Ultra-Wide Band Fall Detection System

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TÜBİTAK

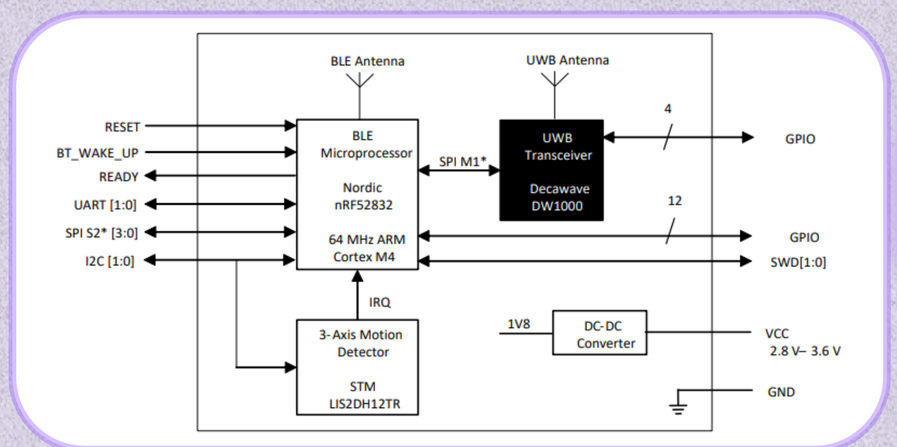
Introduction

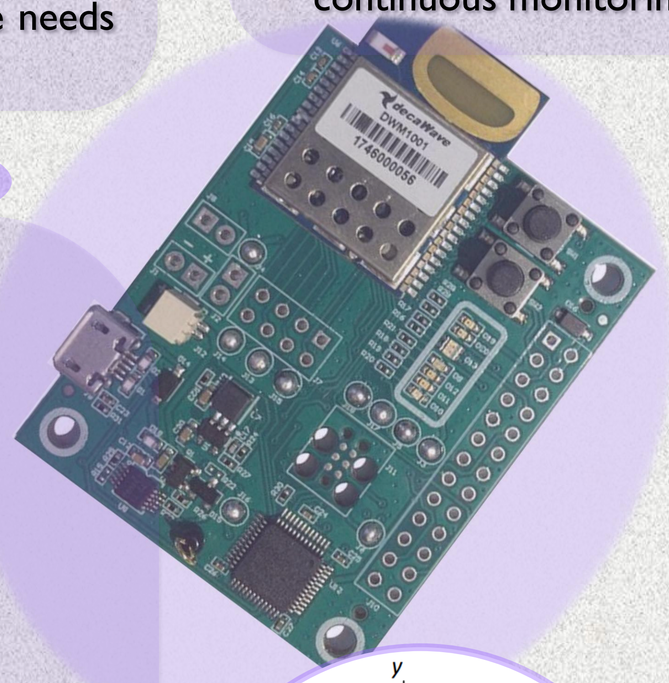
- Today, technology helps us solve many problems, including keeping older people safe. Falls are a big concern because they can cause serious injuries. Our project aims to prevent this by using special sensor devices called DWM1001 modules.
- These small, wireless gadgets can detect how a person moves in different directions. When someone falls, their movement changes suddenly, and these sensors can notice that. By checking the signals between the devices, we can tell if a fall has happened. This system helps us know quickly if someone needs help, making life safer for older adults.

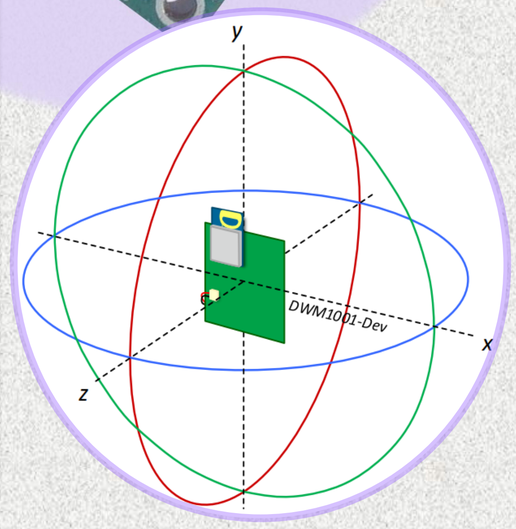
Why Ultra-Wide Band (UWB)?

