1. Saumya Balina (IIIT Hyderabad)
2. Nishu Pandey (IGDTUW, Delhi)
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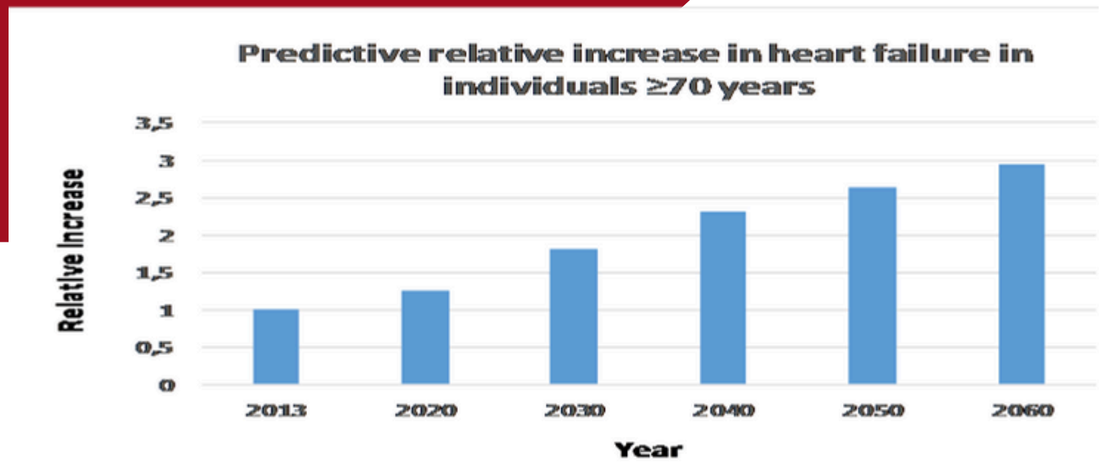
4. Kanan Agarwal (MNIT Jaipur)
5. Shruti Kayal (IIT Guwahati)

Smart Bracelet

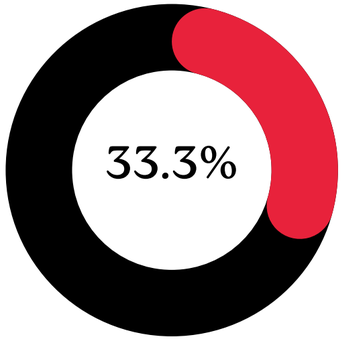
SW Group No. 2

EMPATHIZE



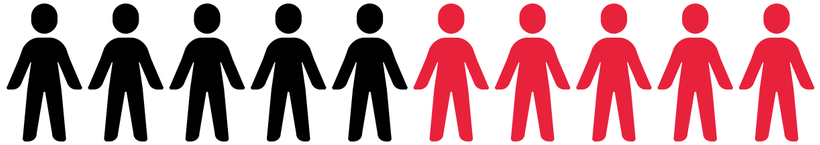
Heart disease, including heart attacks, is a leading cause of death among older adults globally. According to the WHO, cardiovascular diseases (CVDs) account for an estimated 17.9 million deaths annually, with a substantial proportion occurring in individuals aged 60 and above

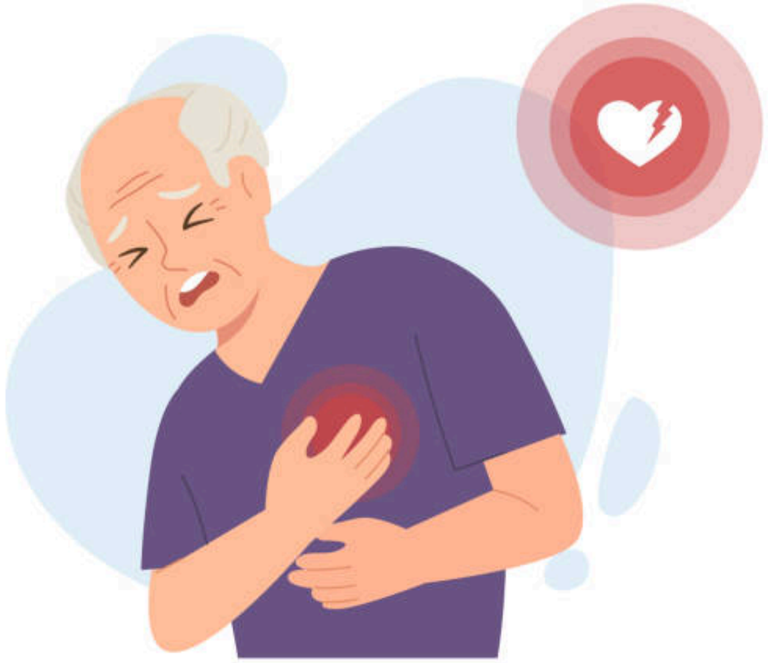
Approximately one-third of people aged 65 and older fall each year globally.



Globally, falls are the second leading cause of unintentional injury deaths, with an estimated 684,000 individuals dying from falls each year.

About 50% of heart attack deaths occur in individuals aged 70 and above.



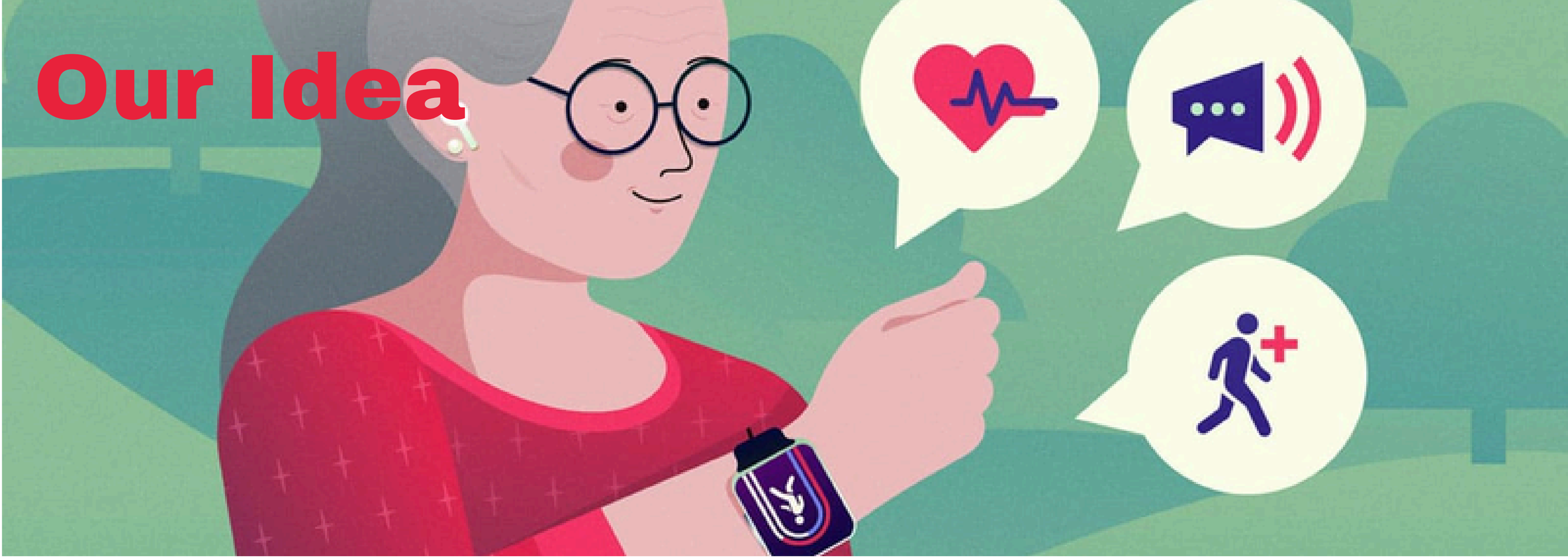


HELP ME!
Please do something...

Problem Statement

- People above the age of 60 and with health conditions like heart disease, dementia, Alzheimer's, etc. often require continuous monitoring. They need a non-intrusive, reliable, and user-friendly device to monitor vital signs and provide timely alerts.
- The device must monitor heart rate, track physical activity, and provide emergency assistance.

Our Idea



We plan to make a unisex bracelet that will be lightweight and flexible.

Generally, elderly people find technology difficult to use, so we wish to make an easy to use and non-intrusive accessory.

