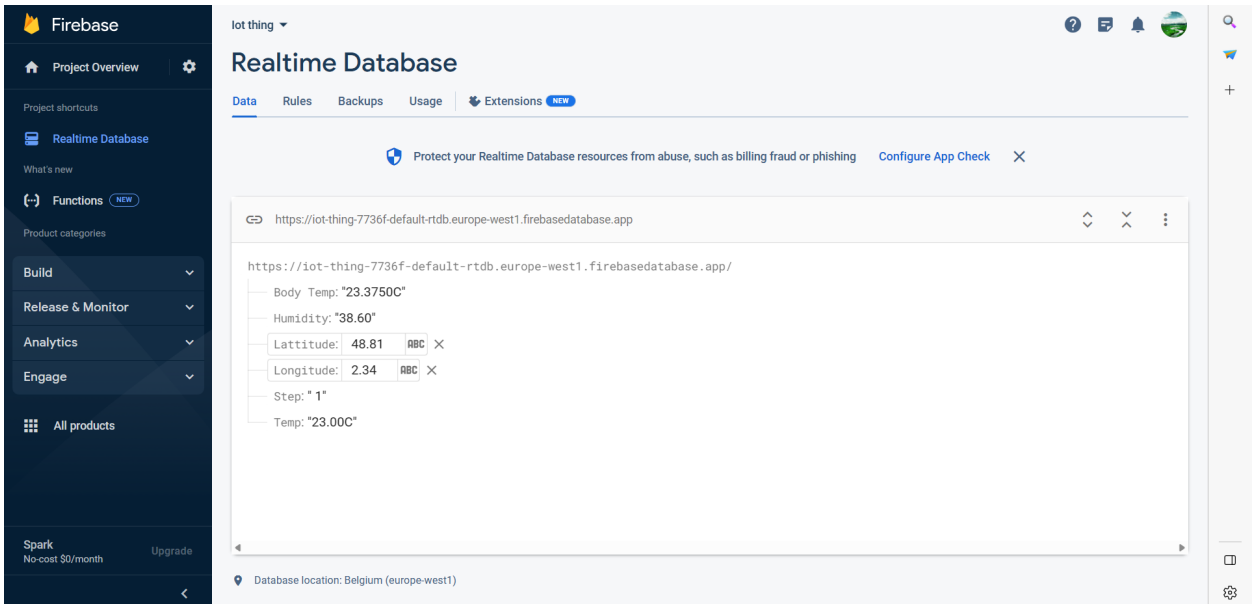
3. The raspberry pi will act as a gateway for our project, we have to write a python code to receive data from the arduino and send data to the database.

Integration Part:

We have to integrate both Mobile platform and Fixed platform by sending the data to the raspberry pi. For the Mobile platform we used 9600 baud rate and Fix platform we used 115200 Baud rate. We wrote a python program by specifying our baud rate and our port connection in the raspberry pi separately. We successfully received the data from both of the platforms.