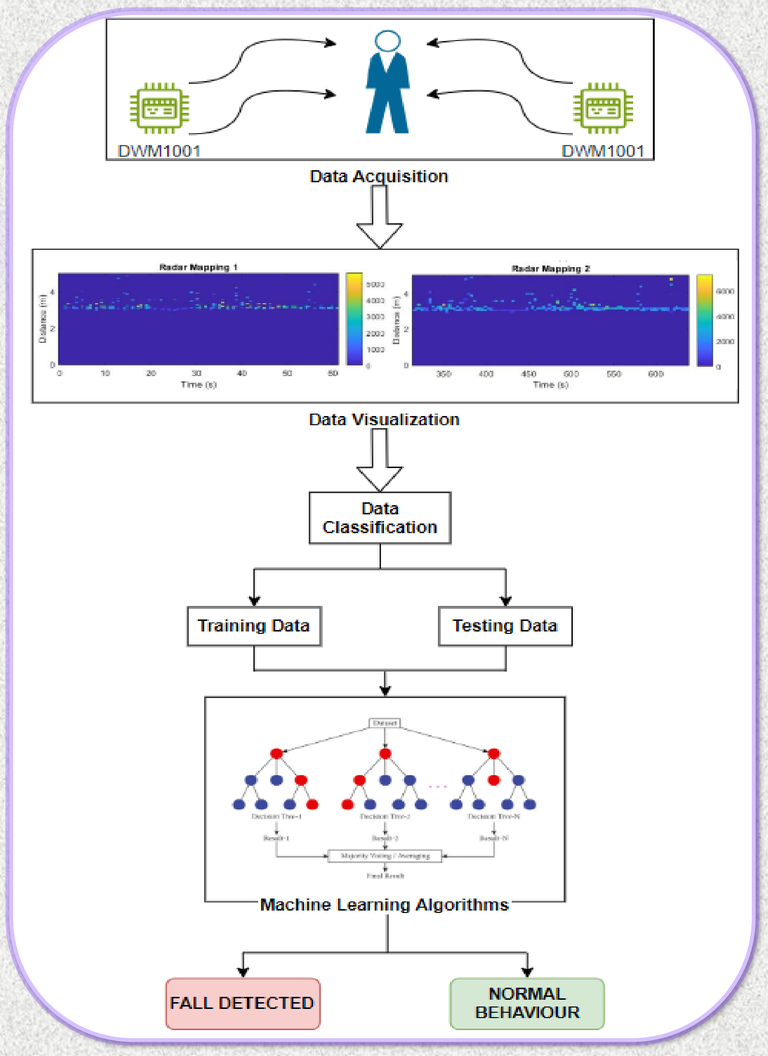
- **High Accuracy**: UWB can precisely measure the distance and position of objects, which is crucial for detecting falls accurately.
- **Reliability**: UWB works well in various environments, including indoors, where obstacles can interfere with other signals.
- **Fast Data Transmission**: UWB provides quick data transfer, ensuring timely detection and alerting in case of a fall.
- **Low Power Usage**: UWB uses less power, making it ideal for continuous monitoring without frequent battery changes.

Specifications and Design Requirements





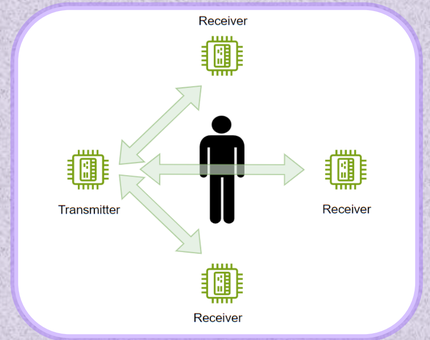




- Low power - Sleep mode: <5µA
- Supply voltage: 2.8 V to 3.6 V
- J-Link on-board for debug and flashing via USB
- PANS firmware for DWM1001:
  - Flexible software architecture allowing UWB based RTLS application
  - Module APIs for configuration and interfacing over SPI, UART, BLE
- UWB PCB antenna (6.5 GHz centre frequency)
- 6.8 Mbps frame data encoding
- Point to point range: up to 60m (line-of-sight)

Methodology

- Segger Embedded Studio: Module Configuration
- Python and MATLAB: Data classification and machine learning.



- ToF(time of flight) calculations and embedded antennas are used to determine distance and amplitude.
- Experimental results of these values classified the data and that classified data feeds the dataset of the machine learning algorithms which determines the specific actions.
- All systems work simultaneously to determine new actions as FALLING or NOT FALLING.

Machine Learning Algorithms

- Random Forest Classification
- K-Nearest Neighbors (KNN)
- Convolutional Neural Network (CNN)

Results and Discussion

- We successfully established UWB communication between four DWM1001 modules and collected data showing how signals changed during activities like standing, falling, and walking between them. The project demonstrated that UWB signals can detect various activities, highlighting their potential for motion detection and environmental monitoring. Future work will focus on improving data analysis and exploring additional activities to better understand signal variations.

References

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