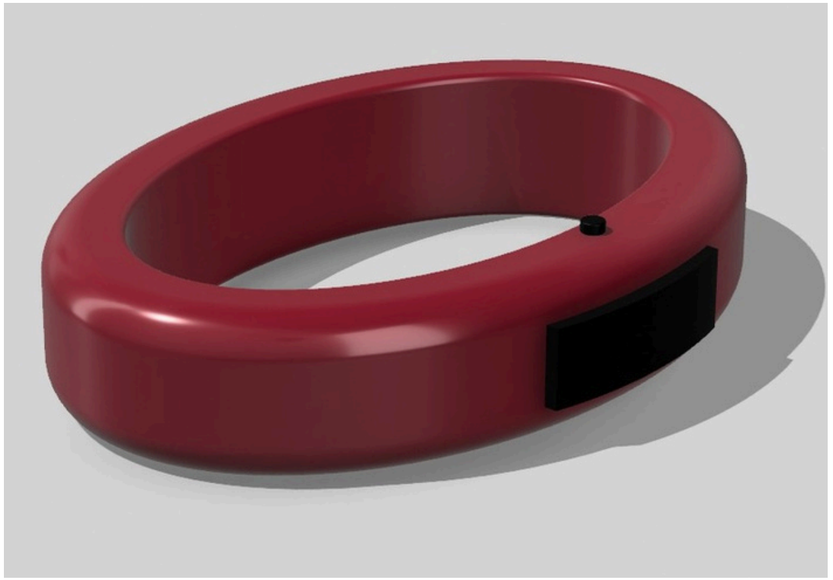
It will use energy-efficient sensors and optimized software to extend battery life.

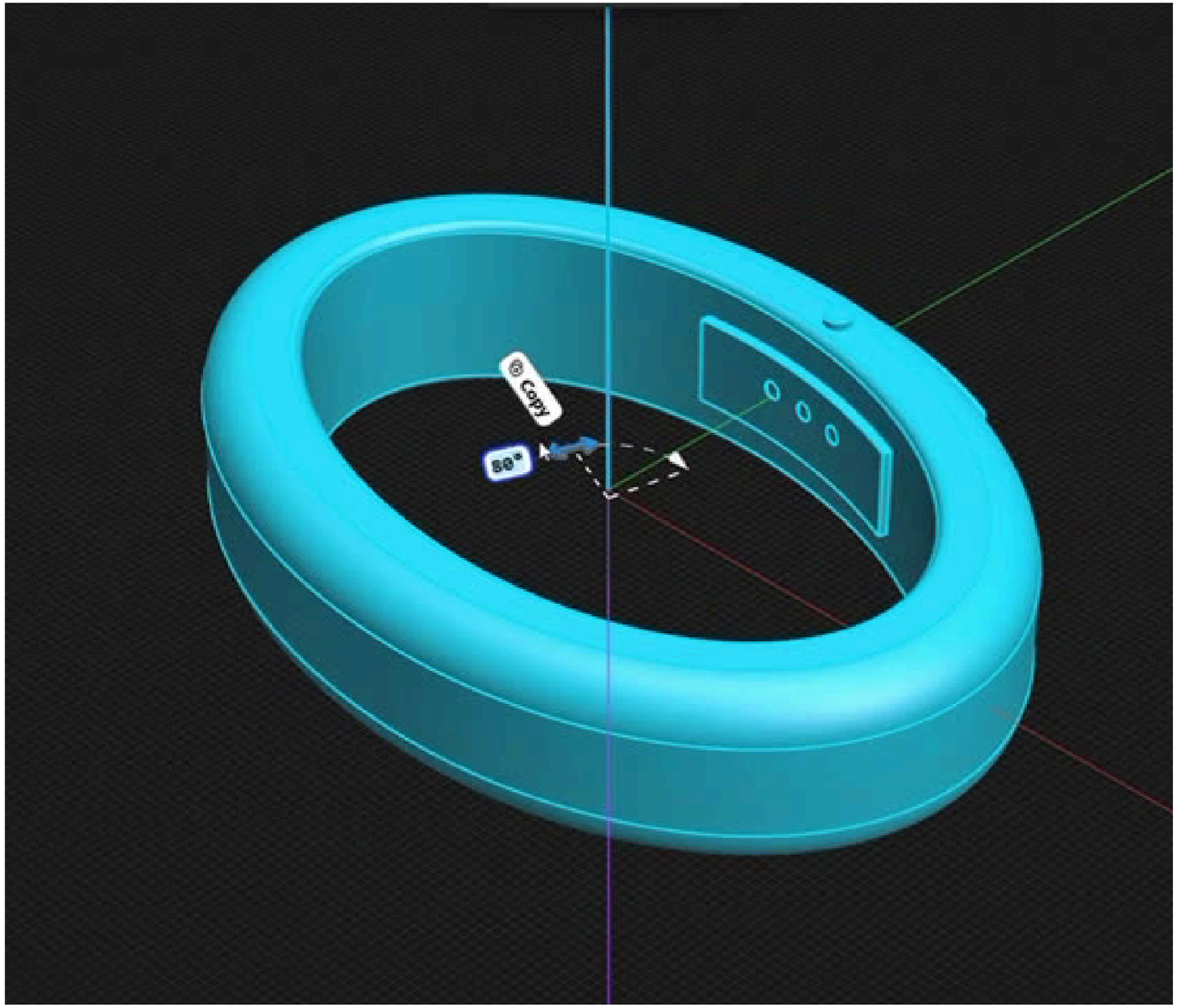
The bracelet will be connected to a mobile app, for real-time data tracking, sending emergency alerts and cloud-based storage for health records.

PRESENTING OUR PROTOTYPE...

ElderEase

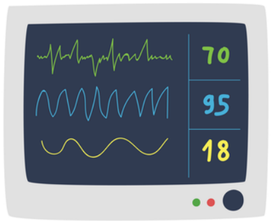
A Smart Bracelet for Worry-Free Elder Care




