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Review

Health parameters monitoring by smartphone for quality of life improvement

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ABSTRACT

The large diffusion of smartphones equipped with new built-in sensors has stimulated researchers to develop applications in different fields. The aim of this work is to provide an overview of the most significant health-care applications. Interest is focused on the use of (i) 3D accelerometer for actimetric, body posture and falls monitoring, (ii) camera for evaluating cardiovascular system parameters, blood oxygen saturation, and eye pathologies, and (iii) microphone for recognizing diseases of the respiratory system. A comparison of these applications to traditional medical devices is discussed, in order to highlight strong and weak points. Limits and possible future research directions are argued.

Contents

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1. Introduction

The ever-increasing diversification in mobile phone use [1] has made available new human–machine interfaces (e.g., touchscreens, voice and gesture recognition), high and affordable data rates of mobile networks, and new powerful and simultaneous energy efficient microprocessors [2]. Moreover, different sensors (Fig. 1) not strictly related to communication are integrated such as Complementary Metal-Oxide Semiconductor (CMOS) sensors of the camera to take pictures and record videos, accelerometers to detect the rotation of the screen, and GPS to use the smartphone as road navigator or to detect possible loss of the smartphone. All these sensors permit extending the smartphone from a communication device to a measurement device [3] for monitoring health parameters and quality of life.

Owing to a very large diffusion worldwide, about 93% of world population (Fig. 2) are smartphone users [4]. However, there are also common diseases diffused around the world, Fig. 3, which can be prevented or better treated through continuous and ubiquitous health monitoring by the smartphone.

Europe has the highest median age in the world, where about 20% of the population is aged 65 and older. Smartphone is a great support for ensuring a safe environment and quality of life improvement by monitoring diseases related to the musculoskeletal system and fall detection for the elderly.

A 2014 report of the American Heart Association [5] estimated the mortality risk of the population due to high blood pressure at about 41%. Daily monitoring of the heart

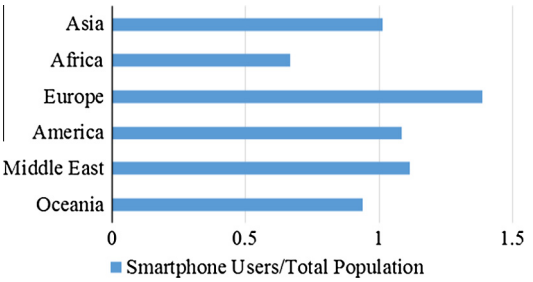

Fig. 2. Smartphone users for continent.

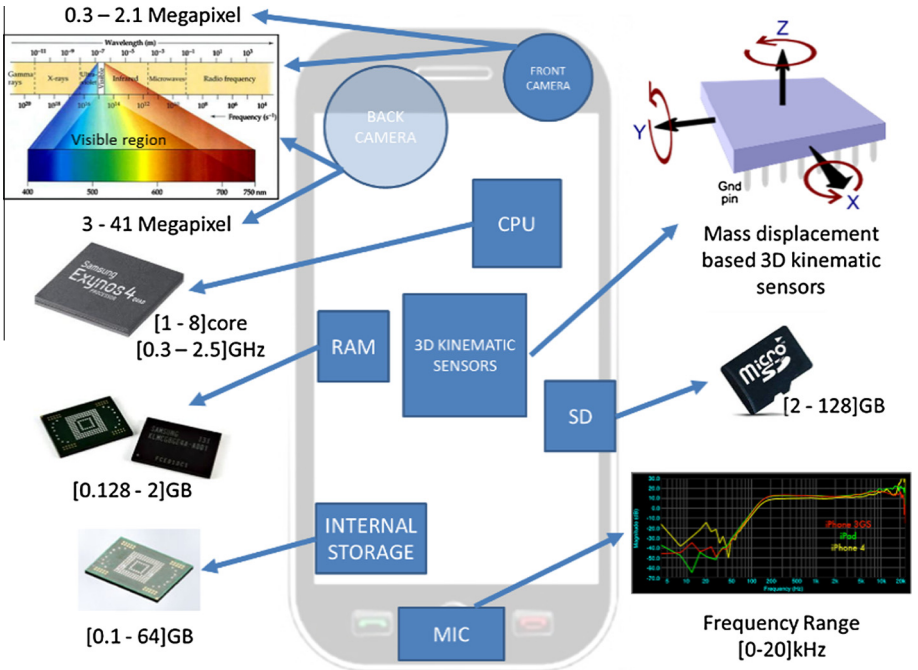

Fig. 1. Built-in sensors and hardware components making the smartphone an interesting tool for health monitoring and quality of life improvement.