ABSTRACT

Monitoring Vital Signs in Vehicles using mm-Wave Radar and Machine Learning Approaches

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Keywords: Vital signs monitoring, mm-wave radars, machine learning

In recent years, the combination of radar sensors and machine learning has transformed vital sign monitoring, especially in the healthcare and automobile industries. This study uses mmWave radar technology in vehicles to monitor vital signs, which addresses issues such as driver weariness. When integrated with machine learning, the technology provides non-invasive, privacy-preserving physiological monitoring solutions in settings such as patient care facilities and vehicle cabins, while still performing efficiently in demanding environments. Machine learning improves the accuracy of radar-based monitoring by processing vast amounts of sensor data, but maintaining precision in noisy situations such as vehicles is difficult. This study addresses these issues by correctly monitoring both drivers and passengers (Ahmed & Cho, 2024).

This presentation discusses hardware restrictions, implemented solutions, and current software concerns related to vital sign acquisition. Techniques like Gaussian noise addition and Generative Adversarial Networks (GANs) can enhance the accuracy and reliability of collected datasets. Autoencoders are preferred over traditional filtering methods like Kalman filters, as they can effectively solve non-linear problems and remove noise and background. Machine learning approaches such as Convolutional Neural Networks (CNNs) and self-calibrated Long Short-Term Memory (LSTM) are found to be more effective for feature extraction in diverse environmental conditions (Zheng et al., 2021). Traditional autoregressive models are noise-sensitive, so machine learning methods like Temporal Convolutional Networks (TCNs) are recommended for signal processing, real-time vital sign recording, and reconstructing heart rate variability without connected sensors. Cutting-edge hardware solutions like radars and graphical processing machines, such as Jetson Nano, are utilized by the research team to address the challenges of real-time machine learning (Zhang et al., 2022).

References

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