Fitt's Law - Calculator

Human-Computer Interaction | Week 6 | Elias Group 4 | Ryan, Seeun & Tara

Symbolic Calculation Table

Symbol	Description	Time
B/BB	Pressing/Clicking mouse button	0.1s/0.2s
P	Pointing at target using mouse	PLACEHOLDER for the old UI / 1.022s for new UI (see “Fitt’s Law Calculation” for how these values were obtained.)
M	Mental act (thinking)	1.35s (according to lecture slides)

Other symbols have been omitted because they are not in use for this scenario. See the "KLM - CO2 Calculator" assignment for a table using more of the symbols.

Fitt’s Law Calculation

$$MT = a + b \times log2(\frac{D}{W})$$

The formula for Fitt’s Law shows that the movement time (MT) needed to move a pointer from a starting point to an object of width W at distance D will take the a and b constant values, depending on the input device. Thus, in the end basing the values off W and D will allow one to cover the movement time needed for the user to take to get to the object. Discluding the coefficient b the logarithm is the index of difficulty(ID), which rates the level of complexity to reach the target, no matter the device used to display the target.

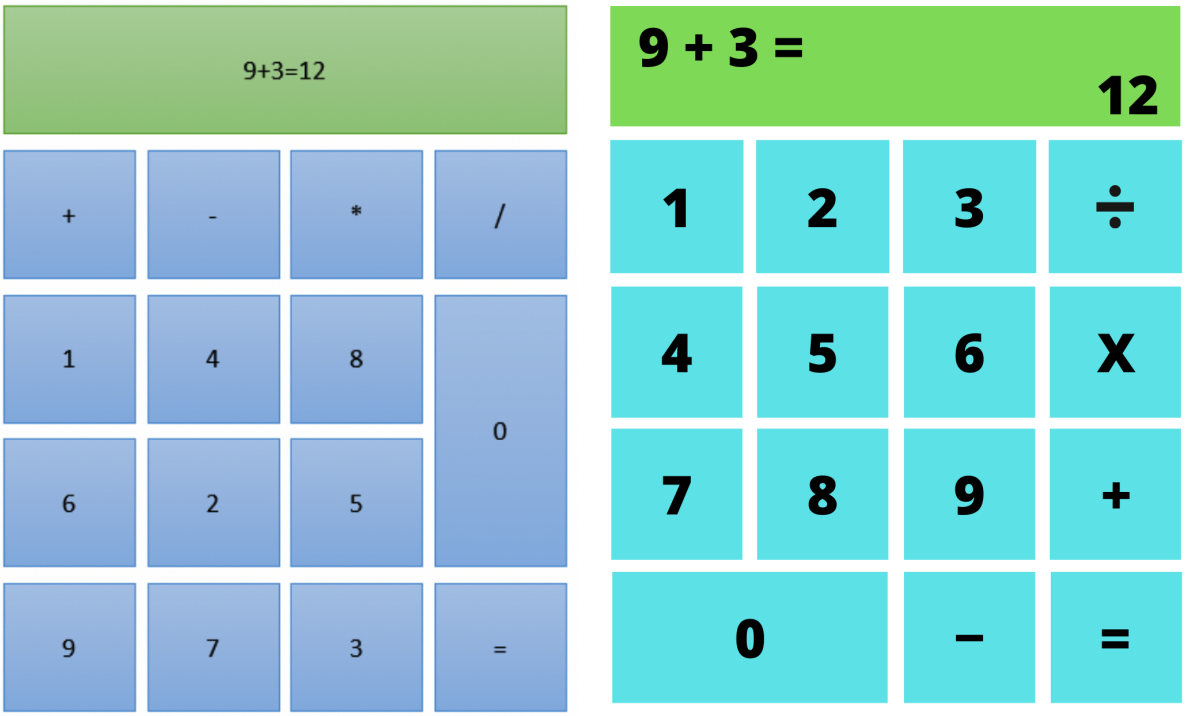
We opted to set coefficients *a* and *b* to equal 0.8 and 0.204 respectively, based on the numbers supplied from [1] in the formula for Fitt’s Law when calculating the pointing time P in the KLM calculation.

