An overview of Physical Activity Monitors

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ABSTRACT

Recently, the percentage of different kind of diseases incidence increased due to physical inactivity, which was addressed by the World Health Organization (WHO). This becomes a crucial problem in worldwide health. There are lots of physical activity monitoring device were developed due to this. The aim of the paper is to find out the importance to develop a physical activity monitoring device to obtain effective and persuasive. After research on the literature, I found that the social support, healthcare support, wearable device, smart device, visible feedback and recognize function are important components in physical activity monitoring device.

Author Keywords

Physical activity; Physical activity monitor; Smart device.

INTRODUCTION

In this contemporary era, inactivity becomes a main concern in health society. [5] recommended that "to promoted and maintain health, all healthy adults aged 18-65 year need moderate-intensity aerobic physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic activity for a minimum of 20 min on three days each week". [4] reported that obesity, diabetes, cardiovascular disease, cancer can be caused by physical inactivity. This kind of health problem not only occurs in adults, it also occurs in children. Numbers of physical activity monitors and systems have developed according this in the market.

Although the reports identified the problem, the physical activity monitors and systems were developed, but there are a lot of people still at the inactivity status. This report will look at the literature in this situation. It will describe the components were used for physical activity monitoring, such as devices, software, communication channel, functions and other issues were mention on monitoring. It also will describe what roles of healthcare practitioner in during the monitoring.

RESEARCH

Device

This section describes the different devices were used in physical activity monitoring.

Smart device

Recently, smart devices become more and more popular in our daily life, it changed the way we work, play and manage our life. Smart device can refer to a ubiquitous computing device. Normally it is a cordless, mobile, and able to connect with network and it is capable of voice and video communication. It can easily interact with people to complete their tasks. It has better performance, faster response and portable.

The paper [1] use smart phone for collect data and represent results. It use the sensors (accelerometer and gyroscope) embedded in the smart phone to generate physical activity information.

The paper [3] use Viliv S5 UMPC to get the data and present data/results.

Wearable device

Physical activity monitor is for monitoring the physical activities, which include walking, running and other activities. Most of them required hands and legs move together, so the sensors for collect data must be design as wearable. Most of physical activity monitors in the market are using sensors to collect data instead manually enter the data to the system.

Wireless body sensor network was introduced in [2]. The sensor device was small and light and not harms the physical activity practices. The system transfers the data from sensor to server use wireless communication network. This also can improve the usability of the system.

Mobile platform in [3] compose by three inertial measurement units (IMUs), a heart rate monitor and a mobile companion unit. The measurement units and a heart rate monitor were placed onto three different body positions. A chest sensor included one IMU and the heart rate chest strap was tie need the heart. The second IMU and the third IMU was placed over the wrist and the side of ankle. The mobile companion unit is Viliv S5 UMPC.

A wearable embedded device was introduced in [8]. This device designed for dietary and physical activity monitoring. It composes by a front unit and the back unit. The front unit is a circle board which included MCU chip, SDRAM memory, flash memory, SD card, and other sensors. The back unit is the battery and a GPIO-controlled vibration motor. It was designed to wear around the neck.

A wearable device with built-in heart rate variability was introduced in [11]. The device is a small, light weight, easy to use and low power consumption. The device is compose by a set of sensors consists of a 3-axial accelerometer, a 2-axial gyroscope, a heartbeat detection circuit, battery and SD card. It was designed to wear on the chest of an individual.

Software

WEB Interface
The system in [3] introduced the WEB Interface for clinician to set up plan and manage the physical activity sessions for patient.

Interactive TV (i-TV) interface
The system in [3] introduced a i-TV interface to provide monitor subjects that are offered to them by the clinician. This is a special interface can be use by any kind of users which include elderly people.

Transfer data

Wireless communication
There are two common types of wireless communication, online and offline.

Online communication normally used WiFi, 3G, and 4G etc.

Offline communication normally used Bluetooth and ZigBee. Both of them support ad hoc network. Bluetooth allows data transfer rates up to 3 Mbps and in a range of up to 10 meters. ZigBee allows data transfer rates up to 250 kbps and in a range of up to 75 meters. ZigBee has lower power consumption than Bluetooth. [2] The result in [2] showed that ZigBee had low rate of lost packets.

Without communication
The wearable device in [11] performed offline in data processing. The device only recorded the data; health professional will retrieve the data from SD card after a recording. This also increase the accuracy(no loss data).

Ways to present data/result/feedback
There are several ways represent feedbacks. The first one is give immediate feedback, such as [1]. The second one is give feedback after the health professional review the results, such as [2].

Most of the monitors display the collected data/result on the mobile device, such as [1][3]. [1] also design an interface to represent the rate of active status of a user, aquarium and garden. Even more, the system in [3] can recognize what activity was doing in a period of time.

Not all the system display their feedback on visible. The system [8] represented feedback on the device by activate the vibration motor, so the user can feel it.

Roles of healthcare practitioner
The purpose from developer to create a physical activity monitor is monitoring people's physical activity, but they don't have specific target for only one group of people and normally they don't have a lot of medical information about all kind of patients. So the system can't recognize the specific needs for a user or the patient and if he doesn't know the risk in some physical activity that may lead to serious accident. This section describes the roles of a health practitioner in some of physical activity monitor.

The system in [3] allows clinician to set up a specific plan for a patient and put the related educational material for a patient. The clinician can manage can control the sessions.