Copy
90°

KEY FEATURES

SOS Alert System

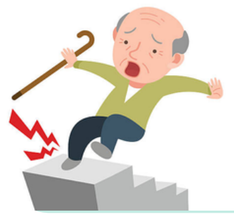


Heart Rate Monitor

Activity Tracking

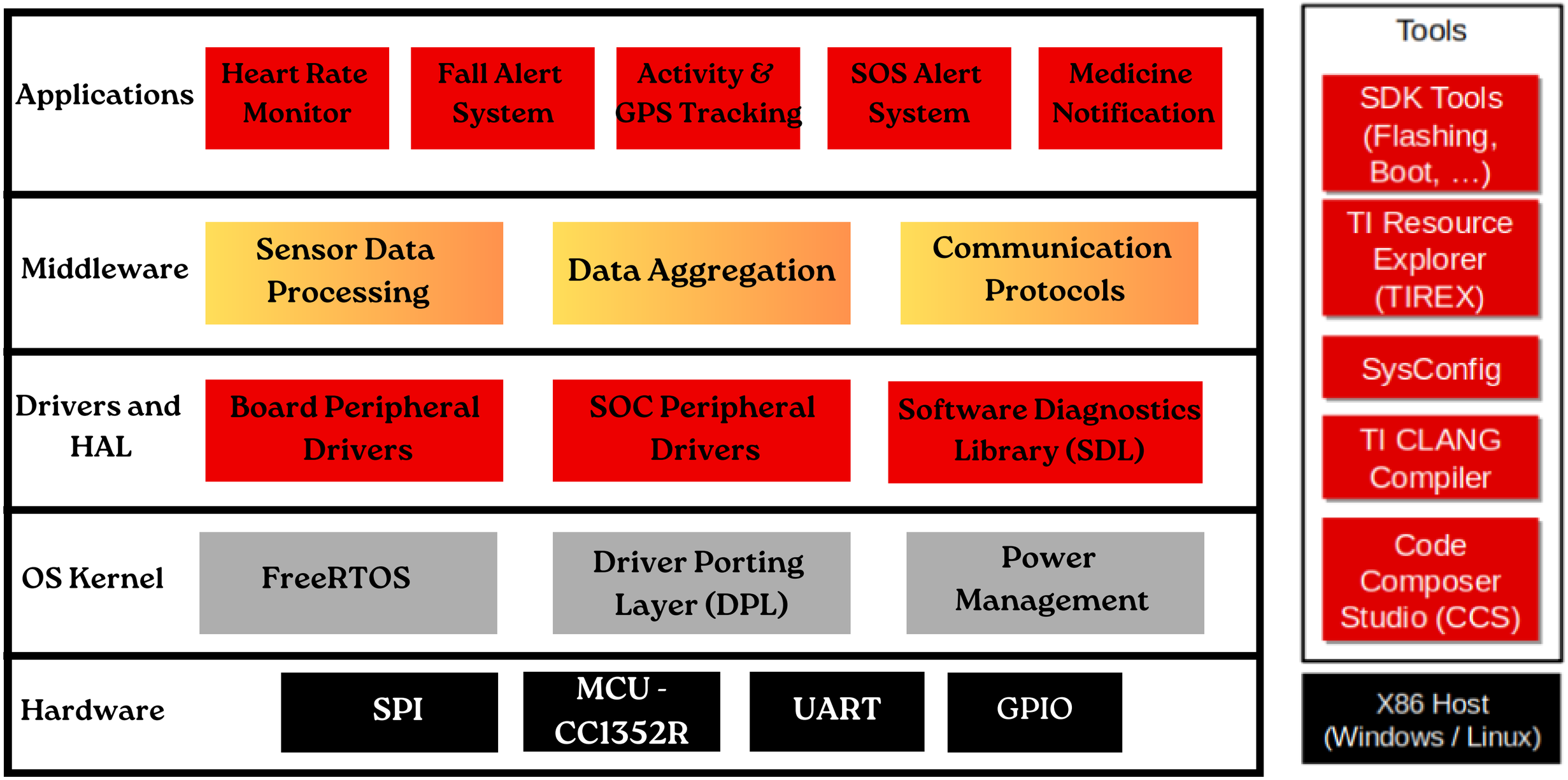
GPS Tracking

Medication Notification

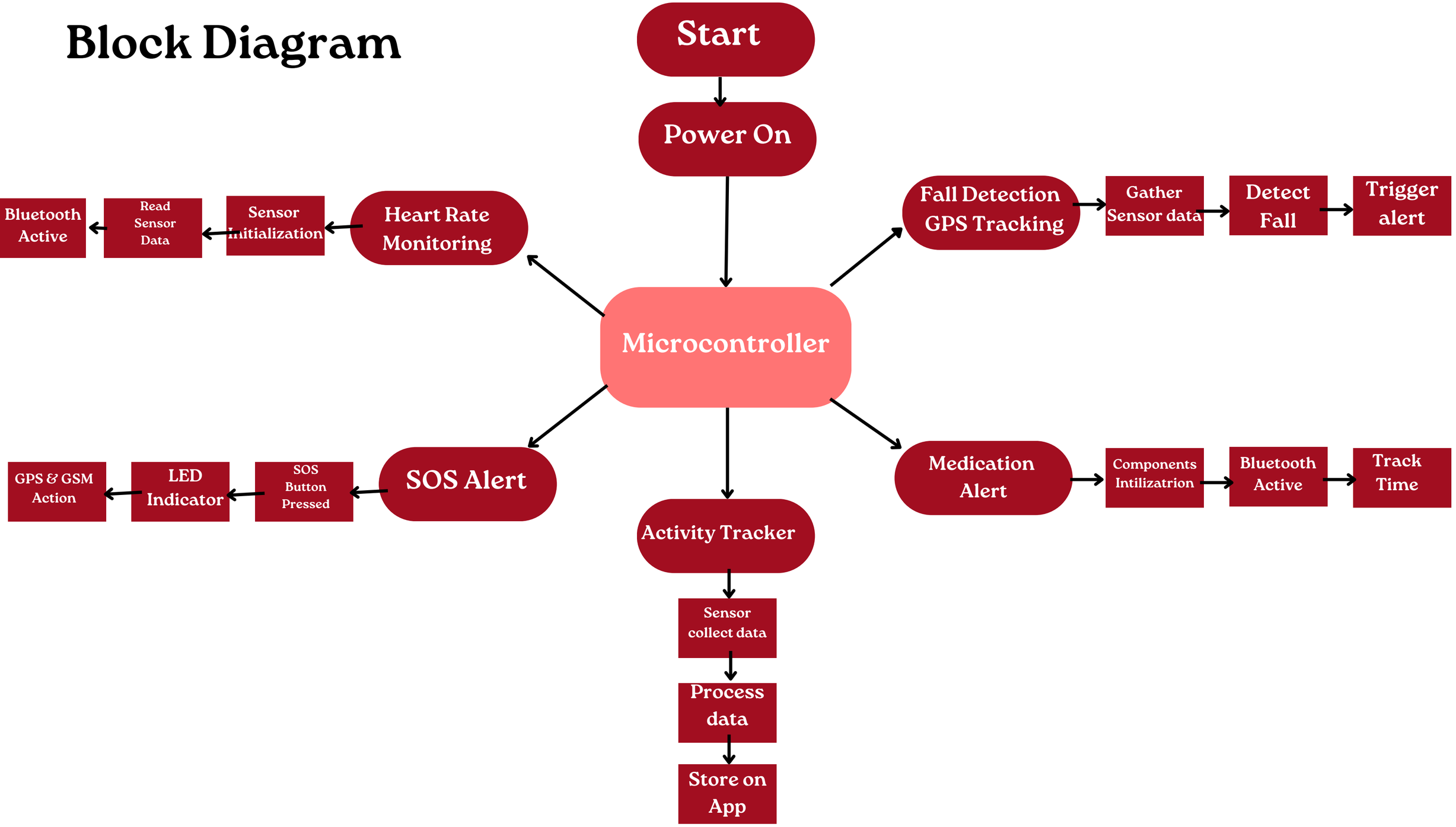


Fall Alert System

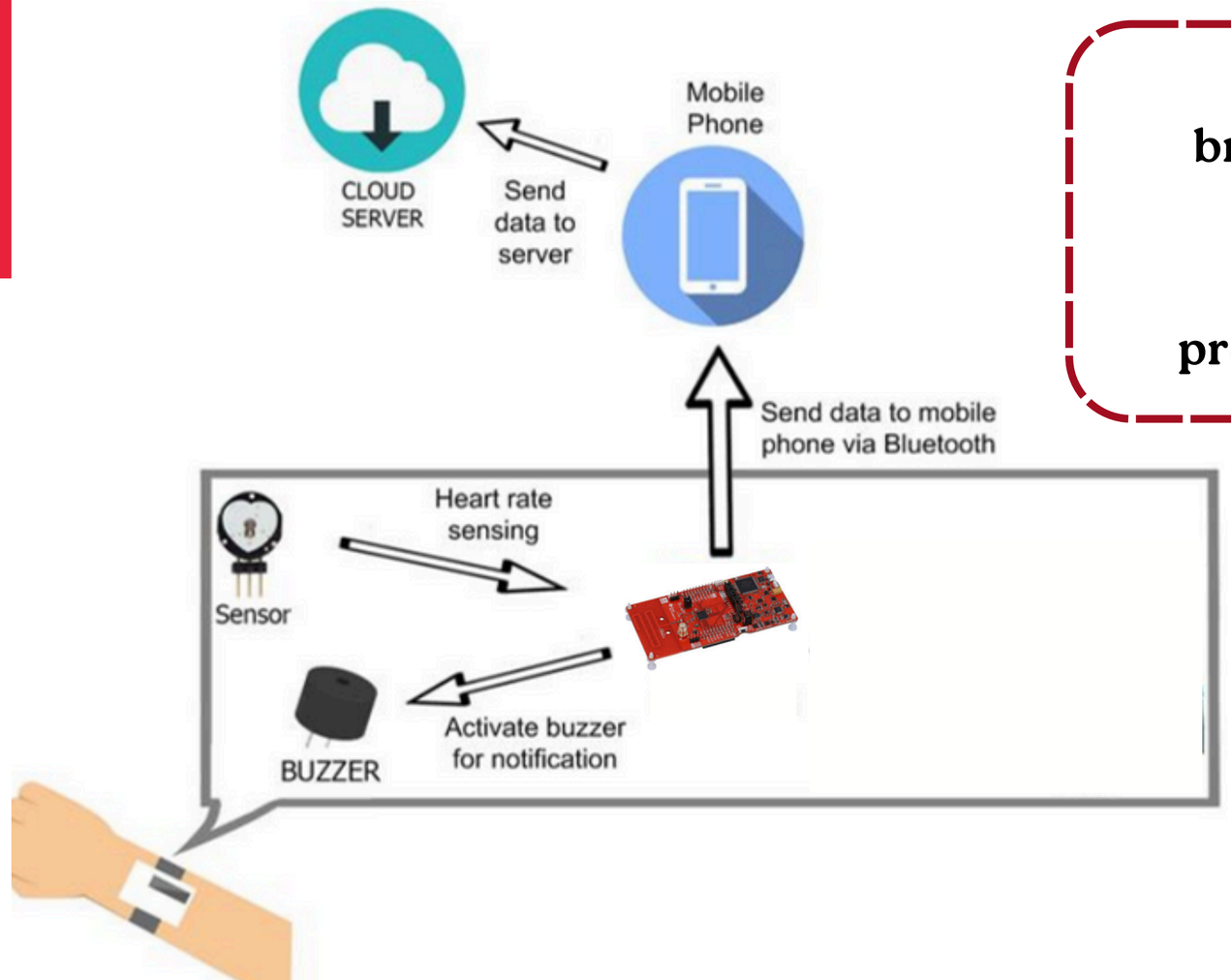
SOFTWARE ARCHITECTURE



Block Diagram

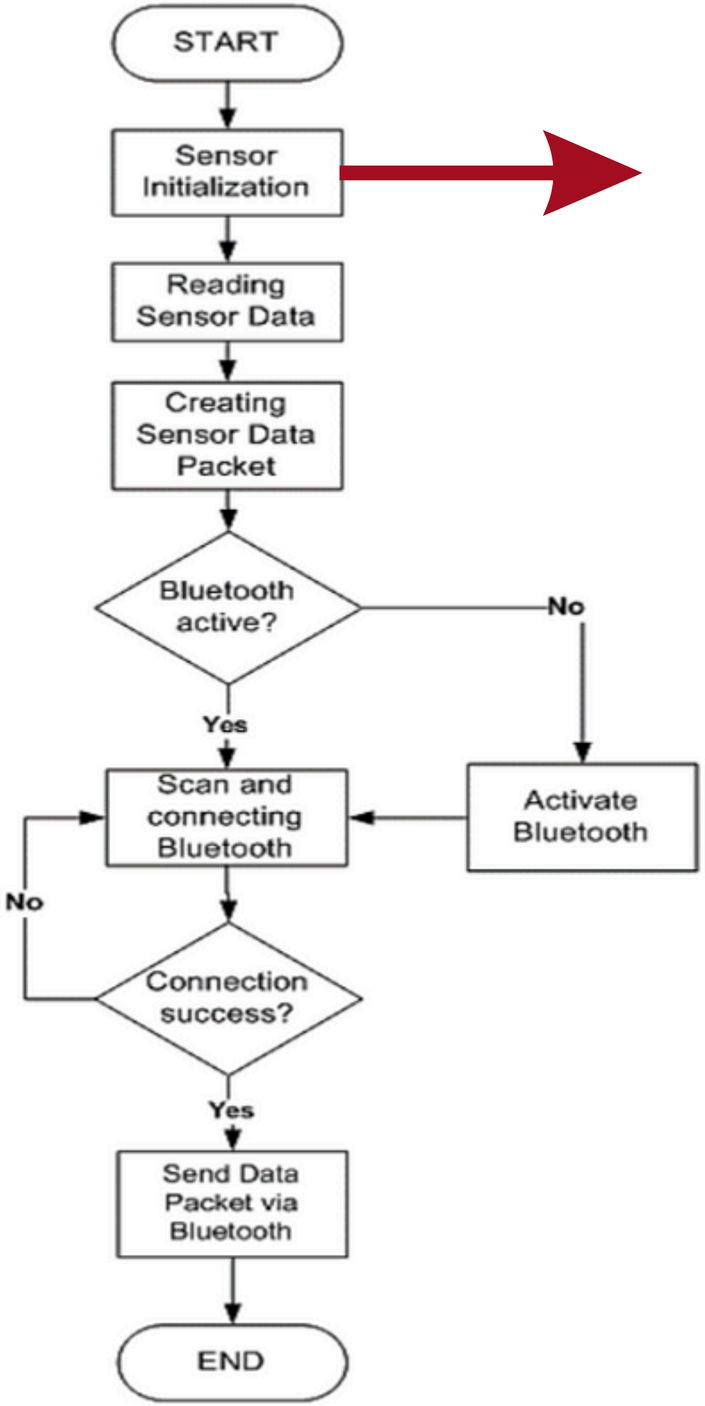


HEART RATE MONITOR



