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ELEC-E7852
Computational Interaction and Design

Assignment A6b

Biomechanical Simulation

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December 2024

Acknowledgement

Parts of the code implemented in this work were generated with the assistance of GitHub Copilot. None of its proposals were, however, employed without refinement and necessary tweaks to adapt it to the nuances of the tasks at hand; making it impossible to identify and subsequently mark which lines of code were human or machine-made, for many were the fruit of the combination of both.

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1 Introduction

Understanding the relationship between movement performance metrics such as speed, accuracy, and trajectory is essential for validating predictive models of human motion. In this assignment, the goal is to validate (or disprove) the presented simulated biomechanical model with real-world validation. To do so, an experiment is proposed. Its aim is to empirically test movement performance predictions through a touchscreen task designed to measure speed, accuracy, and touch trajectories.

2 Methodology

The main basis for the experimental setup is the use of a touchscreen tablet; which will be displaying five sequentially presented circular targets of varying sizes and positions. The single participant will thus be performing touch interactions on the presented targets while the system logged their touchpoints, timestamps, and target details (Figure 1). This will allow for the measurement of the participant's speed, accuracy, and touch trajectory.

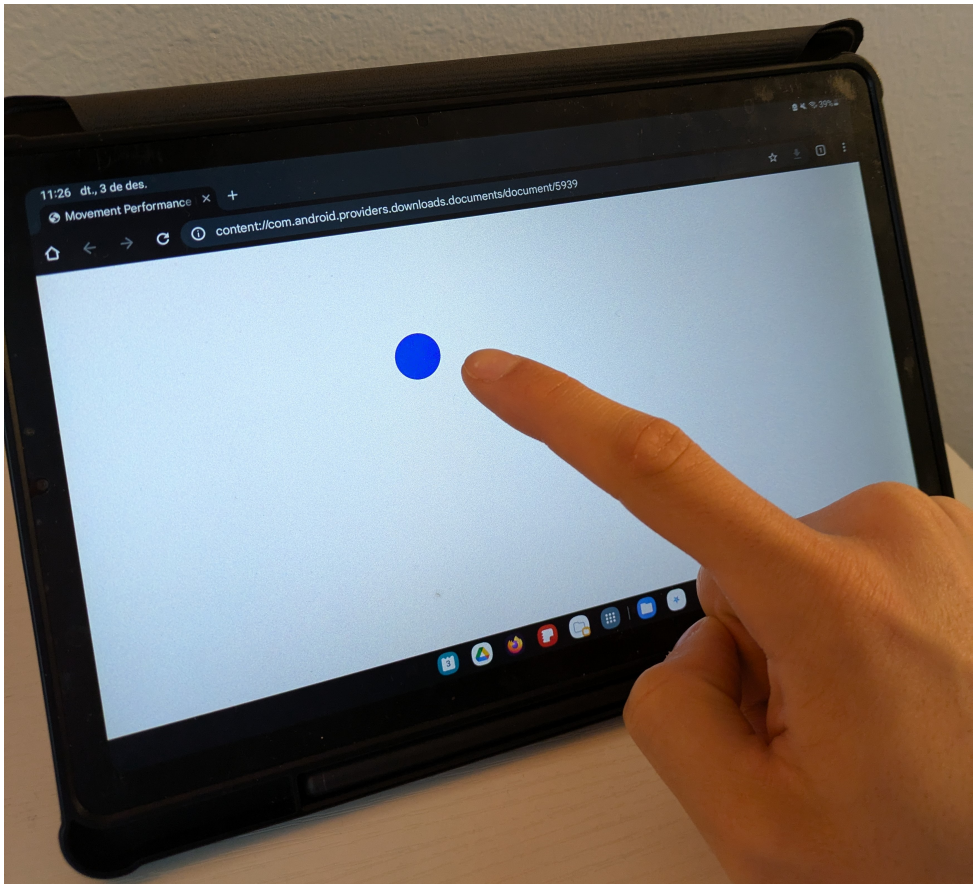


Figure 1: Example interaction of the participant with the presented task.

The design for the experiment was implemented in HTML. The targets took the shape of blue circles on the screen, varying in size (30–70 px) and location. They remain visible until touched, at which point the system recorded the interaction details and moved to the next target. This data collection system is also embedded into the web interface. Each touch interaction triggered a logging function that captured touch position (x, y coordinates), timestamp, and target details (x, y coordinates); all in .json format. All together, this allowed for later easy construction of graphics using Python reflecting the interaction nature produced by the participant.

