HW 3
CS 522

Github Repository Link: HERE

Fitts' law is used to describe the relationship between an input modality, movement time, distance and accuracy. This concept is of particular interest to HCI researchers as they can evaluate various pointing devices and their respective targets. It studies the relationship between target sizes and movement times and how 'different conditions affects the coefficients within the Fitts' law relation'. [1]

For designing the experiment, I used Psytoolkit. Psytoolkit was designed to conduct a variety of cognitive psychology experiments. It is designed and maintained by Gijsbert Stoet a psychology professor at Leeds Beckett University in the UK. I first heard about Psytoolkit in a cognitive psychology class taken by Professor Stellan Ohlsson here, at UIC. Although, I initially began coding the experiment on Javascript. I thought it would be a great opportunity for me to explore a different programming environment. Psytoolkit is easy and reliable but, it has its own quirks. Figuring it out did take a while, but I thoroughly enjoyed learning something new and perhaps, even something I would not get to try once I graduate.

While designing the experiment I used two target sizes (widths 10 and 20) and three distances (200, 300, and 400). I used squares as my target shapes as suggested by MacKenzie and Soukoreff in [1]. The following are screenshots of the experiment setting.

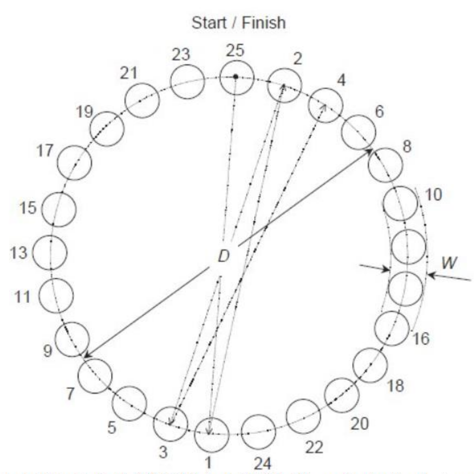

Figure 2 - Multi-directional tapping task. This illustrates the multi-directional tapping task described in the ISO9241-9 standard (2002). This paradigm has the advantage of controlling for the effect of direction. Circular or square targets may be used. The path the subject follows begins and ends in the top target. The arrows indicate the path subjects follow using the pointing device, to alternating targets clockwise around the circle. Software to capture subjects' movement times must graphically indicate which target the subject should proceed to next.

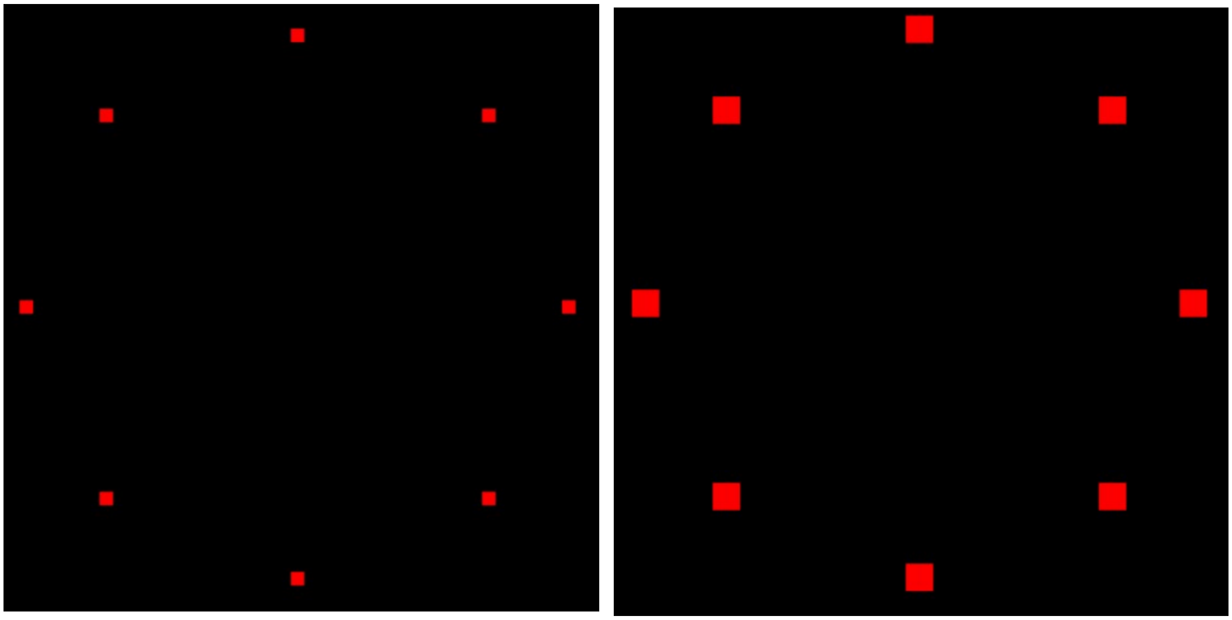

Figure 2: Target sizes 10 (left) and 20 (right). Distance between targets is 400. (Not to scale)