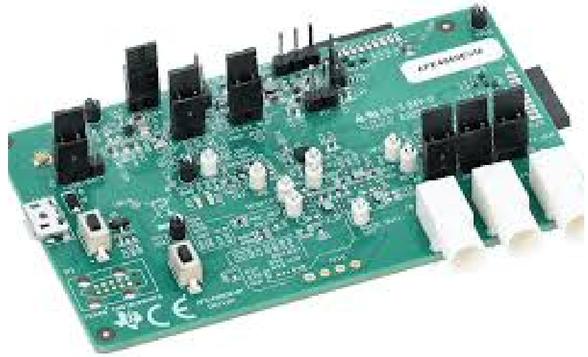
Integrating a heart rate monitor into a smart bracelet aims to provide real-time monitoring of cardiovascular health, offering invaluable insights into the wearer's well-being while promoting independent living and peace of mind.

It is a significant step towards enhancing their quality of life and ensuring proactive health management.



Our Choice

AFE4950



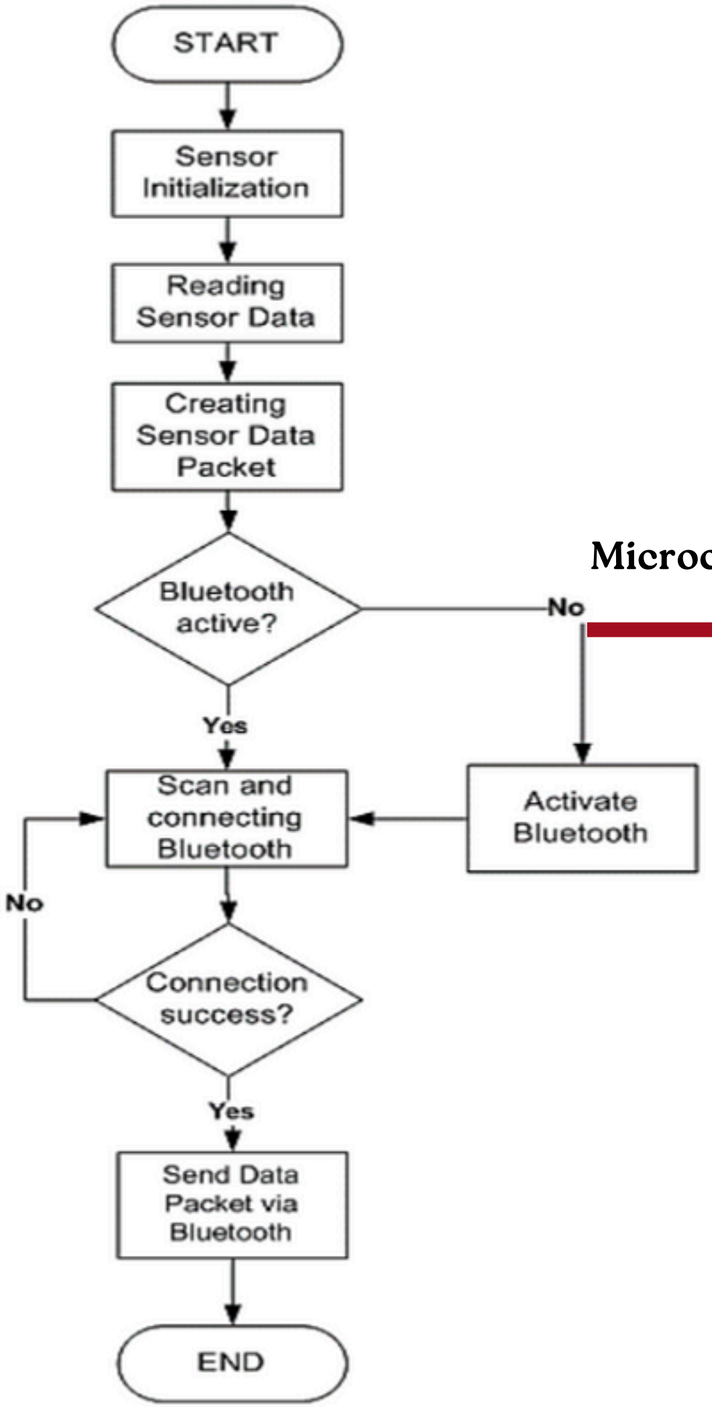
Why?

