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Towards Racing Gamification with Natural Interface for post stroke Rehabilitation

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ABSTRACT

Stroke patient basically suffer from limited movement, they cannot control their balance very well, therefore the therapy that involve repetitive motion, harmonization and stability workout should be applied to them. The invention of Kinect has lead people to applied this device as a tool for recovering patient from stroke because its capability on tracking the skeletal of human body. Racing Game is very popular among the adults, elderly and even kids, the rule it's quite simple and understandable. The combination between the racing game and natural interface will lead to innovative application which is potential to be used as home therapy for post stroke patient. User will be required to move some parts of their body such as both hand, arm, head and even shoulder. The body tracking is provided by depth camera that can capture and interpret human body gesture recognition to be used as interaction command. The human skeleton will be displayed onto screen to control the car in the game and the result of racing will be synchronized with user excitement which is recorded through Kinect video.

Keywords: Racing gamification, natural interface, stroke rehabilitation, depth image.

1. INTRODUCTION

The existing system for post stroke rehabilitation is quite expensive and mostly require particular skills to operate the system. This research aims to utilize the Kinect camera assist patient to regain their strength to physical exercise. This training is required for each stroke patient to recover their nerve by exercising the certain movement repetitively. The Kinect device is easy to be setup at home and doesn't oblige to certain procedures.

2. RELATED WORKS

The stroke is one of attack that come to brain which can happen suddenly in their daily activity1]. Stroke occur because the blood that flowing to the brain area is blocked, so the cell inside brain will suffer because lacking of oxygen and the cell will die eventually [1]. This will affect the human body, they cannot control their muscle and they even can loss their memory. The patient who got actual treatment can regain some muscle and control to do light task in their daily live[2]. Nevertheless, the proper theraphy required determination for regular exercise and avaibility of resources(device, nurse or operator)[3]. The common therapy only concern on recover the leg for walking and upper limb for holding capability. The

needs of home base therapy is dreamed by some patient because it can helped them to recover quickly with familiar and convenient environment. Nowadays, the VR technology has offer some opportunity for the low cost theraphy tools that can be used easily in their home[4-5]. Furthermore, The natural interface has been investigated several years back. They are focuss on invented travel interface, multi touch, text display, button less clicking and haptic device for large environment interaction [6-11].

On the other hand, researcher also aims to improve realistic facial expression of virtual human to augment the interaction between human and virtual reality. Some numerous methods such as: fluid simulation for sweat and tears effect. the oxygenation concentration under skin also become consideration to adjust skin colour of avatar [12-16]. The interactivity between human and machine also can be performed through brain computer interface that read and analyze brain signal in accordance to the emotional condition of human. Subsequently, emotion state will be mapped to body action: walk, collision avoidance behavior and facial expression [17-20]. The previous statement has deliberate that Kinect has affect some sector such as medical, military or even engineering, they are producing an innovative ways of interaction for assisted surgery using new interface [21-23].

3. RESEARCH METHOD

The proses is started by adjust the position of the Kinect, then it will started to recognize the position of the user. User will grab the depth image of the user then it will be converted into sequence of video that will analyzed further. User or patient will be asked to play the racing game by their body. Even though in the stroke rehabilitation some parts of body is quite hard to be moved, this will motivate user to gain control over the game, refer to Figure 1 for diagram of methodology.

Materials:

Material for experiments covers: Kinect Camera for depth image sensor
Computer with advanced processor and Graphics card

Methods:

- Kinect Camera Positioning
- Depth image data stream
- Random Decision Forest Algorithm
- Randomly choose a set of thresholds and features for splits.

Pick the threshold and feature that provide the largest information gain.
Repeat the process until a certain accuracy is reached or depth is obtained. The captured imaged data stream will be processed and analyzed random decision forest algorithm to capture the human gesture in real time (refer to equation 1 and 2)[24].

$$f_\theta(I,x) = d_I\left(X + \frac{\mu}{d_I(x)}\right) - d_I\left(X + \frac{v}{d_I(x)}\right) \quad (1)$$

whe e $d_I(x)$ is the depth at pixel x in image I and *p* $\theta = (u, v)$describe offset *u* and *v*.

$$P(c|I,x) = \frac{1}{T}\sum_{t=1}^{T} P_t(c|I,x) \quad (2)$$

In order to classify the pixel x in image I, the process will be started from root then do evaluation repeatedly as calculated by Equation 1, the decision of branching

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whether go left or right is based comparison with threshold τ. If the leaf node is reached in tree t, $P(c|I,x)$ as learned distribution used to store labels c.

