IC-SAFE: Intelligent Connected Sensing Approaches for the Elderly

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I. INTRODUCTION

The norm of our societal life consists of various communication methods. However, senior citizens, young children, and people with age-related diseases often find it hard to express themselves. They are not fully aware of their need for help or how to ask for assistance. This lack of awareness decreases the quality of life and even endangers those individuals.

The primary objective of the IC-SAFE (Intelligent Connected Sensing Approaches for the Elderly) is to track the safety of the elderly by using various connected, intelligent wearable sensors. Dementia patients have been observed to perform specific actions, alluding to their need for assistance. In theory, an individual can recognize a lack of movement (a long idle status), the onset of aggression or tremors, and aggravated dementia due to depressive rumination as an issue. However, a patient with dementia will not be able to appropriately express their needs to a caretaker in a timely fashion. IC-SAFE consists of motion sensing, classification, and evaluation functions (Fig. 1). IC-SAFE provides an automated and minimally invasive solution for sensing initial symptoms of distress (both physical and emotional) by coordinating motion data, including walking gaits, arms and leg tremors, and long lounging positions to classify the safety status of dementia patients both physically and emotionally. Lastly, it alerts family members and caretakers about the situation before the symptoms foster a further diagnosis.

This project identifies several scenarios for dementia patients and proposes a few practical detection algorithms. It has been observed that patients with dementia perform certain repetitive motions, such as walking in a circle and sitting idle with their head bowed, in addition to the onset of other symptoms, such as aggravated tremors in the hands, knees, and ankles. We have obtained these motions to indicate emotional or physical status changes. We further characterized these actions as abnormal walking patterns and repetitive movements, specifically hand and leg tremors. To eliminate false positives triggered by reading books, regular walking, and handwriting, we have identified a threshold between similar actions, all of which have a high confidence rate.

Feasibility tests have been performed using IMU (Inertial Measurement Unit) sensors in various positions, and data from these experiments have been gathered. We have proposed efficient real-time algorithms using analytical learning methods and identified several safety target scenarios by analyzing the corresponding gait data (Fig. 1). Although the current prototype is a basic experimentation prototype, it eventually targets to automate an Alive Inside [1] application as a future product. Alive Inside is a humanitarian project to revitalize the memory of senior citizens by playing cherished music of their youth (and memory). However, due to being a manual process, music cannot start playing when needed. IC-SAFE would be able to automatically sense emotions and play the right music for the patient (the music selection is another area of research - AI-driven precision music DJing) via bone-conducting headphones or intelligent speakers such as Alexa, Google Assistant, and Siri.

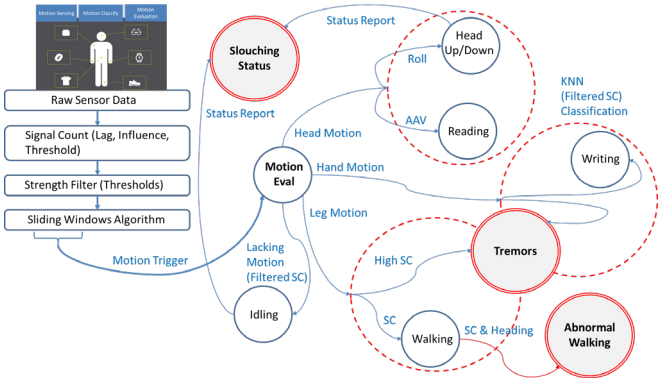

Figure 1: IC-SAFE Algorithm

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REFERENCES

1. Alive inside, http://www.aliveinside.us/land.