- High Accuracy
- Low Power Consumption

Integrated PPG and ECG Measurements:

PPG : Provides accurate optical heart rate monitoring.

ECG: Offers detailed electrical heart activity data, enhancing the health monitoring capabilities.



Microcontroller

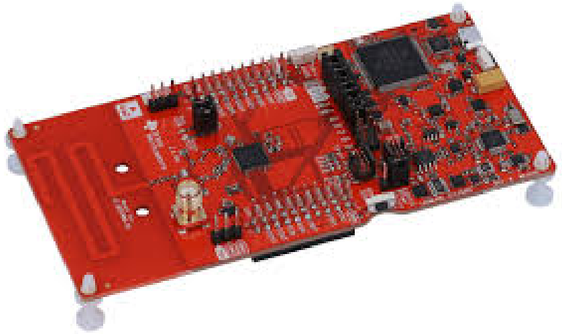
Communication interfaces

Compatible with the AFE4950 sensor

+

Suitable for GPS tracking

Includes BLE capabilities

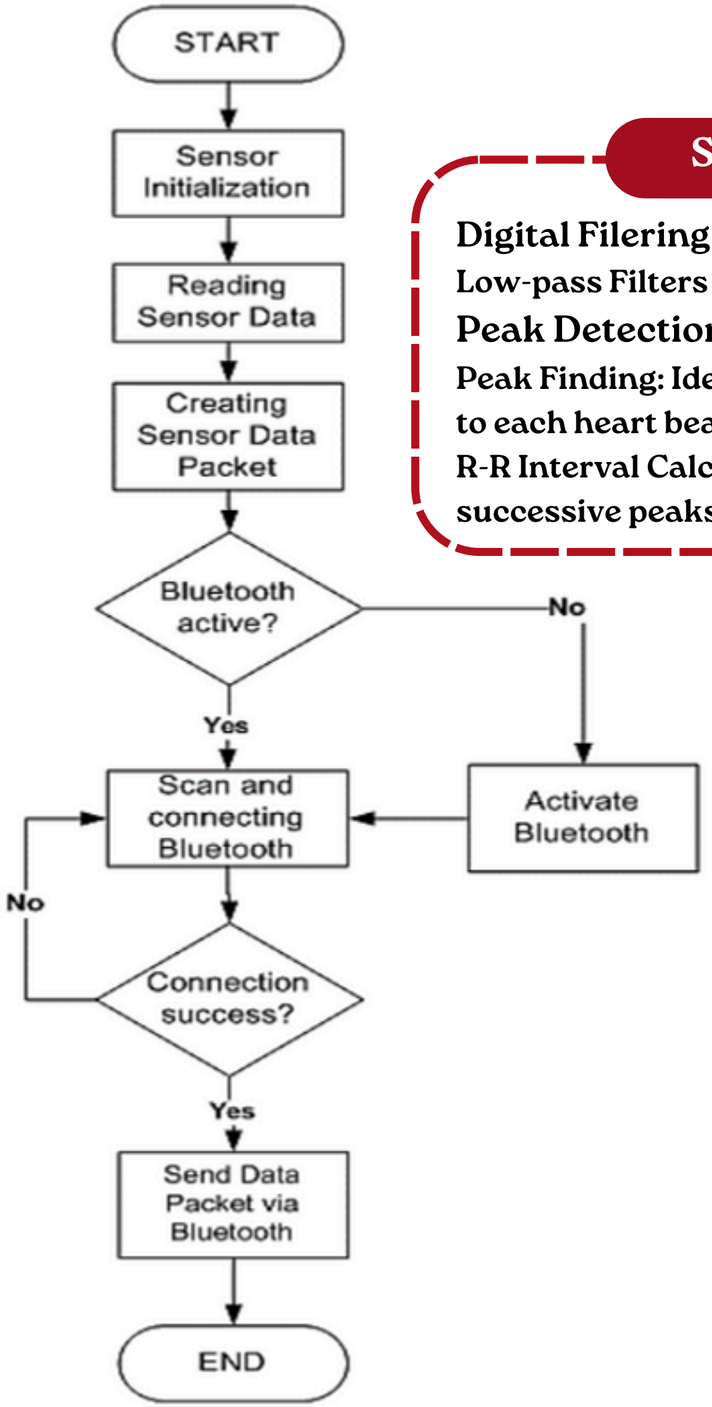


CC1352R

SPI SPI is chosen for its high-speed data transfer capability, essential for real-time heart rate monitoring.

BLE BLE is used to wirelessly transmit heart rate data from the smart bracelet to a mobile application.

Which algorithms do we need?



Signal Processing Algorithms

Digital Filering :

Low-pass Filters and Band-pass Filters

Peak Detection:

Peak Finding: Identify peaks in the filtered signal corresponding to each heart beat.

R-R Interval Calculation: Measure the time interval between successive peaks (R peaks) to determine heart rate.

Data Transmission and Synchronization

Algorithms for transmitting heart rate data via Bluetooth Low Energy (BLE) and ensuring synchronization with connected devices or apps.

- **BLE Data Packaging:** Format heart rate data into BLE packets for transmission.
- **Data Synchronization:** Ensure accurate time-stamping and synchronization.

Heart Rate Calculation

Once the R-R intervals are determined, algorithms calculate the heart rate in beats per minute (BPM).

- **Simple Averaging:** Average the R-R intervals over a period to calculate heart rate.
- **Beat-to-Beat Analysis:** Calculate instantaneous heart rate based on recent R-R intervals for real-time monitoring.
- **Peak Counting:** Count the number of peaks per minute in the filtered signal to estimate heart rate.

Activity tracking

By embedding a sophisticated activity tracker within a smart bracelet, we can monitor daily movements, provide personalized insights, and encourage regular physical activity. This technology not only supports physical health but also contributes to mental well-being, fostering independence and enhancing quality of life for elderly individuals.

Features of Activity Tracking

- Sedentry Reminder
- Calories Burned
- Steps Taken
- Active minutes
- Distance Travelled
- Specific Activity Tracking

FLOWCHART

Sensor Selection and Calibration

Develop Activity Recognition Algorithm

Firmware Development

Hardware Integration

Companion App Development

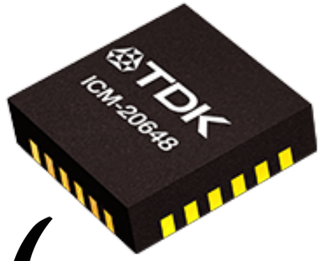
User Experience Design

Accelerometer: BMA-280

Measures the acceleration of any body or object in its instantaneous rest frame

High Accuracy

Low Power Consumption



Gyroscope: ICM-20648

Measures an object's angular motion, or rotational speed

Activity Recognition Algorithm

Rule-Based Activity Recognition Algorithm

- Data Collection: Gather accelerometer and gyroscope data.
- Preprocessing: Filter and segment data into time windows.
- Feature Extraction: Calculate basic features like mean, variance, and peaks.
- Rule Definition: Set thresholds for activities (e.g., walking, running).
- Classification: Apply rules to classify activities based on sensor data.

Machine Learning-Based Approach

- Data Collection: Collect labeled sensor data across various activities.
- Preprocessing: Clean and segment data, extract relevant features.
- Model Selection: Choose and train a model (e.g., Random Forest, SVM).
- Model Training: Optimize model parameters and validate performance.
- Deployment: Implement trained model for real-time activity recognition.

FALL ALERT AND GPS TRACKING SYSTEM

By embedding a reliable and efficient fall detection system within a smart bracelet, we can significantly reduce the risks associated with falls, ensuring timely intervention and support. It is a significant step towards enhancing their safety and well-being.