The CMS and PAIS in [2] were developed for health professional. They can monitor and manage the physical activity session for patients. They have totally control in the system. The patients can't see their results in their device.

Functions
Functions in physical activity monitor can indicate the target group of users and they are also the selling points of a product.

The paper [1] introduced self-management capabilities and Social Support capabilities. There are four self-management capabilities: self-measurement, goal setting, self-monitoring and self-comparison. These four capabilities increased user's adherence to the PA program, increase their comfortable and these were private plans for themselves only. There are two social-support capabilities: peer-social comparison and peer-social support. These two capabilities have stronger persuasive effect which included rise users' performance and increase users' adherence to the PA program.

The paper [2] introduced 8 functions in CMS, and 12 functions in PAIS. The health professional can use these functions in CMS and in PAIS to manage users, physical activity sessions and data. All of these functions were designed for health professional only. The UCEMEPA [2] also use SIAF [10] to management and persistence of the collected information. All these functions together in the system provided more efficiency, accuracy and reliable.

The paper [3] introduced recognize function. According the data collected by the IMUs and heart rate monitor, the mobile application can recognize which activity the user is performing. This can improve the usability of the system.

The paper [11] introduced detect postural movement function. The device can detect postural movements by 3-axial accelerometer and a 2-acial gyroscope. This function can identify the fall and some of simple physical activities. This provided benefit to elderly people.

Other issues

Target user
Inactivity people is the main target user for physical activity monitors, they included the elderly people with health problem [11], sedentary officer, unhealthy people, homely people (like stay at home without doing any activity) and other people with perceived barriers[6]. These people mostly required the physical activity monitor.

Approach
Most of the system use one-to-one approach [1],[3],[11]. Each user has its own sensors and device.

[2] use one-to-many approach. A health professional holds a mobile device to manage several individuals. The benefits of this approach are increase management on sensors, less intrusive monitoring and facilitated the communication between mobile device and the server.

Promotion
According to the research target group and reasons on inactivity, promotion is one of issue in physical activity monitor. An appropriate promotion can change people from an inactivity status to an activity status, from a life with health risk to a healthy life.

Family support is one of promotion, like walk to a nearby park with whole family on Sunday morning. Elderly people want to spent time with grand children, parents can have relaxing time with children and children can play in the park. This also increases the perceived benefits from young people. The results in [6] showed that children with higher levels of perceived support from their parents and friends reported higher levels of self-efficacy and enjoyment related to physical activity, and lower levels of perceived barriers.

Social support is another of promotion. People tend to work in a group, compare with other people and share with other people. The results in [7] showed that social relations integral to the exercise environment are significant determinants of subjective well-being in older adults. It [7] also showed that it can decrease loneliness over the 6-month intervention period. PersonA [1] uses Facebook as the platform for social support. Users can share their results with friends or other groups of people, and discuss with them.

Special device is another of promotion. [1] introduced device promotion, PersonA use mobile phone as part of the system to encouragement people gain more activities. According to [9] smart phones represent 12% of total global handsets in 2012. So users can use mobile phone to do the self-management task and interact with social network in any time and any place.

Usability
The questionnaire in [2] showed that the system is useful for managing physical activity sessions, facilitates the management of physical activity sessions, easy in registering/querying data of physical activity sessions and improve their job of managing physical activity sessions. The result showed that more than 80% of the participators would like to use the system.

Security
PersonA in [1] provided methods to ensure the communication is secure and confidential. The first method required the authentication process to log into the system. The second method is the communication framework in the system can handles processes which included encryption and authentication. The third method is the confidentiality setting in system carried on the Facebook confidentiality setting.

Persuasiveness
To maximize the effectiveness of the system, persuasiveness rise as an issue in physical activity monitor.

There are four methods been addressed in [1]. The first one is an application in the system with psychological and social values, such as Facebook. The second one is the interactive interface. The third one is the system included simple tasks. The fourth one is the system has some functions can rise users' attention, such as immediate feedback, reminders and so on.

Some reasons for inactivity
Normally, elderly people thought they were aging, and they rejected to join any activity due to the low energy level.

Sedentary officer were too busy during the week day, so they always choose to relax at home during weekend, like lying on the sofa and watching TV for the whole after.

The unhealthy people group includes the people with bad diet habit and the people with health problem. The most reason for inactivity is low perceived benefits.

And the reason for those people with perceived barriers is obvious, no support and afraid to involve.

There is another general reason is no companion, no competition and no sharing.

FUTUREWORKS
The founds in investigate experiment for elderly people indentified that there are still a lot of improvement in smart device, such as big button or big visible screen to display result or a more sensible (like in [8]) part embedded in the system.

Current recognize functions only for simple activity detection. These functions may have to improve the function, such as indicate heart attack and other emergency situation.

CONCLUSION

Physical activity monitoring device provides a new change in healthcare society, it helps clinical to manage patients' physical activity session and collect reliable date.

After research on the literature on the components on physical activity monitoring device, I found that the social support and healthcare value support from clinician are important in the content of monitoring; the wearable device with sensors and smart device are another important part in the interaction of monitoring; a visible display for result and feedback is the other important part in the promotion of monitoring. The last important is recognize function. To maximize the effects and benefits to patient and users, these components should be put into the physical activity system.

In the future, physical activity monitoring device will become more and more important in healthcare society, people can use them to monitor their daily life to prevent some diseases could be occurs.

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