

ABSTRACT

Falling is the second leading cause of unintentional death in the world according to the WHO (World Health Organization). Unfortunately, the elderly are the most frequent victims of falls. Falls can occur anywhere, but one common place for such accidents is the bathroom. However, currently, there are not many fall detection systems that can effectively detect these accidents, especially in sensitive areas like bathrooms, without causing privacy concern to the users inside.

Several studies have been conducted to detect falls, some of which utilize sensors that can preserve the privacy of users in the bathroom. One of these sensors is radar, which is chosen because it can maintain user privacy, especially in the bathroom, and its ability to detect falls regardless of the environmental conditions it faces (such as minimal lighting and fluctuating temperature). In this research, a fall detection system is designed using radar as the sensor placed in the bathroom. The continuous radar data is preprocessed using FFT and STFT techniques, and a Deep Learning LSTM algorithm is employed for fall motion classification. The classification results are then sent through the IoT Supabase platform to web applications and WhatsApp notifications, allowing users to be aware of the situation and provide immediate assistance.

The final outcome of this design is a fall detection system capable of accurately detecting fall motions with a precision rate of up to 93%. Additionally, it consumes low power, measuring at 0.021 kWh over 8.5 hours (equivalent to a power consumption of 2.4 watts). Furthermore, the system has been tested to operate continuously in a humid environment (around 95% relative humidity) for up to 10 hours, and it has proven to preserve user data privacy because the spectrogram data produced by the radar is challenging to near impossible for humans to interpret in general.

Keywords: falls, radar, privacy, LSTM, FFT