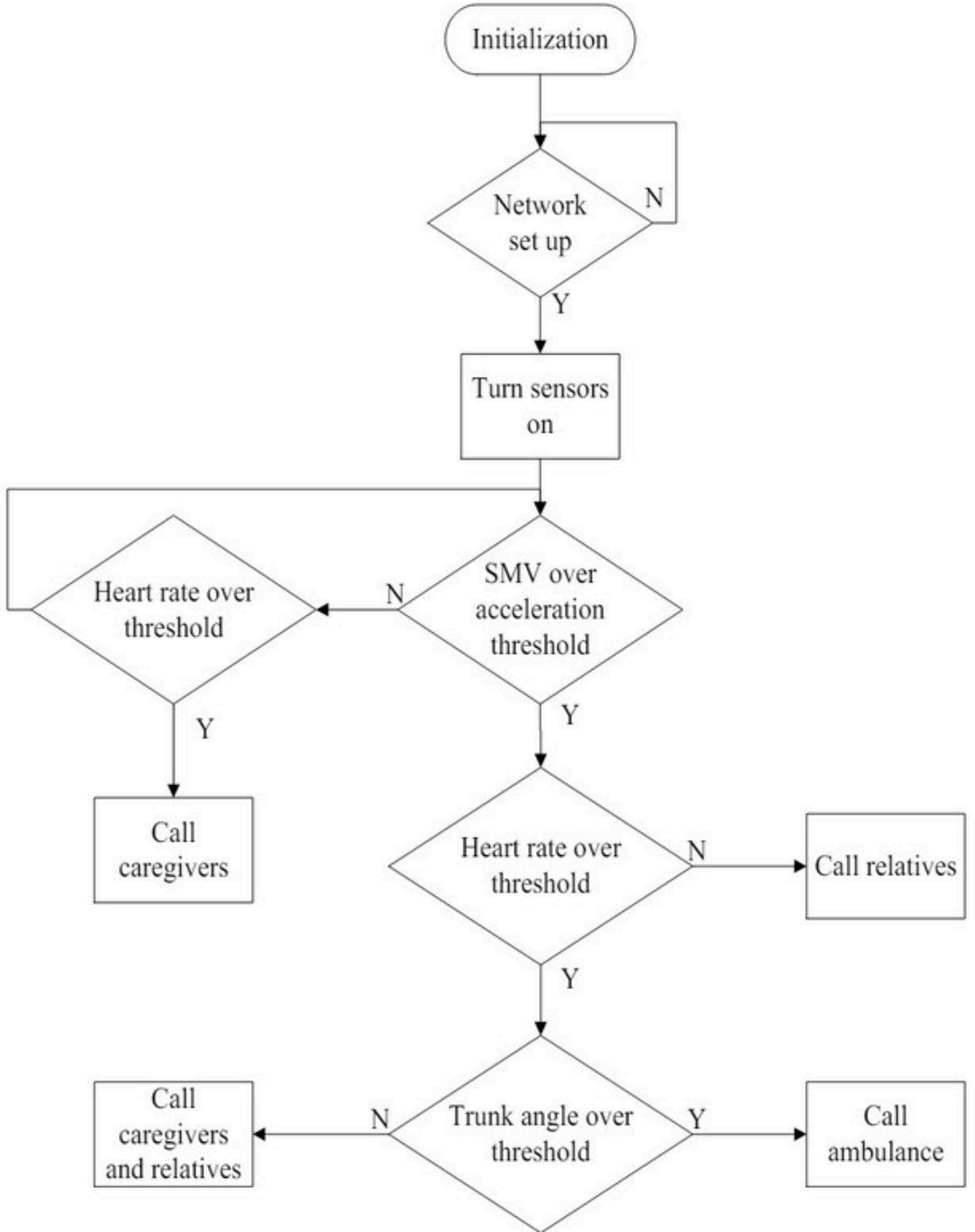
Flow of Fall Alert System

Fall Detection Algorithm

- **Threshold-Based Algorithms:** These algorithms detect falls based on predefined thresholds of acceleration and angular velocity.
- **Machine Learning Algorithms:** More advanced systems use machine learning models trained on large datasets of fall and non-fall events to accurately predict falls.

Alert System

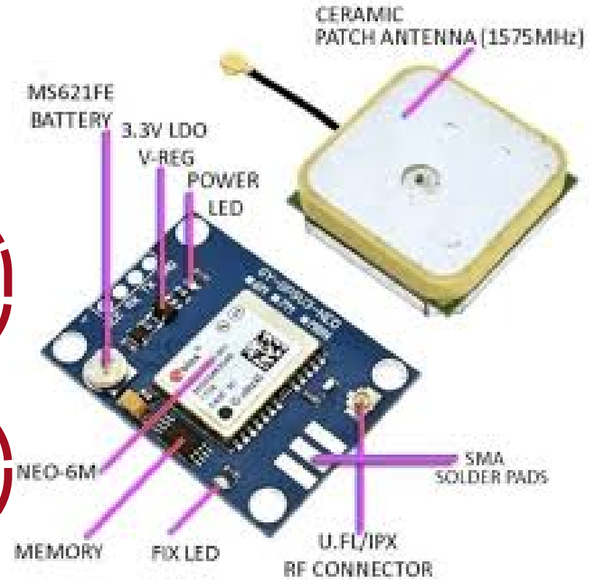
- Sending an alert to a predefined list of contacts (family members, caregivers).
- Providing real-time GPS coordinates of the user's location.



GPS TRACKING SYSTEM

For integrating a GPS module with the TI CC1352R microcontroller

u-blox NEO-M8N



Components of a GPS Module

GPS Receiver: Processes signals from GPS satellites includes an RF front-end to capture and digitize satellite signals.

Microcontroller Processes the digital signals received from the RF front-end and executes positioning algorithms to determine location, speed, and time.

Communication Interface: The best communication interfaces to use are typically UART for the GPS module and SPI for any external memory like flash memory.

GPS TRACKING SYSTEM

Software Development

- The GPS modules receive signals from multiple satellites. These signals contain data packets encoded in a standard format, typically NMEA (National Marine Electronics Association) sentences.
- Data parsing involves reading these NMEA sentences, extracting the relevant data fields, and converting them to usable

`$GPGGA,123519,4807.038,N,01131.000,E,1,08,0.9,545.4,M,46.9,M,,*47`

Sentence Type: '$GPGGA'

Time: '123519 (12:35:19 UTC)
Latitude: '4808.038,N' (48 degrees, 7.038 minutes North)
Longitude: '01131.000,E' (11 degrees, 31.000 minutes East)

Fix Quality: '1' (GPS fix); Number of Satellites: '08'
Horizontal Dilution of Precision (HDOP): '0.9'
Altitude: '545.4,M' (545.4 meters)
Height of Geoid: '46.9,M' (46.9 meters above the WGS84 ellipsoid)

ALGORITHMS

GPS Data Processing Algorithm

Kalman Filter:

A recursive algorithm used to process noisy GPS data and produce a smoothed and more accurate position estimate.

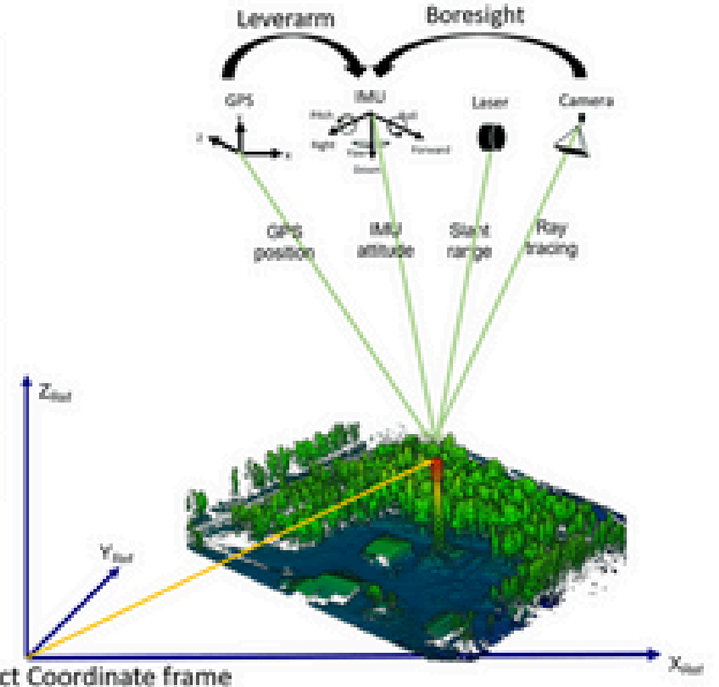
Dead Reckoning:

Uses data to estimate the current position based on the last known GPS position when GPS signals are weak or unavailable.

