CSCI599 Project: HapticPuppet

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Description:

Based on Feick, Tang and Kruger's research, HapticPuppet is a drone-based interface that enables kinesthetic haptic feedback by providing multidirectional force in the mid-air. The HapticPuppet works by using strings to attach multiple coordinated drones to different parts of the human body such as hands, fingers or arms. HapticPuppet has a wide range of applications, such as augmented reality, virtual reality, rehabilitation exercise and remote collaboration (Feick et al., 2022).

Objective:

In my project, I will use AirSim to simulate HapticPuppet. I will simulate the user's hand, attachment points, strings and drones in airsim, and realize and measure the force generated by the drone on the attachment point. In addition to this, I will simulate a real-world scenario of exercising using the HapticPuppet as a rehabilitation belt. If there is still extra time, I will simulate the scene where the left and right hands use the rehabilitation belt to exercise at the same time.

Milestone 1: In AirSim, I will simulate a drone, a hand, an attachment point on one of the fingers and a scope which connects the attachment point and the drone in a simple 3D environment.
Date: 10/28/2022

Milestone 2: I will set 5 buttons. The function of the 5 buttons is that when different buttons are clicked, the drone provides haptic feedback to the finger in different directions. I will implement the function of the 5 buttons:

when the 1st button is clicked, the drone gives the finger an upward force;

when the 2nd button is clicked, the drone gives the finger a downward force;

when the 3rd button is clicked, the drone gives the finger a leftward force;

when the 4th button is clicked, the drone gives the finger a rightward force;

when the 5th button is clicked, the drone does not apply any force to the finger.

Date: 11/6/2022

Milestone 3: When the button is switched, the position of the drone may change greatly, which requires me to plan a path to reposition it quickly, and also need to prevent the drone from colliding with the user's hand. I will implement a simple path planning algorithm (simple APF) for the drone, which requires the drone to quickly relocate in 3D space and avoid colliding with the hand.

Date: 11/11/2022

Milestone 4: Measure, record and analyze the force delivered by the drone over a period of time when each button is clicked.

Date: 11/13/2022

Milestone 5: Simulate the scene of the human hand using the yoga belt to do exercise. When the person's hand is raised, the yoga belt becomes loose, and the force felt on the person's hand decreases; when the person's hand is lowered, the yoga belt becomes tighter, and the force felt on the person's hand increases. Simulate and evaluate this haptic feedback with a drone.

Date: 11/20/2022

Extra Milstone: Simulate the scene when the user's left hand and right hand simultaneously use the yoga belt to do exercise. In this scenario, the path planning and obstacle avoidance algorithms may need to be updated.

Milestone 6: Complete a report and prepare for the project presentation.

Date: 11/28/2022

Github Link: https://github.com/HangZhengPeggy/CS599

Reference:

Abdullah, M., Kim, M., Hassan, W., Kuroda, Y., & Jeon, S. (2017). Hapticdrone. *Adjunct Publication of the 30th Annual ACM Symposium on User Interface Software and Technology*.

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