Health Wearables Turn to Fashion

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INTRODUCTION

In the early years of manned space exploration, it is observed that astronauts easily loose a sense of time. Consequently they forget to eat in time and are not constantly fit to operate. From the need to monitor the physical condition of astronauts during travel, it became customary to equip their clothing with health sensors (Soller, 2002). One can see this as an early instance of health tele-monitoring.

These measures originate from the customary monitoring of test pilots to find the effect of extreme flight situations on the human body. But in space travel, the monitoring was not just performed during a couple of minutes but routinely for weeks or even months. This has been extended to other situations where a human pilot is confronted with extreme, potentially life-endangering situations, such as car racing. In all such situations, the clothing can be rigged with a wired network of a fixed-design sensory network and connected to a single control room (Jafari, 2006).

With the advance of microelectronics, a potential consumer market is opening. Mobile Health (m-health) is a technical challenge at the crossroads between personal fitness and hospitalization costs. Lack of exercise and/or bad nutrition undermines health and brings diseases such as heart failure and diabetes that can be hardly cured once become easily noticeable. Ultimately hospitalization cannot be avoided. Such stays will be regular and lengthy while surgery will be part of the service.

Tele monitoring is currently tested to reduce the length of hospital stays and the number of check-up visits by providing post-surgery health monitoring at home over remote links. On the other hand, a proper life style can delay the advent of diseases or even preclude their coming. The current research interest is to collect data on large groups of people to identify risk groups. Then persons with a high risk can be identified and will receive pre-screening. Consequently, organizing special heart failure and diabetes clinics reduce hospital costs.

People do fitness in order to stay in shape. Usually it requires a regular doctor visit to ensure that the training does not damage the person's health. Self-quantification allows the person to play doctor himself, making the health check available constantly. There are little more health-related products in the common house than the thermometer, scales, cough drops and the medicine cabinet. Tele-monitoring requires additional 2,500 Euro worth of equipment to be installed in the house of the patient. This price tag cannot be tolerated for the average household, but the insurance may pick up the tab for the approved patient. Usually health-monitoring equipment is found in clinics and fitness clubs, where many people can take advantage. The modern equivalent is the 'kiosk': a dedicated booth in public places in and outside hospitals that can be visited at will and provides equipment in a direct link to the hospital infrastructure.

M-health is the next step to bring affordable healthcare in the home, and to any place where a person goes. It can be attached as simple gadgets or be integrated as plaster, garment or ornament. But it will only be more than a consumer gadget, when it (a) gets medical quality information and (b) communicates that information to the medical world, if desired and necessary. Further into the future, but not that far away, is the caring home, where healthy dwellers are measured to ensure that any health-endangering conditions can be detected and brought to the attention of a physician in time.

According to the World Health Organization (WHO) such precautions can reduce the amount of visits to the hospital by 90% (WHO, 2011)!

In the following, the history of wearable devices is outlined, coming from m-health to e-fashion. Then the state-of-the-art of oximetry technology is discussed, leading to an overview of trends in consumer health technology, leading to conclusions on their role in personal life-style improvement.

BACKGROUND

The m-health arena has started from a replacement market. Here Apps are administrative systems where the end-user is logging available data as provided from other sources. Examples are body temperature from a thermometer, calories from the food wrapper and body weight from bathroom scales. Such products do not provide more than a simple agenda for logging and many products share a lack of enthusiasm in the market.

The arena is growing in interest. Here electronic devices are integrated into common products, like bracelets, plasters and chains to provide single measurements on the body. A number of them still require additional handling. For instance, the usual glucose meter requires a blood sample to be taken and prepared for a special portable device. There is a tendency to become less invasive using intraperitoneal sensing (vanDijk, 2015), but non-invasive would be even better. A nice example is the gradual miniaturization of the pulse oximeter, which has gradually decreased in size while moving from the hospital to the clinic, and which will likely become as common as the thermometer in the very near future.

The forerunner in the pursuit of personal health is the fitness market. Apps like RunKeeper and EndoMondo have received a lot of attention for the creation of social health networks. Gradually they will make inroads to electronically capture health data. The widely accepted Cooper test is based on the correlation between the VO2max and the distance covered in a 12 minute run (Cooper, 1969). Hence it indicates fitness by the ability of the body to use oxygen while running. This can nowadays be monitored with a strapped-on oximeter. Another requirement for fitness training is heart rate or ECG monitoring. Here we find an exponentially increasing amount of wearables with more or less success. Here continuous logging of an oximeter is an attractive alternative.

The typical health service needs first of all to provide a regular check like yearly done by the family doctor, i.e. looking at health in general. This can be seen as the Mc.Luhan effect on health provision, where instead of having the doctor come for a yearly visit, ICT will allow a regular check-up which can be viewed by the doctor at any time and any place. In other words, the players in the health service game are swapping places. The every Tom, Dick and Harry are not really concerned with health till they get sick. They do not want to be treated as patients and are therefore not susceptible to public information provision. When health gets their interest, it is usually through a desire to stay forever young. Alternatively, when they have been to the hospital, the main interest is to get back into shape.

Beyond the Thermometer

The exemplary device for electronification of health equipment is the pulse oximeter, originally created to support the anesthetist in his work. This device measures the degree of perfusion and thereby certifies the distribution of anesthetics. Then Aoyagi notes that a longer observation shows also the pulsating period of the blood pulse. This opens the door for non-invasive measuring more health parameters _ like cardiac functions showing atrial fibrillation and stress _ for everyday use through the single photoplethysmographic (PPG) signal. Wieringa (2007) re-calls the evolution of the thermometer into a common household product and then foretells that the modern oximeter will revolutionize personal healthcare in a similar way.

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