New UI P value using Fitt's Law

With a width (and height) of 231 pixels for the majority of the blue coloured buttons (e.g. = or + button) and a width between the buttons of 22 pixels, the distance between two adjacent buttons (measured centre to centre, as seen in Lecture 16) is 253 pixels. Using all these values, the MT for moving a pointer from one button to an adjacent one is thus: *0.827s*. The MT value is *1.03s* for the same movement with a distance of 2D.

To calculate the time needed to move from the ‘3’ button to the ‘+’ or ‘=’ button respectively, the diagonal distance was calculated using Pythagoras’ law (resulting in distances of 565 and 800 pixels). The MT values with these new distances plugged in for D resulted in MT values of *1.063s* for the movement from ‘3’ to ‘+’ and *1.166s* for ‘3’ to ‘=’.
We then took the average of these 4 MTs to give our value of *1.022s* for P to be used in the KLM model calculation.

Original Calculator Interface vs New Calculator Interface



The initial designs of the number keys were in a complicated order, in other words the placement of the number keys were not logical. In order to allow the users to increase learnability, efficiency and memorability in the newly adapted calculator, the number keys have been relocated based on the number keypad. For example, in the initial design the signs were separated by the 0 button, whereas in the new design all signs are linked together, without having to skip a key in between the signs. Moreover, the reason why the number signs start from the top left side was decided upon with the use of the gutenberg diagram. The gutenberg diagram has shown that many users tend to move from top left to bottom right. As a result, the team decided to place all the signs on the right hand side with having the equal button at the very right bottom, because it would give output, thus finalizing the user's action. In addition, the zero button was created as a bigger button, in comparison to the others to display that zero was the final numeric button given in the calculator.
On top of the illogical button allocationing, the size of the numbers and signs were inappropriate, because as a user it was unclear to read the signs due to their small sizes as well as the fact that the multiplication and division signs used were not the conventional signs. Therefore, all the signs and numbers were changed to bold and larger sizes with the use of the

conventional multiplication and division signs. In relation to making the text on the buttons clearly visible to the user, a brighter tone of the colours were used because the text was in black bright colours allow the black to stand out more. Thus, we used a brighter shade of blue and green to make the text visible.

KLM Calculation - Original UI

It is assumed for both UIs that the user starts the process with their hand on the mouse

1. M - User thinking about where the "1" button is located
2. P - Pointing mouse to the "1" button
3. BB - Clicking on the "1" button
4. M - User thinking about where the "3" button is located
5. P - Pointing mouse to the "3" button
6. BB - Clicking on the "3" button
7. M - User thinking about where the "+" button is located
8. P - Pointing mouse to the "+" button
9. BB - Clicking on the "+" button
10. M - User thinking about where the "2" button is located
11. P - Pointing mouse to the "2" button
12. BB - Clicking on the "2" button
13. P - Pointing mouse to the "3" button
14. BB - Clicking on the "3" button
15. M - User thinking about where the "=" button is located
16. P - Pointing mouse to the "=" button
17. BB - Clicking on the "=" button

System response time has been omitted (for both calculations) because performing simple addition will have a negligible effect on time using even remotely up-to-date software and hardware.

$$T = 5M + 6P + 6BB$$
$$T = 5(1.35) + 6(1.1) + 6(0.2) = 14.55s$$

KLM Calculation - New UI

1. M - User thinking about where the "1" button is located
2. P - Pointing mouse to the "1" button
3. BB - Clicking on the "1" button
4. P - Pointing mouse to the "3" button
5. BB - Clicking on the "3" button
6. M - User thinking about where the "+" button is located
7. P - Pointing mouse to the "+" button
8. BB - Clicking on the "+" button

9. P - Pointing mouse to the "2" button
10. BB - Clicking on the "2" button
11. P - Pointing mouse to the "3" button
12. BB - Clicking on the "3" button
13. P - Pointing mouse to the "=" button
14. BB - Clicking on the "=" button

$$T = 2M + 6P + 6BB$$
$$T = 2(1.35) + 6(1.022) + 6(0.2) = 10.032s$$

Works Cited

[1] J. Hernando, “Fitts' Law Calculator,” *codepen.io*. .