Title: Human Activity Recognition Using Thigh Angle Derived from Single Thigh Mounted IMU Data

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Abstract:

Accurate human activity recognition is a challenging research topic in various fields. This paper presents a novel approach to detecting human activities based on thigh angle computed using data from a single thigh-mounted Inertial Measurement Unit (IMU). The goal of this work is to assist the vision impaired in indoor navigation. The algorithm utilizes simple signal processing techniques such as peak detection, zero crossing detection, and timers to identify activities based on the thigh angle computed from accelerometer and gyroscope data. The algorithm achieves promising results in activity detection in indoor pedestrian navigation applications, with accuracy rates of above 78% for standing, above 92% for walking, and no measured errors for sitting.

Keywords: Human gait analysis, activity recognition, inertial sensors, indoor navigation

Introduction:

Accurate human activity recognition is crucial for precise pedestrian tracking. In indoor navigation, the main activities are standing, sitting, and walking. This paper proposes a novel approach for human activity detection using the thigh angle derived from a single thigh-mounted IMU. Previous work has primarily used 3-axis accelerometers or a combination of accelerometers and gyroscopes for activity detection. The authors aimed to develop a computationally efficient algorithm without the need for extensive filtering. They assumed that the accelerometer's y-axis aligns with the thigh, allowing the gyroscope's x-data to represent the thigh's forward and backward movement.

Existing Work:

Previous research on human activity detection has used 3-axis accelerometers or a combination of accelerometers and gyroscopes. Various algorithms have been proposed, but many of them are computationally intensive and require high processing and memory capabilities. The authors discuss the limitations of existing techniques, including their accuracy in slow walking speeds and stair climbing.

Indoor Activity Detection Algorithm:

The authors collected data on walking, standing, and sitting activities using a thigh-mounted IMU. Thigh angle was computed by fusing accelerometer and gyroscope data. The algorithm detects activities based on the envelope of the thigh angle and the detection of steps. Activities are classified as standing, sitting, or walking based on specific thresholds and timing mechanisms. The algorithm achieves accurate activity detection with minimal computational demand.

Experimental Setup:

The experiment involved two young females and two young males without any disabilities or impairments. The IMU was attached to each thigh, and two trials were conducted for each thigh. The data collected during the experiment was used to validate the proposed algorithm.

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