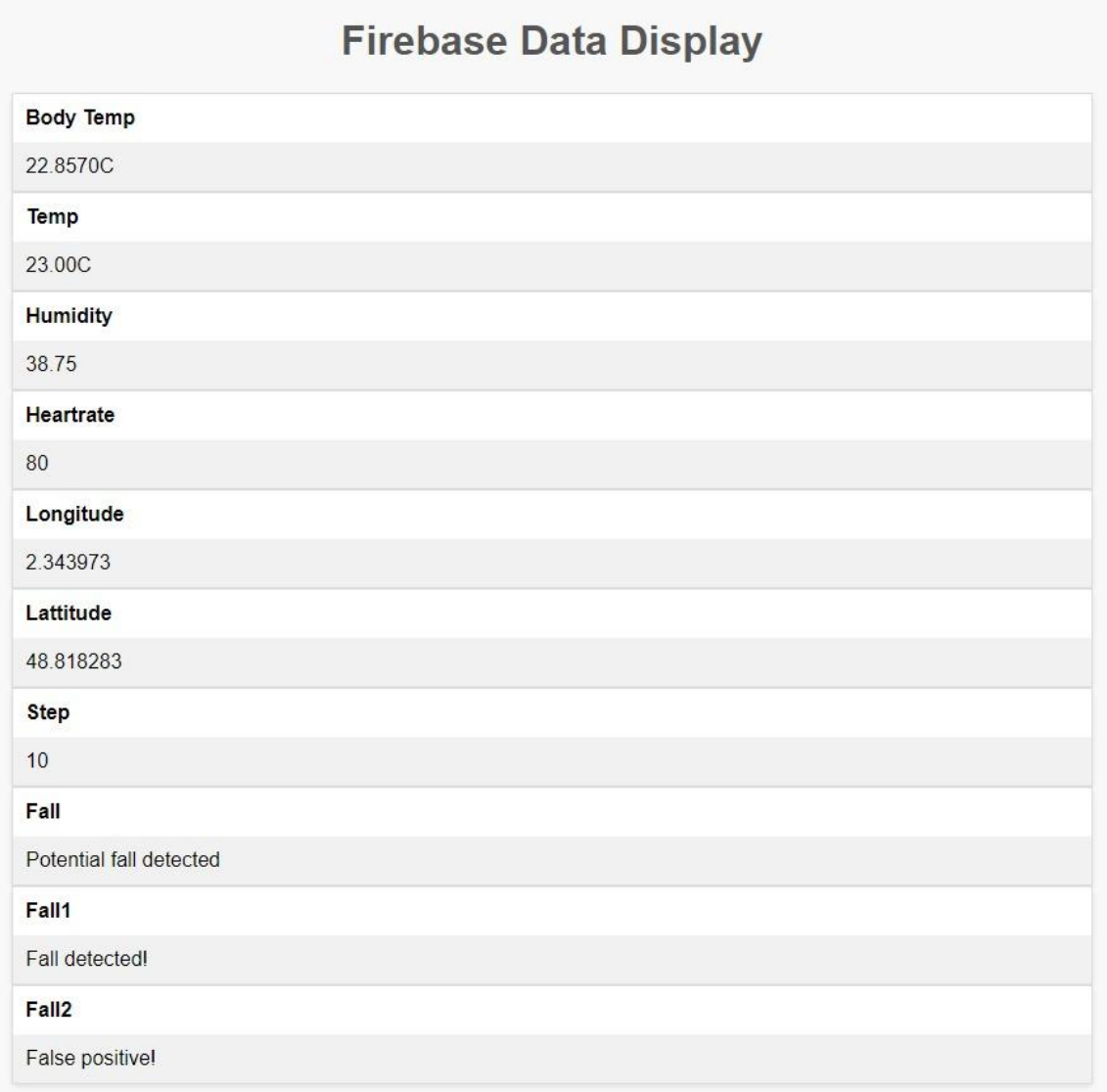
Firebase:

After receiving the data, we have to send this data to firebase. Firebase is a set of backend cloud computing services and application development platforms provided by Google. We have to create a project in firebase, and enable a realtime database. We are able to get the API key for that database, this API key is used to send data from raspberry pi to firebase. We have to write a python program with this API key to send data to the database.



Data Visualization :

For website development, we use HTTP and JavaScript and Firebase Realtime database for the database. The HTTP component is responsible for loading the necessary JavaScript libraries and retrieving data from the Firebase Realtime database. By combining the HTTP and JavaScript components, the code establishes a connection to Firebase, retrieves data, and dynamically updates the HTML to display the data on the webpage. This allows for real-time updates based on the data stored in the Firebase Realtime database.



Firebase Data Display

Body Temp
22.8570C
Temp
23.00C
Humidity
38.75
Heartrate
80
Longitude
2.343973
Lattitude
48.818283
Step
10
Fall
Potential fall detected
Fall1
Fall detected!
Fall2
False positive!

