

# Smartwatch as an Assistive Technology: Tracking System for Detecting Irregular User Movement

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## ABSTRACT

Wearables may have notable potential as an assistive technology for persons with various difficulties. Although quite popular, smartwatches' niches are still revealing. One of them is definitely in the domain of assistive technology due to their communication and location features. Positioning features enable parents or caregivers to know the whereabouts of child or persons with disabilities, thus increasing their safety. The paper presents smartwatch tracking system for people with complex communication needs with emphasis on detection of smartwatch wearer's common movement routes. The application is a result of multidisciplinary research performed in the area of information and communication technology, as an assistive technology aiming to explore the technological possibilities of connecting new generations of mobile devices and their technological supplements, or wearables, in order to establish a different communication and location aids.

## KEYWORDS

Assistive Technology, Disability, Irregular Route Detection, Smartwatch, Smartwatch Tracking, Wearables

## 1. INTRODUCTION

A person who cannot communicate in conventional ways has needs that are highly individualized and complex (Pavlisa et al., 2012). Nowadays, persons with Autism Spectrum Disorder, motor disability, cognitive disability or childhood apraxia of speech are considered as persons with complex communication needs (King, 2006) or shortly, persons with CCN. They use different modes to communicate - ranging from low-tech to high-tech devices. The complexity of communication processes should make us consider all forms of AAC depending on the function of communication (e.g. conversation, instant messaging, writing e-mails, presentations). Smartwatches are often described as a new tool for people with complex communication needs because a person can easily wear it on the wrist at all times, unlike other devices they could easily lose or misplace. It is important that the application on the watch is easy-to-use and that it gives the user a feeling of independence. The following are advantages of using smartwatches for persons with disabilities:

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- Proximity - wrist mounted;
- The possibility of remotely alerting in an emergency;
- Reminders about where and when to be and what to do;
- To use it for presentations;
- Tracking possibilities;
- Improvement of the quality of life for the whole family.

The literature shows that adults who use AAC combine different modes, from manual signs to high-tech devices. The research shows that the use of common technology like smartwatches, smart phones and tablets broadens the communication skills especially for adults who are seeking employment or are employed (Bryen et al., 2007, Muller, 2014). Adult AAC users report the use of smartwatches during training, using text-to-speech or delivering highly effective audio-visual presentations.

Another innovative function of the smartwatch puts it in the category of safety products. Namely, children and some adults with Autism Spectrum Disorder and/or intellectual disabilities still need a considerable amount of surveillance from their parents in order to keep them safe. Some children and adults have a tendency of wandering from their everyday environment (Solomon, Lawlor, 2013). The smartwatches can be used for tracking children with CCN. The watches are used in the same manner even for tracking teenagers. Nowadays there are applications which alert the parents/caregivers when their children change locations, leave a defined safe zone or enable them to locate their lost child. The function of the smartwatch as a safety product contributes to better quality of life of the whole family because it reassures them that their child or adult will be safe while wearing the watch.

The paper presents multidisciplinary research performed in the area of information and communication technology, focusing on the smartwatch application as the assistive technology for locating persons with CCN based on the concept of “safety zones”. The research gathers scientists and experts from ICT, educational and rehabilitation sciences, psychologists and graphical designers. The paper is organized as follows. Section 2 presents research background in terms of multidisciplinary cooperation and potential of using smartwatch as an assistive technology. Section 3 describes some graphic design issues related to smartwatch applications. System for tracking smartwatch wearers is given in Section 4. System enhancement by detection of smartwatch wearer’s movement routes is given in Section 5. Paper concludes with some results and future work remarks.

## 2. RESEARCH BACKGROUND

Since smartwatches appeared on the market, there were several inquiries from the Croatian community related to the persons with CCN for the application that would allow locating persons with CCN. Smartwatches are becoming more and more present on the market, they are rather affordable and have the desired location-related functionalities. Before the emergence of smartwatches, many medical solutions were available to users through smart phones, as presented in a study by Silva et al., 2016. Smartwatches can be observed as an alternative or complimentary device to a smartphone, and the idea is to use smartwatch for providing the location of a person with CCN while parents or caregivers could get the location of a smartwatch wearer in real time via mobile and web application. There are several examples of using smartwatches for positioning people, such as the work presented by Correa et al., 2016. Other researchers, such as Lee et al., 2015, tend to apply smartwatches for indoor positioning by using innovative approaches since GPS typically performs poorly in closed environments.

Smartwatch application aiding adults with mental health issues like ADHD and mild forms of attention deficiency, using two tools to foster extended focus and tools to reduce anxiety/stress, is described in (Dibia, 2016). Efforts for supporting and securing the everyday life for the elderly by using smartwatches are presented by Lutze et al., 2015. Lee and Song (2016) present a scheme to analyze problematic behavior in children with developmental disabilities by using a 3-axis accelerometer,

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