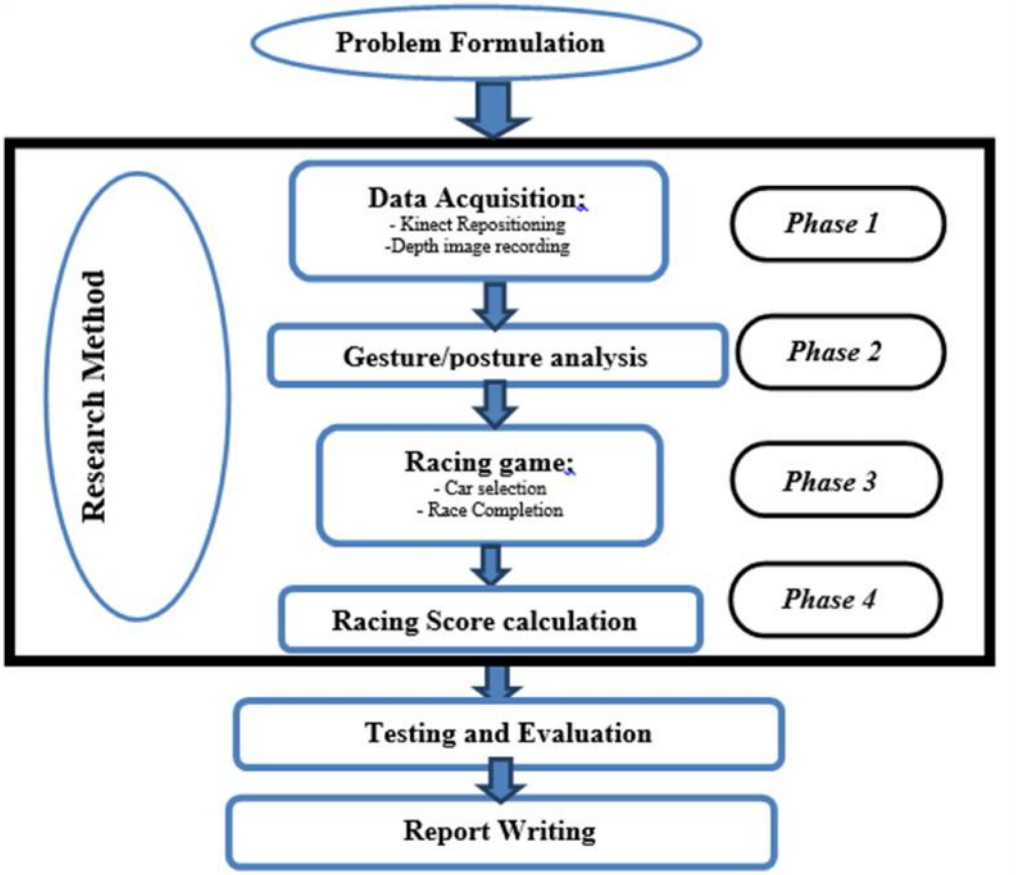

FIGURE 1. Research Method

The racing game that used for the post stroke rehabilitation has several features such as main interface that consist of several button for interaction. Figure 2 shows the main interface that have four menus: Play, High Scores, Setting, Help and Quit.

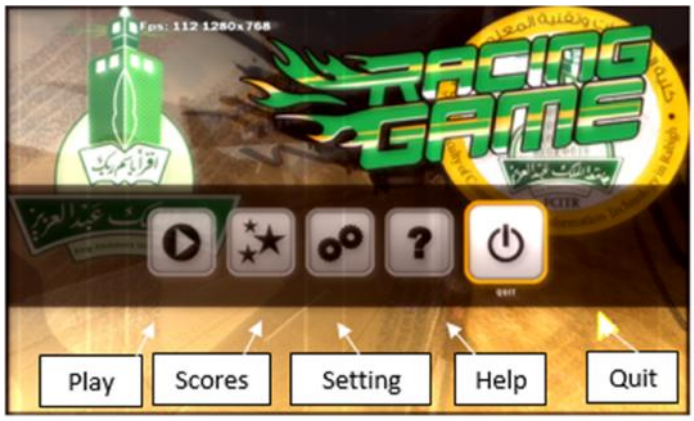

FIGURE 2. Main Interface of Racing Game

After car selection, user may choose track as shown in Figure 3, whether they want use beginner, expert or even advanced track. These tracks shows the level of difficulty of game. The more advanced game, the track will have more curve for turn and more obstacle on the track. In order to do menu selection user only need to wave their hand and the cursor will move according to the hand. Some information such as lap (1/3 laps), FPS (Frame per Second). On left bottom the RPM (rotation per minute) and speedometer also presented to give an information regarding speed. The timer is showing position of the current car in the racing game.

FIGURE 3. The Starting of Racing Game

Figure 4A show the movement of user hand 30 degrees toward his right spine and its cause moving forward and right, when user just need go straight user only need to put his hand in front of chest. Figure 4B shows the player playing the game without holding any control.

FIGURE 4. (A) and B User move their hand to control steering

Patient can control the car by grabbing an imaginary of steering wheel. The accelerator and brake has been setup automatically. Seizure your hands left or right steers the car. There is drawback of the natural interface with Kinect, because it doesn't have tactile feedback that can give you the sensation of running off the road or colliding with a light pole.

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4. CONCLUSION

The curiosity of human to use their own body as a controller has turn from dream to reality. This phenomenon of natural interface has lead us to an idea of providing the racing game as post stroke rehabilitation where user are asked to do some task such as: menu selection and driving the car using both of their hand. The result show that most of game user very excited and they played with game happily. The extension of this project can be used for controlling other application such as medical application, military, robotic or entertainment. The result is quite fascinating, synchronization between tracking and car movement is in real time. The integration with voice recognition also can be implemented in the future, so the interaction will become more natural and attractive.

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