Final Platform:

The following is the functionality list of the final platform after the integration of mobile platform and fixed platform:

Fixed Platform

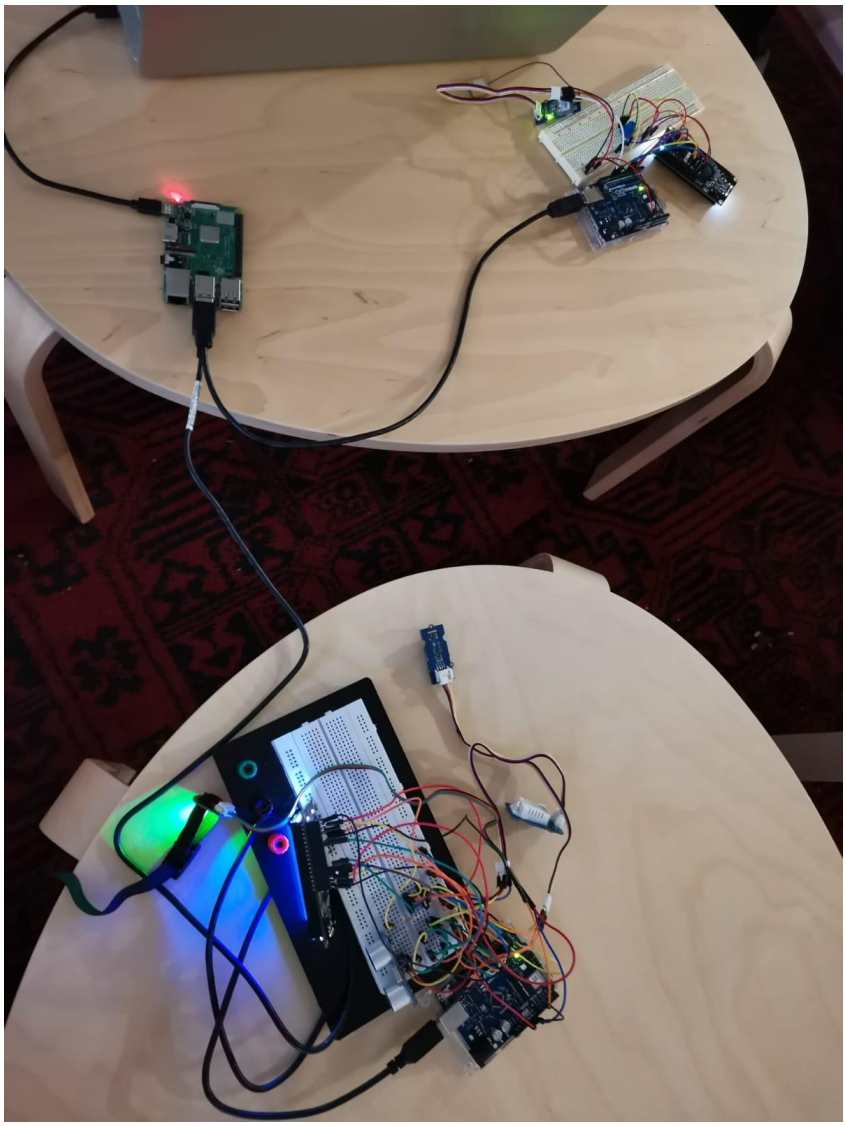
- Presence detection
- Room temperature and humidity measurements
- Body temperature measurement
- Heart Rate measurement
- Display measured data on LCD display
- Send sensors data to Raspberry Pi gateway through USB cable

Mobile Platform

- Step Counter
- Fall Detection
- GPS
- Display measured data on LCD display
- Send sensors data to Raspberry Pi gateway through USB cable

Website

- Display data gather from both Arduino of fixed and mobile group
- Update data in real-time according to the changes in database



Conclusion:

Health monitoring systems in smart environments are receiving increasing attention in order to provide complementary solutions to traditional medical services.The mobile parts of this project has presented a fall detection system, GPS address monitoring, step counting and virtualization of all the data on webpage . A 3D-accelerometer inbuilt into the arduino wifi microcontroller was used to detect and process the directed acceleration and determine whether there was a fall or not based on some already measured thresholds. Also use its data to count steps, and use an external gps sensor to locate the latitude and longitude.

The successfully completed functions include: fall detection and gps location. Asides the inability to communicate these sensors' parameters via bluetooth, the system operates normally. The system is also designed to detect a situation whereby the user accelerates above the fall threshold and doesn't maintain that fall position for a given set time as in the case of a stagger and sends a 'false positive' message.
After completing the project that lasted the whole semester, we reviewed and integrated knowledge in sensors, digital circuit fundamentals and communication principles. The project, through teamwork, not only lays a foundation for in-depth study of our majors in the future but also let us solve real-life problems.