DR.VR

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In a relatively affluent society such as much of the United States, one would figure much of the population would regularly take steps to ensure they have great overall health given their financial ability. However, the contrary holds true. “The decline in the use of medical services was widespread, taking place regardless of health status,” said Brett O'Hara, chief of the Census Bureau's Health and Disability Statistics Branch. Even considering age differences, “Medical provider visits become more likely with age, as 37 percent of young adults 18 to 24 did not visit a provider at all during the year, compared with 8 percent of those 65 and older” (O'Hara).

Our research project, DR.VR, aims to solve this problem. The main inspiration to creating this project was the relationship of convenience and importance on the subject of global healthcare. There are countless ideas combatting a specific well-known condition or disease. However, one aspect of health often swept under the rug is basic regular health the general public are often too indifferent towards to check up on. No one bothers to schedule a doctor’s appointment for a regular checkup because it is just “regular”. Unfortunately, many people do not feel financial health investments are worth the time unless it requires immediate attention. While regular checkups indeed aren’t urgent, they are crucial for providing the public with important warnings on their current lifestyles and any risks they are leaning towards; hence, DR.VR came to life. Our product allows patients to reproduce the benefits of a regular doctor’s appointment without the financial or time-demanding burdens. With virtual reality and machine learning based analytics, we are able to produce a product that can positively affect many lives across the world.

Figure 1: *Patient loads into DR.VR virtual clinic*

DR.VR simulates a real-life doctor’s office visit for the patient. After putting on a VR headset a patient the patient gets to experience a virtual comprehensive checkup. A desk, chair, medical posters, objects, and diagrams are placed throughout the room. A virtual doctor is present ready to introduce you to the Check-Up Exam. The evaluation is divided into 3 series of tests: the visual, audio, and physical components. In each component there are 2-3 tests the patient goes through by interacting with the scene in the VR headset and responding using the controllers provided. The purpose of these tests are to acquire data to serve as a comparison with real-world applications. For each test, there was a large data set of scores obtained from performing the tasks that we cross reference with medically obtained averages for people of normal health. A verbal and textual prompt is given to instruct the patient on what task needs to be completed for each test. After all tests have been executed, a feedback diagnostic is given to the patient with results and analysis on various aspects of health, and recommendations on what course of action to take next. The tests taken by the patient are as follows:

Eye Exam: To measure eye vision, the patient is placed “20 feet” (in perspective of the VR environment) from an eye chart. They will be asked to verbally indicate what letters they see and we use Google Cloud speech recognition to grade their indications. From this we can estimate the patient’s eye score.

Color Blindness Test: To test for color blindness, the patient is shown two colors of very similar shading, and is asked to press the button on the controller once a difference in shades can be seen by the patient. The time taken to recognize the difference as the odd color increases in hue will be used to estimate whether the patient has color blindness.

Figure 2: *DR.VR is positioning patient to take a virtual eye exam*

Figure 3: DR.VR instructing patient on how to take color vision test

Hearing Frequency Exam: To measure hearing frequency, a frequency pitch audio source is played for the patient in 3D space. When heard, the patient presses an indication button to stop the audio and the mapped frequency with the time taken to hear a sound is the highest frequency that the patient can hear. This is compared to the classical scale (20 to 20,000 Hz) to judge the patient's hearing ability.

Hearing Volume Exam: As explained by the heading, base sound is played to the patient with increasing volume until the patient can hear it. The goal is to test if the patient may need hearing aids by checking if the base volume heard is higher the average for a person of normal hearing.

Location Perception Test: In an unlit environment with no obstacles, a one-shot sound is played for the patient. With VR technology we can "place" this sound at any position relative to the patient. They are required to estimate where the sound came from, and their margin of error from the audio source will determine their audio perception capabilities.

Balance Test: One of the many advantages for utilizing VR technology for medical testing purposes is it allows us to harvest coordinate data on each of the used components to determine the current posture of the patient, using the headset's physical rotation, along with the alignment of the headset and controllers, the patient can be provided feedback on their posture and how well-balanced they are when performing various tasks.

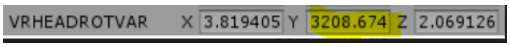

Figure 4: The Oculus Rift's measured variance of the patients head rotational movement during a balance. DR.VR assesses the patient has poor balance and coordination.

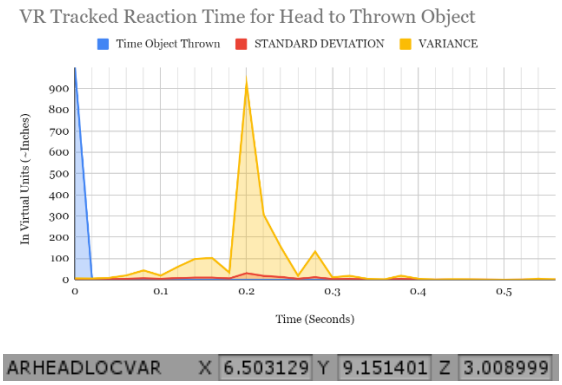

Figure 5: The graphed HTC Vive's VR tracked reaction associated with the variance of a Logitech HD Web Camera's AR generalized head location tracking. These results correspond to a good reaction time relative to the normal human reaction time of 0.25 seconds.

Parkinson's disease Test: A simple method of testing for the risks of Parkinson's disease is by checking the tremoring of one's hand when doing menial tasks. We can monitor this by checking the coordinate change in controller movements and determining whether there is sufficient oscillation to deduce a cause for concern for the patient's specified age.

Physical Perception Test: To measure physical perception, the patient is tested by reacting to an object being "thrown" at them in Virtual Reality as well as having an object placed at a random location with the patient required to estimate how far that object is. These allow for measuring the patient's depth perception and reaction time involving motor skills.

It was important to note in the diagnostic section that any evaluation determined is merely an approximation; it should serve as guidance for the patient to take initiative and make a doctor's appointment if they find concerning results in any of the evaluated fields. The core strength in DR.VR's impactfulness is global scalability. The goal of our research project is to allow people all over the world to have access to tests that can help them make better decisions about their health and give them prescriptions comparable to those of the world's top physicians. Through further research, we hope to prove the implementation of this project is feasible and impactful. We hope to do further testing in real scenarios to expand upon these tests and make the test more data rich to decrease the testing time and give the patient more information about their health.

For more information about our project and a working prototype, please visit DoctorVR.ml.

Figure 6: DR.VR verbally communicating test results which are saved as a text file onto the patients desktop or PC. Our team is currently working on sending results directly to professional doctors in real time during the checkup