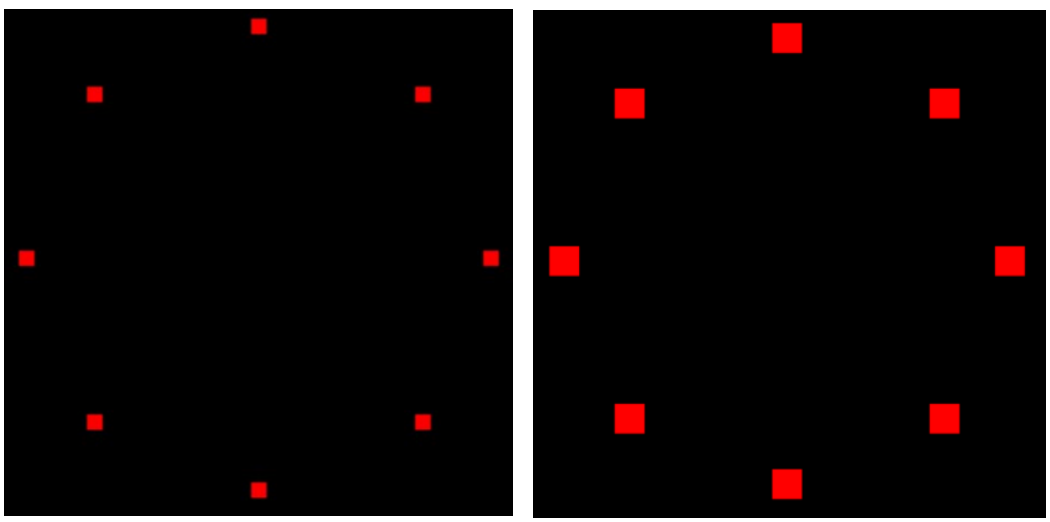

Figure 3: Target sizes 10 (left) and 20 (right). Distance between targets is 300. (Not to scale)

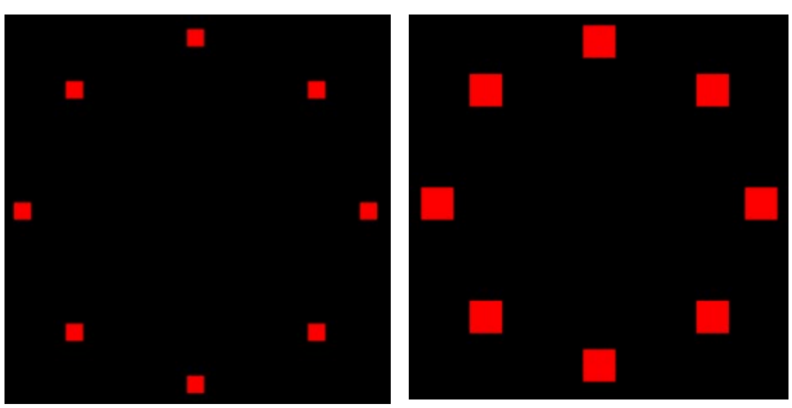

Figure 4: Target sizes 10 (left) and 20 (right). Distance between targets is 200. (Not to scale)

```
readmouse l 2 10000 range 2 2  #Measures time in milliseconds between clicks
save $x $y $w $distance        #Saves x and y coordinates along with the width and
                               distance in a data file
```

The above two commands are snippets from the source code. The first command measures the time between two clicks. The 'range' makes sure that only the click on the square target is measured. Accidental clicks are ignored. The 'save' command is self-explanatory. It saves the x and y coordinates of the target along with their width and distance.