3 Results and Conclusions

The design of the experiment clearly mimics the one of the first modelled tasks for the provided biomechanical simulation, where the agent has to touch targets that procedurally appear in different positions and sizes. Let us now see the collected data from the real user. Figure 2 provides a general

overview of touch positions. Here, one of the first real-life biases that the biomechanical model fails to properly simulate gets displayed quite clearly. Since the user is a right-hander, there is a tendency on a touch screen to touch the targets on its right side, rather than on their very centre, as the simulation tends to attempt at all times.

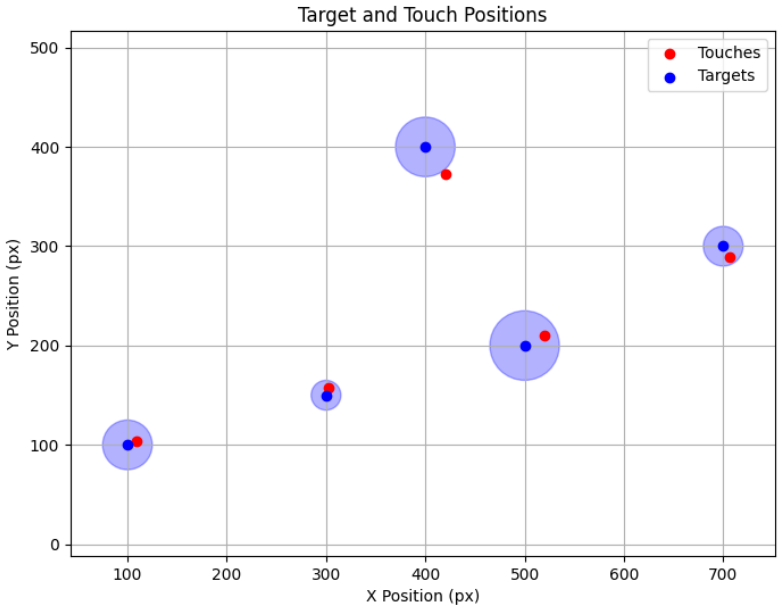
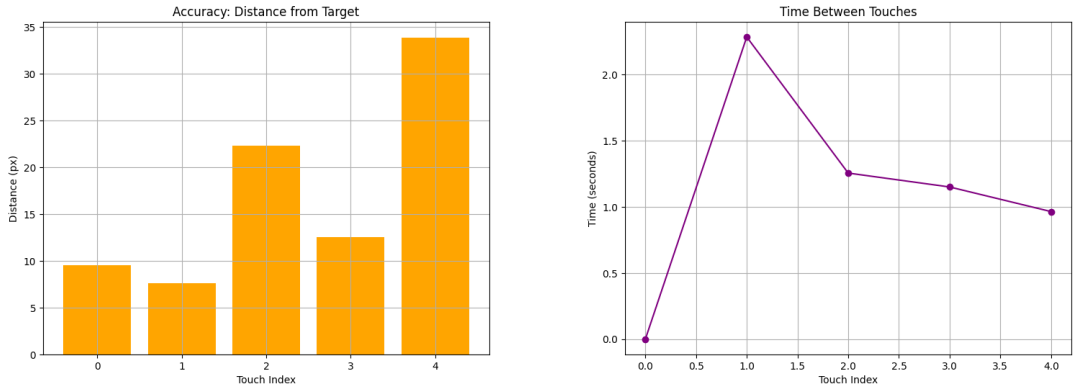


Figure 2: General overview of target positions versus touch positions.

Furthering insights into the collected data are introduced in Figure 3. With the real user, and in line with previous assignments, there is a noticeable increase in reaction speed beyond musculoskeletal limitations that is bound to eye and brain processing capacities for different target sizes (see the second target being the smallest one). Similarly, and in line with the first observation related to right-hand usage, there is clearly a delta in position touch when dealing with targets that are further from the natural resting position of the hand in the table (like the top-most one). This delta seems to also have a correlation with size, as larger target sizes seem to yield actual touch positions further from the centre - a behaviour also not observed with the simulation, where the target is always the centre of the objective task.



(a) Position delta: touchpoint vs. target center.

(b) Time delta: target apparition vs. touch.

Figure 3: Position and time deltas for the user testing.