

ABSTRACT

\This research focuses on the increasing need for a more effective fall detection system, especially for the elderly population who are at high risk of serious injuries due to falls. The study is motivated by the limitations of conventional fall detection systems, which often fail to identify falls accurately. Therefore, there is a need for a solution that can enhance detection accuracy while minimizing false detections. This system is expected to provide a more reliable and efficient solution for detecting falls, particularly in the context of the elderly population. The proposed solution in this study is the design of a fall detection system utilizing four subsystems: network, compressive sensing, machine learning, and a web-based application.

In the network subsystem, three nodes are used, each consisting of an ESP32 module and an MPU6050 sensor configured in a partial mesh topology and communicating using the ESP-NOW protocol. This method provides good data communication with a latency of 102 ms and a packet loss rate of 1%. The compressive sensing uses FFT compression and Gaussian Random Projection methods, which function to reduce 50% size of sensor data without losing essential information. The data is then reconstructed using the Basis Pursuit (BP) method. To convert the data back into the time domain and ensure all resulting data is positive, Inverse Fast Fourier Transform (IFFT) and absolute value extraction are performed.

The Decision Tree Classification machine learning algorithm performs well in data clustering with an accuracy rate of 96%, compared to the KNN algorithm at 92% and the SVM algorithm at 73%. This accuracy is crucial in achieving research outcomes that demonstrate the effective functioning of the internet of things and machine learning systems. Furthermore, the performance testing of the web-based application shows good results with CPU usage at 1.7% and RAM usage at 150 MB. With all the specifications presented and tested, the system will provide a reliable fall detection tool.

Keywords: Design and Development, Fall Detection System, Architecture, Compressive Sensing, Accelerometer Sensor.