Location-Based Algorithms

Geofencing

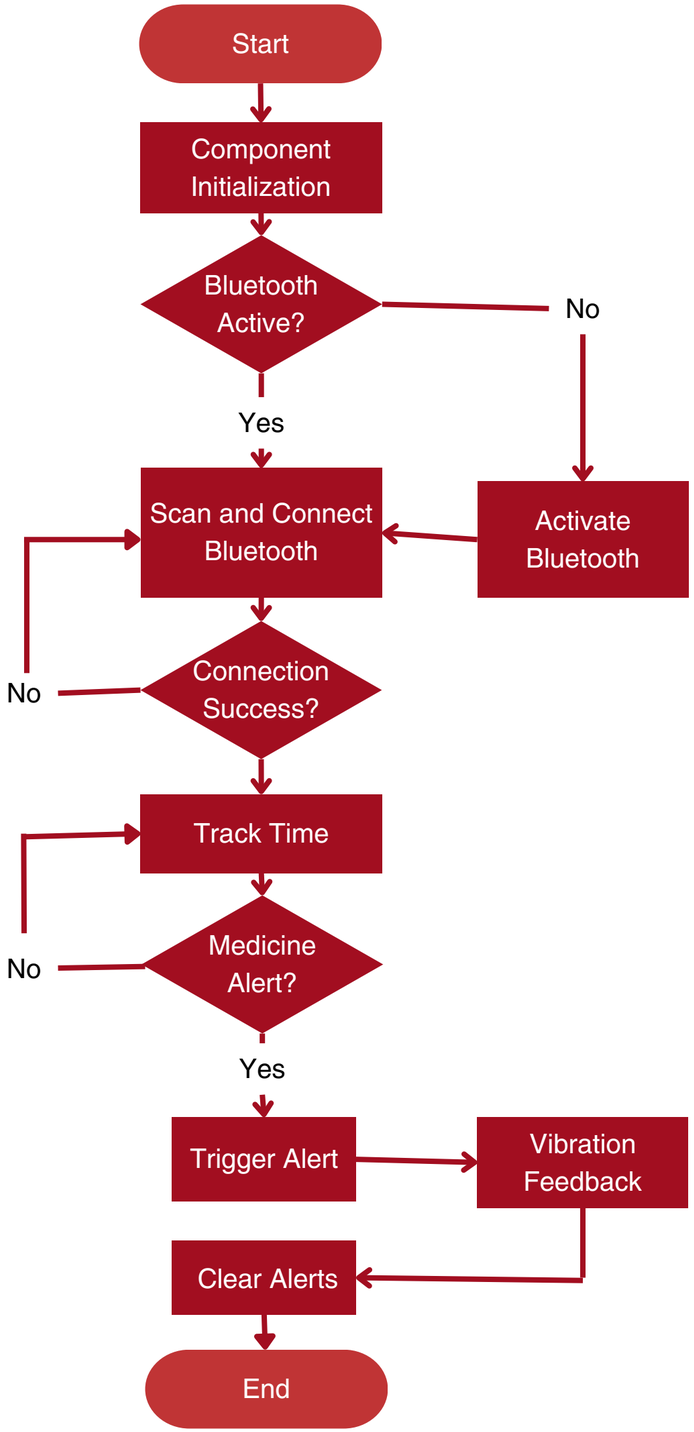
Creates virtual boundaries around specific geographic areas and triggers actions when the device enters or exits these areas.



MEDICINE NOTIFICATION

By embedding a reliable and intuitive medicine notification system within a smart bracelet, we can provide timely reminders, reduce the risk of missed doses, and enhance the quality of life. This technology not only supports physical health but also offers peace of mind for both users and their caregivers.

FLOW


Start
Component Initialization
Bluetooth Active?
No
Yes
Activate Bluetooth
Scan and Connect Bluetooth
Connection Success?
No
Track Time
Medicine Alert?
No
Yes
Trigger Alert
Vibration Feedback
Clear Alerts
End


SOS

FLOW

Connect the RTC module to the MCU using communication interfaces like I2C or SPI.

Ensure proper wiring of the RTC's data (SDA) and clock (SCL) lines to corresponding MCU pins.

Based on the medication schedule, the bracelet's MCU will periodically check the RTC time against the scheduled medication times.

When it's time for a medication reminder, the bracelet will activate the alert mechanism.

Speaker emits a sound alert.

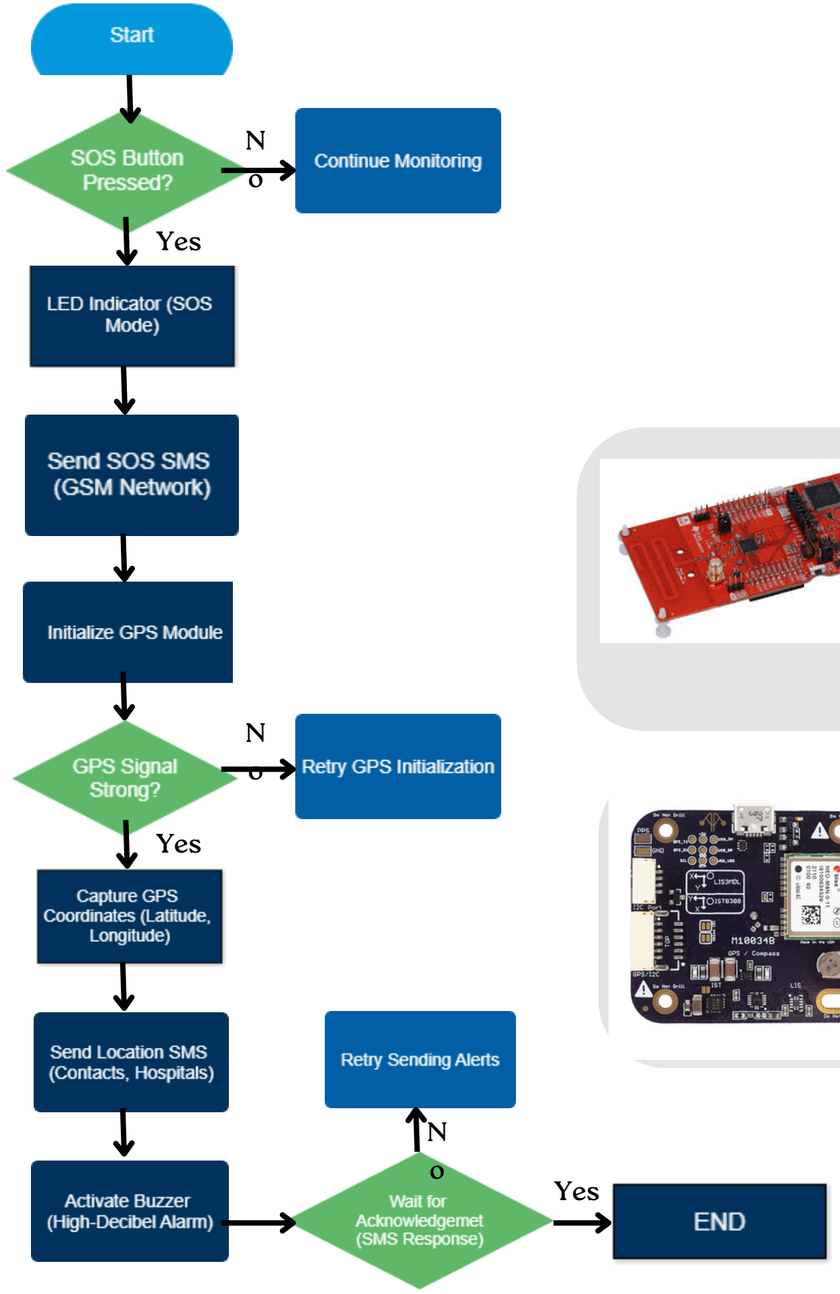
Mobile app that pairs via bluetooth. The app periodically syncs with the bracelet

SOS ALERT SYSTEM

An SOS alert system provides a discrete and accessible means for individuals to call for assistance, whether they are at home or on the go. This technology not only enhances the user's sense of security and independence but also provides relief, knowing that help is just a button press away.

