

A Research of Self-Conducting Six Minute Walk Test

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Abstract: Increasing in number of chronic obstructive pulmonary disease (COPD) has been a large issue, troubled a daily life. Note that it is mostly found in elderly, because it takes time to appear. To fight this symptom, Six Minute Walk Test has been introduced in hospital. However, the result may vary due to many factors from pacemaker or patient themselves. This paper explains how we aim to standardize a result by propose Self-Conducting Six Minute Walk Test, including walking step and walking distance analysis by acceleration sensor. The goal is using smartphone to conduct the test and evaluate result in daily life on by own.

1. Background

In the recent years, chronic obstructive pulmonary disease (COPD) has been increasing in number in Japan causing government to spend around two hundred billion yen a year. It has been a social problem because it came into top ten deadliest diseases in 2012 [1]. The main cause of COPD is smoking and aging, which turns into problem in Japan, because smoking population and elder's population, has been increasing. Therefore, it can be said that changing lifestyle to prevent those diseases could be difficult especially for elderly and other method is needed.

COPD is a lung disease that makes it hard to breathe, making daily life harder and could suffer seriously to death by the suffocation in the end [2]. Furthermore, COPD only get worse because damage to lung cannot be removed; only prevention is acceptable. Plus, it takes time for lung damage to start causing the symptoms, so mostly COPD was found in elderly. Heart disease is also concerned because it is difficult to tell whether the COPD patient also has heart disease or not because they have similar symptoms and common risk factors. Over than 40 percent of whom suffering heart attack will die; not to mention that some of them will die before reaching the hospital [3].

Therefore, it has been noticed that lifestyle should be improved in Japanese society. However, it is still an uncontrollable risk even you play a sport or eat healthy food. Fortunately, to reveal those unseen risk and to support healthy life, there are methods to assess the condition of COPD and heart disease within a few minute, as well as it might measure a risk of getting those diseases, which are six (6) minute walk test (6MWT), shuttle stamina walk test (SSWT) and shuttle walk test (SWT) [4-6]. Although the ideal is to support daily life, there are still need pacemaker and has to be done in hospital which need a commuting and

time. Hence, our research concentrates in investigation of the system that helps those patients to manage their daily life on by own which may be at home, and the intervention condition using these walking method measurements.

2. Walking Tests used for COPD

The goal of these walking tests is to assess functional exercise capacity; generally by measure the distance a patient is able to walk on hard, flat surface in an interval period. Its usefulness is that it evaluates pulmonary and cardiovascular system involved during exercise. Also they have been used as detection for intervention condition. Patient's condition will be recorded right after the test ended; which are blood pressure, heart rate, oxygen uptake and dyspnea score.

2.1 6 minute walk test (6MWT)

This test requires patient to walk in 6 minute, allows walking by self-pace and resting on self-decision [4]. It has been used as to assess submaximal exercise level which suggested as it reflects daily activities. Plus, the result data correlates with the COPD's death rate in wide range. It is simple and can be repeated to evaluate changes associated with the implementation of intervention. Require 30 meters length course.

2.2 Shuttle stamina walk test (SSWT)

Similar to 6MWT, this test requires 10 meters length course and will be done in 3 minutes which obviously unrestricted in area. It has been researched in Japan [5].

2.3 Shuttle walk test (SWT)

Unlike the others, this test provides exercise limitation and peak oxygen uptake since it requires a sound signal to control a pace [6]. Test ends when patient stop walking or cannot reach the point within time. Has endurance version which sound signal is steady and incremental version which signal speed is increased every minute. Although, it

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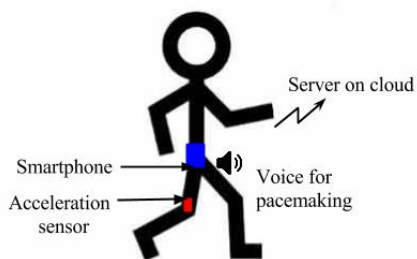


Figure 1. Concept of proposed system

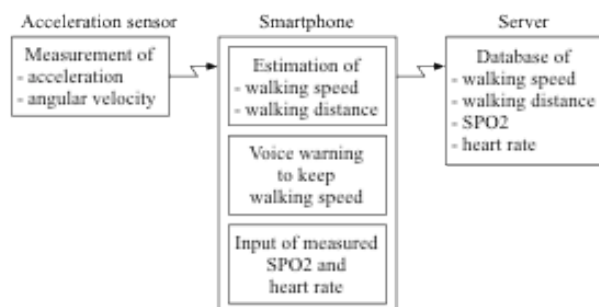


Figure 2. Functional diagram of proposed system

provides precise result, it is not well used in hospital generally because of its strictness, meaning it does not fit most of elderly patients.

3. Proposed System

Figure 1 and 2 show the concept and the functional diagram of our proposed system, respectively. The proposed system consists of an acceleration sensor and smartphone attached on user's body, and database server on cloud.

Acceleration sensor measures user's movement into acceleration and angular velocity data. Smartphone receives the data from acceleration sensor and then calculate into estimation of walking speed and distance, while output a voice warning to keep walking speed. After finished, the user inputs the result of measured SPO2(Oxygen uptake) and heart rate. Database server on cloud will receive the data from smartphone which contain of walking speed, distance, SPO2 and heart rate, so the hospital could follow up the result by monitoring these data.

In the proposed system, we use wireless acceleration sensor to attach at any place of target body to capture a proper movement. It would be attached in various places to find a best position to attach in real life. The goal is to be able to measure walking distance by using sensor.

ATR-Promotion's wireless acceleration sensor TSND121 will be used in this experiment. Multifunction Sensor TSND121 is a sensor for the purpose of human motion monitoring. Accelerometer, gyroscope, magnetometer, barometer, thermometer sensor and AD

converter are assembled in TSND121. The data can be transfer via Bluetooth or USB connection. Also it has memory to save the data when using offline and could be controlled up to 7 pieces by one computer. This sensor is most fit in motion capture, daily life analysis, rehabilitation support, sport movement analysis.

4. Future Plan

Our future plan is to make use of SWT's experiment factor as its precision, to combine in 6MWT method to support when it is needed occasionally. In 6MWT, even though it is a self-pace method, indeed, it is said to be "walk as fast as you can" as it could actually derive submaximal exercise level. Obviously, 6MWT depends on patient's effort only and encouragement is prohibited as it would alter the result. However, in order to control pace properly, some effort or encouragement is required especially when it is third time or later, due to lack of concentration. However, cheering varies result as there is difference in pacemaker. So, In order to control the pace precisely, we plan to make an interactive system that uses patient condition to judge if resting or cheering is needed or not.

Self-management has two parts which are walking pace management and condition monitoring. First, we plan to concentrate in analysis of walking pace by using sound signal as a walking guideline, and then analyze the data from accelerometer sensor which will be attached to target body while walking. It would be interactive with intervention condition monitoring in future plan.

5. Reference

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