An Investigation of Social Identity in Smart Healthcare System for Physiotherapy Exercises

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Abstract  
Introduction of healthcare technologies to improve individual’s wellness have been prevalent in these recent years. However, these technologies do not encourage patients to continue with their physiotherapy exercises. Increasing social identity of an individual is an effective approach to motivate an individual to continue with their exercises. It increases both the pride and respect of an individual. To fill the gap of the need for social identity to be incorporated and the lack of healthcare technologies for physiotherapy exercises, this research draws upon the social identity theory and self-monitoring theory to examine the significance of social identity. This study will provide significant theoretical and practical contributions to the existing knowledge about healthcare technologies.

Author Keywords  
Social Identity, Physiotherapy, Smart Healthcare System

Introduction  
Healthcare technologies have been increasing in these recent years as countries move towards the development of a smart nation. Physiotherapy exercises are critical for recovery of muscles related
A typical physiotherapy treatment would require the patient to go to a particular venue on a weekly basis for several months to complete the whole course of treatment. Patients with work commitments will need to make arrangements with their superiors. Besides that, these exercises are often done individually without any form of weekly progression assessment to motivate these patients to move on. Patients felt that it was a waste of time doing the exercises.

Previous researchers have introduced ways for physiotherapy exercises can be done at home where they can perform in virtual groups through video conferencing [10]. Video conferencing can help individuals to find partners to do the exercises, however, individuals might not be willing to reveal the mistakes they made. Previous researchers [1] have also designed interactive technologies for stroke patients. Such technologies allow individuals to exercise on their own but they do not know how to improve. Therefore, it is important for us to create systems that will encourage individuals to continue with their physiotherapy exercises.

One way to resolve the above-mentioned problem is through the usage of a Smart Healthcare System. A Smart Healthcare System will motivate a patient to complete the whole course of the physiotherapy treatment through the creation of social identity.

This research provides significant theoretical contributions to the existing literatures on DIY health technologies by providing insights on how social identity can influence the adoption of DIY technologies for physiotherapy exercises. Besides contributing theoretically, this research could also provide DIY application designers with the idea that IMU sensors could be use physiotherapy exercises as further analyses could be done with the data captured to improve the recovery progress of the injury.

**Theoretical Background**

**Social Identity Theory**

Social identity is defined as the individual’s understanding about being fitted into a social group [8]. A social group is being referred to a group with two or more individuals who perceive themself to be members of a group based on similar social identities [9]. Social identity is constructed by an individual with reference to three aspects namely identification, pride and respect. Identification refers to the process whereby an individual subjectively combines the impression of themself together with their evaluated self-worth (Respect) and group’s attributes and status (Pride). Respect can be evaluated by comparing the progress of the individual themself against the ultimate goal of the group. This judgment will reflect the individual’s status through self-esteem. On the other hand, pride can be evaluated by comparing the group’s status against other group’s performance. Pride is commonly evaluated through ranking of groups. This would create prestige for the group [11].

The social identity theory denotes that the willingness of an individual to cooperate is heavily reliant on the benefits that he/she can attain from the group (pride). The individual will also evaluate their own status and progress with reference to the other members from the group (respect). An individual who has attained more benefits will have a greater sense of belonging to the group thus being more engaged in helping the group to
increase its status. This will motivate the individual to continue with the physiotherapy treatment.

Social Monitoring Theory
The social monitoring theory [7] states that individuals are very sensitive to the social cues (behaviors of other group members). These social cues are often used to adjust their self-expression. The social cues are derived through the identification of variations of behaviors in social settings. Their behaviors will be adjusted based on these variations. Therefore, if the individual belongs to a group that is highly motivated to complete the whole course of physiotherapy treatment, it is very likely that the individual will be influenced by the group members to complete the whole course of treatment [5].

Smart Healthcare System
The Smart Healthcare System includes a mobile app that is designed with simplicity for patients to select the exercise, an easy to wear wristband and a web portal for patients to view their progress [3]. It caters to the different stakeholders such as doctors, nurses and patients. The wristband is made up of a wearable device. Wearable devices has been considered as a viable low-cost approach for healthcare purposes such as monitoring / tracking of health progression. The wearable devices include power supplies and wireless communication. These wearable devices can be integrated with client-server modal together with a software for algorithm processing and data capturing [2].

Exercise Procedure
All the patient needs to do is to wear the wristband like a watch and launch the mobile app to start doing the physiotherapy exercises. As the patients starts the exercise, the accelerometer and gyroscope will capture the directions on the horizontal and vertical planes. The directions captured as used to determine the angle of rotation and elevation to provide feedbacks for correction of the exercise. The feedbacks will be transmitted to the mobile device the calibrated using Bluetooth Low Energy (BTLE) datastream. Each time the data is captured, Kalman filtering is applied to remove the outliers. The filtering is done with reference to the kinematic state of the sensor. Kinematic state consists of the position, velocity and acceleration data that is captured [3]. The procedures to start the physiotherapy session are shown in Figure 1.

![Figure 1: Procedure of Physiotherapy Exercises with Wearable Sensors](image_url)
their exercises at home during their free time without having to travel to a particular physical venue. Besides that, the patient can also view an analysis of the exercises that they have completed. This would give them an idea of their progression by showing them how far they have gone, how they fare among their peers (respect) and how the team fares as a whole (pride). Such an analysis will create a social identity for the individual thus increasing the belongingness to the group. The screen to reflect and individual's social identity can be seen in Figure 2.

In this way, the patients will be passionate about completing the whole course of physiotherapy treatment. The patients will also be able to make improvements to the way they perform the exercises so that the recovery process could be shortened.

Technical Details
The wearable device used in the smart healthcare system consists of a versatile 9 DoF sensor that compromise of a MPU9150 IMU. It has a built-in accelerometer, gyroscope, and magnetometer that functions over I2C. It is very similar to the 6 DoF MPU6050 for which an extensive library has already been built. Most of the function of the MPU9150 can utilize the open source MPU6050 library. The measurements of the exercises are done with Arduino sketch board that is performed using the Xadow mainboard unit. Kalman filter and Madgwick algorithms were used in the calculation of AHRS orientation as well as dead reckoning positions.

Conclusion
The idea of this smart healthcare system has been validated with various elderly agencies in Singapore. Caregivers from these agencies have very positive feedbacks with regards to this system. We will be performing case studies with the elderlies in the upcoming months to observe the behaviors of the elderlies towards the usage of the system.

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References