The data was collected into an [excel sheet] and the analysis was performed over it. The Index of Difficulty was calculated using Shannon's formula:

$$ID = \log_2\left(\frac{D}{W} + 1\right)$$

The first plot (figure 5) was Movement time over Index of Difficulty. Here, the scatterplot shows the time taken for every click versus the index of difficulty. The next plot (figure 6) show the average Movement time for one target size versus the index of difficulty over the same distance. Figure 7 plots the Index of Difficulty vs. Throughput. Throughput is also called Index of Performance and is calculates as:

$$\mathrm{IP} = \left(\frac{\mathrm{ID}}{\mathrm{MT}}\right)$$

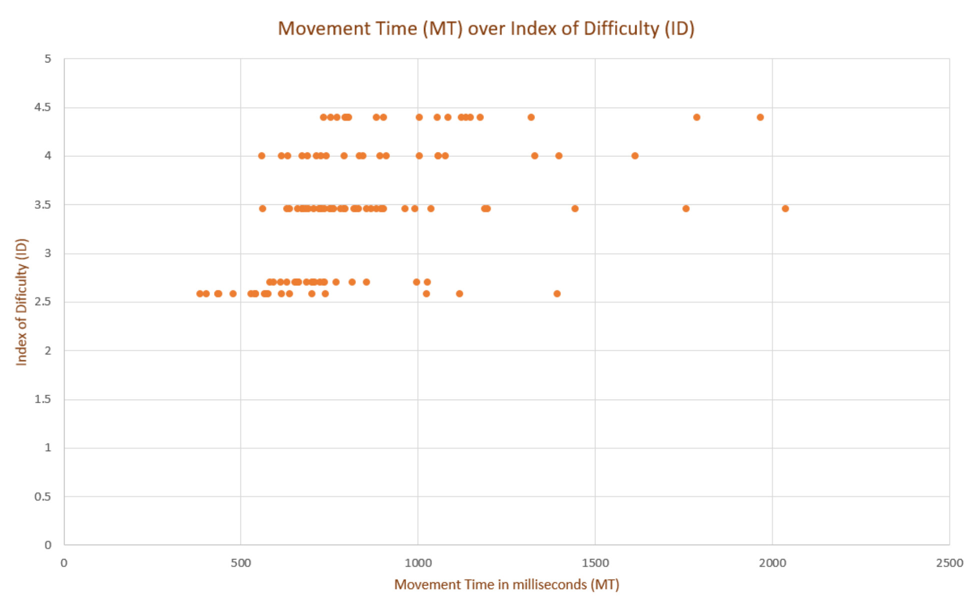

Figure 5: Movement time (for every click) over Index of Difficulty

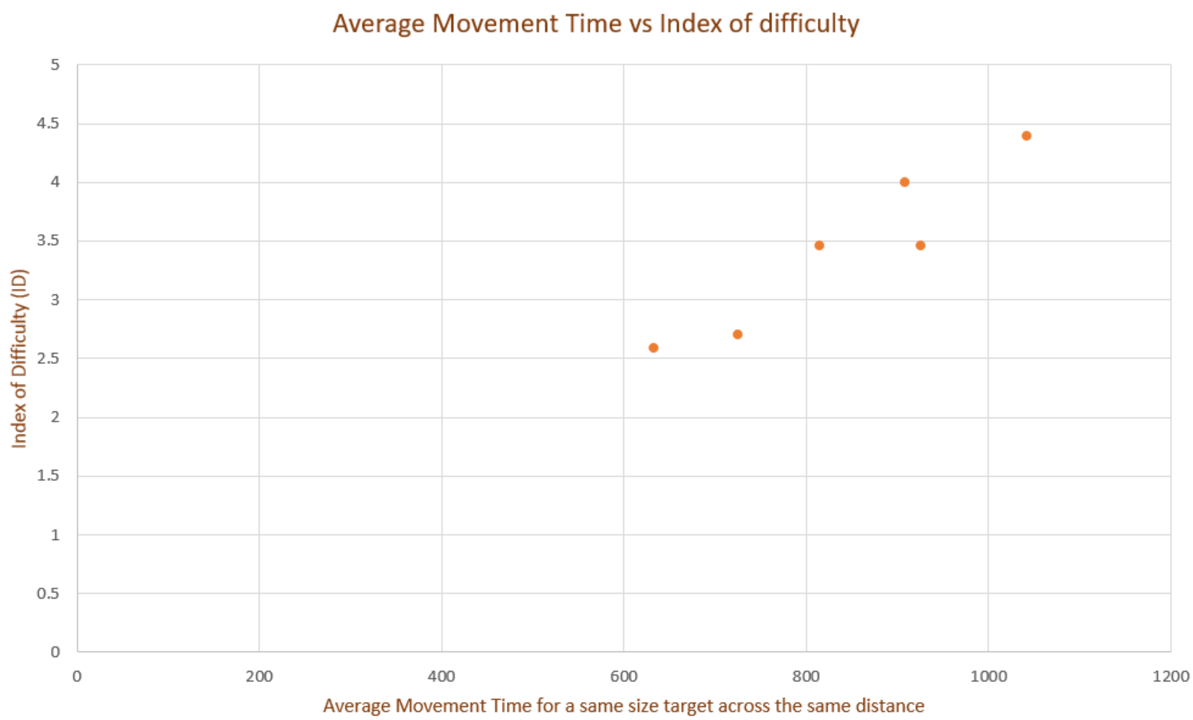

Figure 6: Average Movement Time over Index of Difficulty

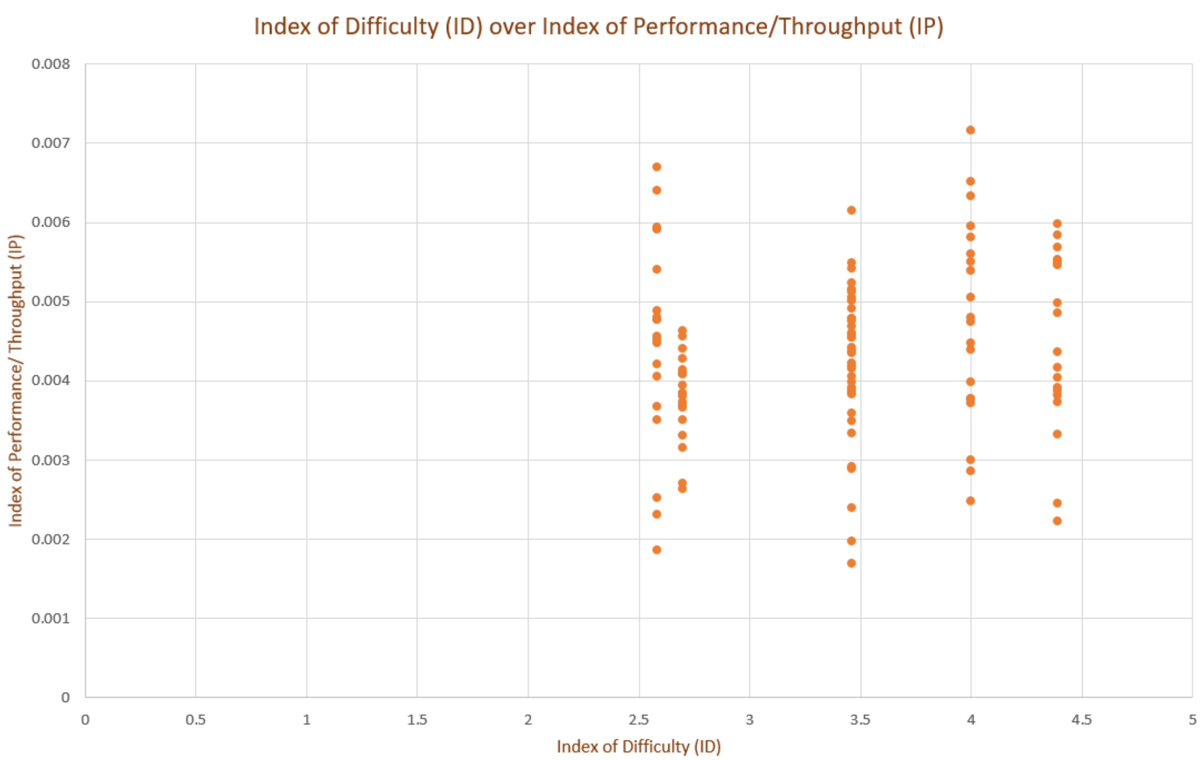

Figure 7: Index of Difficulty over Throughput

Regression was then performed over this data using Excel[2]. When regression was performed over the data where MT was NOT averaged (Sheet 5 here), the R Square value was 0.183039856. And MT = 197.4472647 * ID + 163.9601748.

