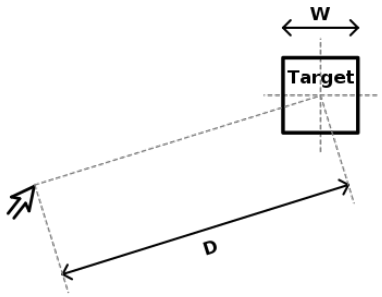
Predictive Modelling for HCI & Ergonomics

Thursday 29th August, 2019

How do we extend Fitts Law to two or more dimensional target tasks with complex factors like usage of shape, color and other visual attributes of the target?

1 Overview of the Project

One of the well known and robust methods, Fitts law identifies an effective model of human psychomotor behavior in the context of Human-Computer interaction. It tells us how time required to rapidly move to a target area is a function of the ratio between the distance to the target and the width of the target.[2]



$$MT = a + b \log_2 \frac{2D}{W}$$

The model generalizes the act of pointing and can be extended to either physically touching an object or virtually pointing on a computer monitor. This in fact eventually led to the factor leading to the mouses commercial introduction by Xerox over the joystick or any other directional movement input device.[1] Fitts law has played an important role in understanding

and designing user interfaces. However, the law is constrained to only one dimension and does not account for factors like usage of color, contrast, etc. due to their complexity. Through this project, *the aim is to design tools to study gaps in various predictive models but primarily Fitts law for two-dimensional target acquisition tasks.*

2 Objectives and Activities

To design, prototype and conduct a series of experiments to identify and study complex factors for two-dimensional target acquisition tasks.

1. **Literature Review.** Studying existing predictive models for HCI: Fitts, Welford, Steering law, etc.
2. **Design of experiments and Prototyping.** Identification of complex factors; and developing a web-based app to facilitate a series of experiments to collect user psychomotor behavior.
3. **Performing Experiment.** Recruiting participants, and carrying out the experiments with the participants, and prepare data that can be studied to model the extension of Fitts law.
4. **Documentation.** Documenting and presenting the results of the study.

3 Scope of the Project

The current scope of the project is limited to experiment design and preliminary testing of the same with participants in a supervised environment. This will eventually go towards deploying a real web app to carry out such experiments at large magnitude and model the extended Fitts law.

4 Expected Skills/Interests

1. Interest in HCI and computational models.
2. Know-how of empirical and quantitative investigation.
3. Experience with HTML and JS to build interactive web pages.
4. Experience with p5.js or similar visual prototyping tools would be an advantage.

5 Learning Outcomes

1. Understanding of the predictive psychomotor models that facilitate groundwork for designing user interfaces.
2. Using prototyping to design experiments to conduct quantitative research.
3. Relationships between complex factors that influence human motor movement for two-dimensional target tasks; Computational modeling.

6 Other Details

- This project does not involve travel.
- Student limit: 20 maximum.

7 Further Reading

- R. V. L. Hartley (July 1928). "Transmission of Information" (PDF). Bell System Technical Journal.
- Drury, C. G. (1971). "Movements with lateral constraint". Ergonomics. 14 (2): 293305. doi:10.1080/00140137108931246. PMID 5093722.
- Johnny Accot and Shumin Zhai (1997). Beyond Fitts' law: models for trajectory-based HCI tasks. Proceedings of ACM CHI 1997 Conference on Human Factors in Computing Systems, pp. 295302. http://doi.acm.org/10.1145/258549.258760

References

[1] Stuart K. Card, William K. English, and Betty J. Burr. Evaluation of mouse, rate-controlled isometric joystick, step keys, and text keys for text selection on a crt. *Ergonomics*, 21(8):601–613, 1978.

[2] Paul M Fitts. The information capacity of the human motor system in controlling the amplitude of movement. *Journal of experimental psychology*, 47(6):381, 1954.