SOS Option

The SOS option in a smart bracelet is designed to provide immediate assistance to elderly users in case of emergencies.

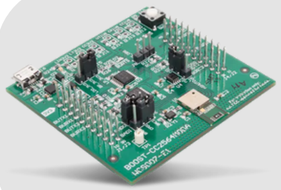


Microcontroller
CC1352R

- Purpose: Manages all operations of the SOS bracelet.
- Features: Low-power consumption, integrated LCD driver, multiple communication interfaces.

GPS Module
u-blox NEO-M8N
IST8308

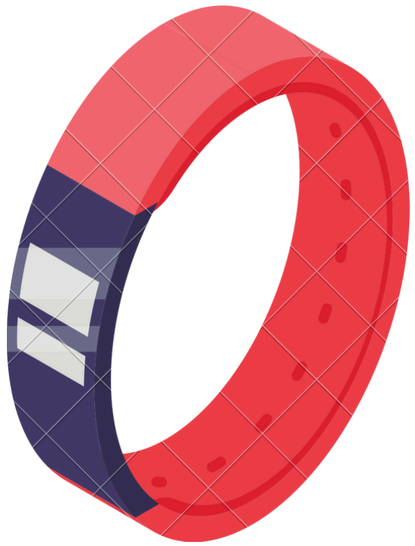
- Purpose: Captures the GPS coordinates.
- Features: High sensitivity, fast time-to-first-fix.



GSM Module
TI CC2564MODA

- Purpose: GSM connectivity for sending SMS alerts.
- Features: Dual-mode Bluetooth and Bluetooth low energy, integrated with high-performance Wi-Fi.

MOBILE APP



Receive Data

Apply ML Algorithms

Sync Data to cloud server

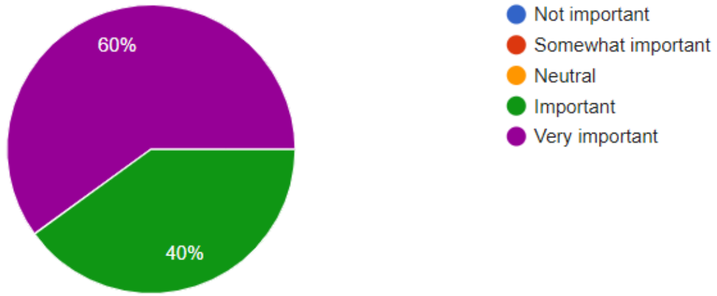
Display

- Heart Rate Data
- Fall Alerts
- Activity Tracking Data

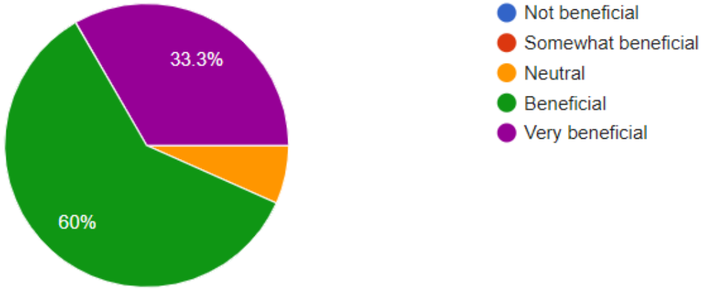
Send Notification Alert

TEST CONDUCTED

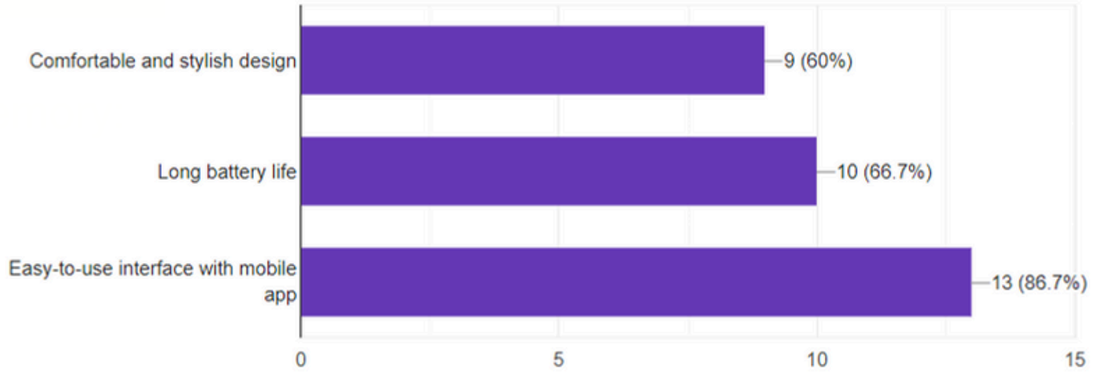
How important do you consider heart rate monitoring for elderly individuals?



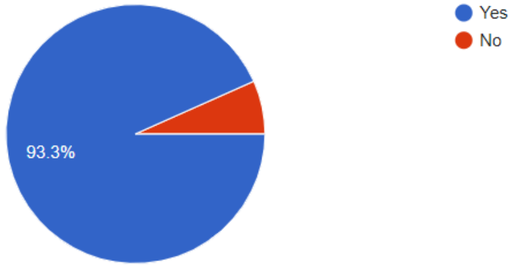
How beneficial do you find the idea of a fall detection and GPS tracking system in a smart bracelet for the elderly?



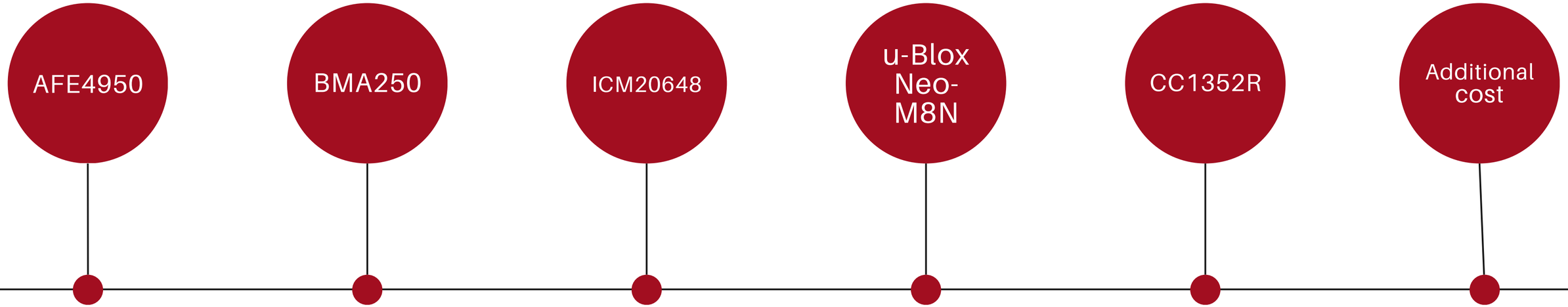
What features would make you more likely to wear the bracelet daily?



Do you think medication reminders/alerts would be useful for the elderly?



Cost



AFE4950	BMA250	ICM20648	u-Blox Neo-M8N	CC1352R	Additional cost
Rupees 400 to 800	Rupees 80 to 100	Rupees 400 to 800	Rupees 800 to 2000	Rupees 400 to 800	Rupees 3000 to 5000

Total Estimated Cost Rs. 6000 to Rs. 7000

Estimated Area: 420 mm^2

Future Scope

- Implementation of wireless charging for rechargeable battery and power management
- Add safety and security protocols to protect from cyber threats and also provide user control to include privacy settings and transparent data usage policies.
- Additional sensors for blood oxygen levels (SpO2), body temperature, etc.
- Utilize ML algorithms to analyze sensor data for early detection of potential health issues.
- 5G integration for faster data transmission and improved connectivity.

References

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keywords: {Heart rate;Senior citizens;Monitoring;Acceleration;Intelligent sensors;Accelerometers;Wireless Sensor Networks;Fall Detection System;Elderly Monitoring;Heart Rate Fluctuation;Sensitivity},

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THANK YOU