The residuals when plotted look like:

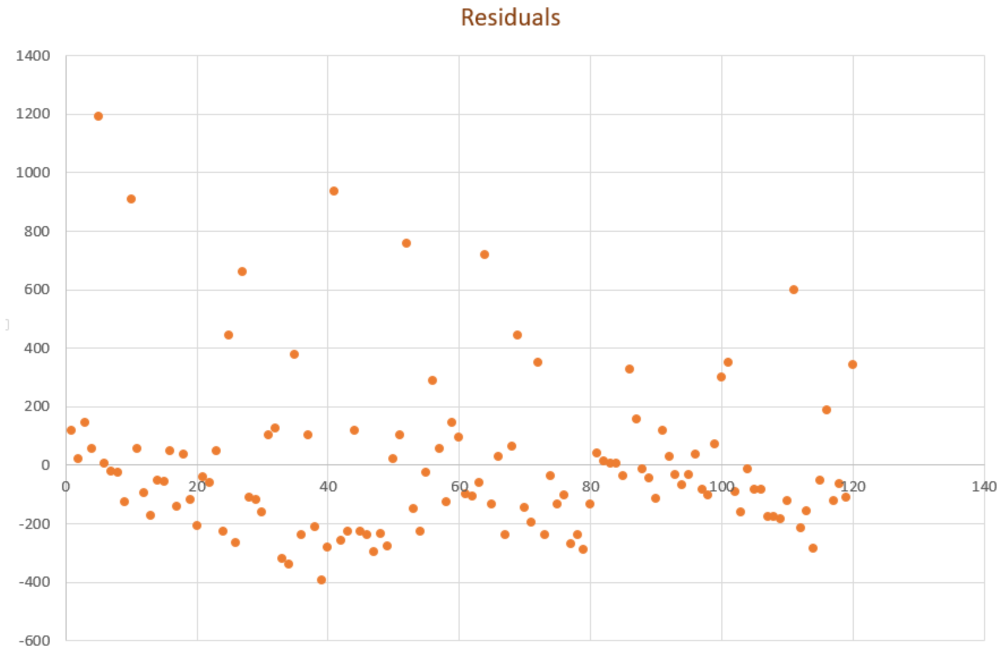

Figure 8: Residuals

When regression was performed over the data where MT was averaged (Sheet 6 here), the R Square value was 0.892055. Which is a much better goodness of fit. And, MT = 197.4473* ID + 163.9602.
The residuals when plotted look like:

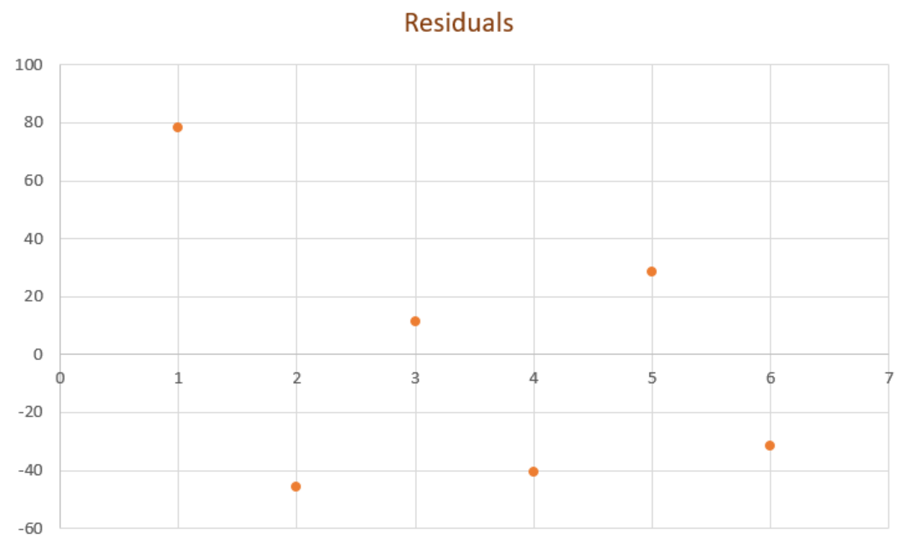

Figure 9: Residuals

References

[1] http://www.billbuxton.com/fitts92.html
[2] http://www.excel-easy.com/examples/regression.html
[3] http://www.yorku.ca/mack/GI92.html
[4] http://sixrevisions.com/usabilityaccessibility/improving-usability-with-fitts-law/
[5] http://www.yorku.ca/mack/ijhcs2004.html
[6] http://simonwallner.at/ext/fitts/
[7] http://www.psytoolkit.org/lessons/#lessons4
[8] http://www.psytoolkit.org/lessons/choose.html
[9] http://www.psytoolkit.org/lessons/stroop_code_explained.html
[10] http://www.psytoolkit.org/experiment-library/fitts.html