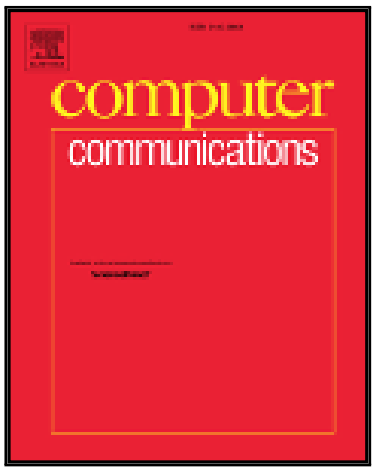

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Exploiting IoT technologies for enhancing Health Smart Homes through patient identification and emotion recognition

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Abstract

Currently, there is an increasing number of patients that are treated in-home, mainly in countries such as Japan, USA and Europe. As well as this, the number of elderly people has increased significantly in the last fifteen years and these people are often treated in-home and at times enter into a critical situation that may require help (e.g when facing an accident, or becoming depressed). Advances in ubiquitous computing and the Internet of Things (IoT) have provided efficient and cheap equipments that include wireless communication and cameras, such as smartphones or embedded devices like Raspberry Pi. Embedded computing enables the deployment of Health Smart Homes (HSH) that can enhance in-home medical treatment. The use of camera and image processing on IoT is still an application that has not been fully explored in the literature, especially in the context of HSH. Although use of images has been widely exploited to address issues such as safety and surveillance in the house, they have been little employed to assist patients and/or elderly people as part of the home-care systems. In our view, these images can help nurses or caregivers to assist patients in need of timely help, and the implementation of this application can be extremely easy and cheap when aided by IoT technologies. This article discusses the use of patient images and emotional detection to assist patients and elderly people within an in-home healthcare context. We also discuss the existing literature and show that most of the studies in this area do not make use of images for the purpose of monitoring patients. In addition, there are few studies that take into account the patient's emotional state, which is crucial for them to be able to recover from a disease. Finally, we outline our prototype which runs on multiple computing platforms and show results that demonstrate the feasibility of our approach.

1. Introduction

The number of elderly people is rapidly increasingly in several countries, including the USA and Brazil [14, 13]. These people tend to live alone and are prone to have more diseases than young people. In addition, they are often treated at home after surgical treatment or after being discharged from hospital. While having a "24/7 nurse" is ideal, most people cannot afford this type of service. This often means that technology is used to monitor patients and elderly people while they are recovering at home. These systems can monitor them and issue alerts to nurses and/or relatives whenever necessary.

In view of this, the use of Health Smart Homes (HSH) is extremely important [29, 30]. The concept of HSH has emerged from a combination of telemedicine, domotics products and information systems; it can be defined as a Smart Home that is equipped with specialized devices for remote healthcare. These devices are mainly sensors and actuators that can take action whenever a critical situation is detected. This has been exploited in several works [37, 28], where the authors propose technological solutions to help caregivers monitor people in need. The aim is to give elderly people who are suffering from a disease, some independence so that they can live their lives in a more self-reliant manner.

During our research, it was found that most research projects are concentrated on improving the daily lives of patients by providing them with specific gadgets, such as alert alarms. This can be seen in [31, 38, 17]. In this sense, Intel Corporation has developed an ultrasound-based system [17] to monitor elderly people at home as part of their Internet of Things (IoT)