

BIOE 4610 - Take Home Exam

1) Discuss advantages and disadvantages of using: a switch array and a joystick

A switch array, as I have understood it, is a set of switches with; two latch switches that turn forward and reverse motion on and off, two momentary switches controlling left and right movement, and possibly another switch that would cycle the rate of travel between pre-set values.

A joystick is a proportional control that requires good head/neck control to drive with accuracy.

One of the advantages of using a switch array to control his wheelchair is that a switch requires less endurance than a joystick, by this I mean that since the joystick is a proportional control it would require a constant tension of the neck to maintain a speed, while the switch would just have to be pressed and a constant speed would be had. A disadvantage of the switch array is that if Larry lost control, it has potential to get out of control and he may not be able to stop the chair if his seating position changes. A joystick may be unusable if Larry's position changes, but it would not necessarily be as hazardous as a switch array. The biggest advantage of using a joystick head control is that it is something that is familiar to Larry. He's used a joystick for the past 6 years and so he would not have much of a learning curve using his head to control it. Another advantage of the joystick is that it would enable Larry to be constantly adjusting his speed, and would lower the probability that he would collide with someone or something. Having the ability to adjust your speed at will, will enable him to better maneuver tight spaces that may be in his house, at school, elevators, or anywhere else he may end up. Another disadvantage of the switch array is that it would require Larry to have relatively good and accurate reflexes, if he needed to stop or turn. Accidentally pressing a switch could lead to frustration as well as dangerous situations for Larry. A joystick would be much more forgiving of any unintentional movements, as they are undone upon readjustment of the head. As Larry's condition progresses and he has less and less use of his neck and head, it is difficult to determine which control will last the longest for him. The joystick's sensitivity can be adjusted to require smaller movements, and the switches can be repositioned to require less movement as well. Overall though, I would recommend that Larry use a joystick head control because he is more familiar with that type of control, and it gives him finer control in maneuvering himself.

2) Explain how you would use the MSIPT model to select an appropriate switch and placement.

The MSIPT model is a method that involves looking at the Movement available to activate a switch, the Site or Sites with which a switch can be activated, the Interface or switch itself, the Positioning of the switch as well as the Targeting (method of selection).

Movement

This part of the MSIPT model is about determining Larry's most controllable, reliable and consistent movement. As was given in the case presentation, Larry's most reliable movement is in his neck and head, though he may have some minor function left elsewhere that would provide sufficient movement for a single switch. It's important that the movement that is chosen is accurate and that Larry will be able to react using that movement in order to select.

Site

The Site of control is the part of the body with which Larry will be activating the device. It would be required that this be a consistent site, at which Larry can know that he has the switch and he would be able to feel that he is able to activate it. An example of this would be a switch that situated under his finger. Depending on the strength of his finger movements, the switch may provide feedback such that he knows when he's pressing it, or it can be that it has a different texture than the things around it so that Larry can find it if he needs.

Interface

This is where the switch selection comes into play, and there are a number of factors that are important to consider when selecting the switch. The sensitivity of the switch will determine how easy or difficult it is to activate the switch, this takes into consideration the strength of Larry's chosen movement. The target area, or size of the activation point is important for accuracy in activating the switch. The target area is affected by the size of the movement that Larry is able to perform, for example, if Larry can only move his whole fist, and then he wouldn't be able to press a button the size of a finger. Another important characteristic of switches that it is necessary to consider is the travel or movement which is required, as this must coincide with the Larry's ability. Feedback is an important quality of a switch, something that will let Larry know that the switch has been pressed. Durability of a switch is important, but completely dependent on the environments in which it will be present. Since the skeleton key program is for a computer, it is unlikely that it will ever go outside, so this could be a place where it doesn't have to be as durable as other switches.

Position

After having selected the switch and determined all of the above, it is now time to determine the appropriate positioning of the switch. There are important things to consider here as well, and they are almost all entirely dependent on the movement that Larry is going to use to activate the switch. It's important to consider orientation of the switch, whether it will lie flat, be inclined, etc. It is also important to consider whether it will be permanently attached to his wheelchair or only usable at his home workstation. Should Larry have to move onto the switch, or will the site always be located above the switch. These are all things that must be considered when choosing a switch.

Targeting

The targeting (method of selection) system that is used by skeleton key is an automatic scanning system. The following is text copied from the “my skeleton key” website.

“Skeleton Key will automatically “scan” through the keys of the keyboard. They are highlighted in a completely customizable pattern that lets you narrow in on the key you want. Every time the key you want is highlighted, click to reduce the number of highlighted keys. When the key you want is the only one highlighted, click to select it and perform its assigned function. Scanning will then resume.” –
www.myskeletonkey.com/features.shtml

In summary, the skeleton key scanning method is a systematic elimination of possible selections, which result in it presenting the desired key. This would only require a simple switch to control it.

3. Does Skeleton Key have any features that would enable Larry to improve his typing speed?

Skeleton Key does have some features that would enable Larry to improve his typing speed. Skeleton Key has a feature that it calls “Dual Word Prediction”, this feature includes word completion and word prediction. While typing, it will bring up the most used words that contain the letters you’re typing. Upon completion of a word, it will predict the word that follows; based on what words you have most often followed the preceding word with. Skeleton Key also contains a feature called “Automatic Word Expansion”. This feature allows you to type a short seemingly random sequence of letters that will be expanded to whatever you have it programmed to expand to. For example, typing the characters “4610” could be replaced with “Design of Assistive Technology Devices”. The final feature that could improve Larry’s typing speed is the “Automatic Punctuation”. This feature “reduces the number of keystrokes required to punctuate text” (www.myskeletonkey.com), and can be fully customized.

Larry will likely use the “Dual Word Prediction” continuously; as it learns which words he uses the most. This will prove to be the most effective feature, and simplest to use. The “Automatic Word Expansion” can be used by Larry to help him expand acronyms like; BIOE -> Biosystems Engineering, CIVL -> Civil Engineering. It is difficult for me to identify many uses beyond acronyms, but I would imagine that as Larry types he’ll be able to identify things that he types quite often, and then he’ll be able to set-up a short-form that can be automatically expanded to say what he would like to say in as few keystrokes as possible.

4. Does Skeleton Key have any feature(s) that would allow the typing of equations? Justify your answer.

I could find nothing in Skeleton Key that would enable Larry to be able to directly enter equations so that they would appear as follows:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

But that being said, with the macro functionality that Skeleton Key has and if Larry is using a program like Microsoft Word 2007 that has formula entering functionality, it's possible that he could bind operator keys to the formula function that word has. Such that when Larry would type "x/" then it would know to turn to $\frac{x}{}$ with the cursor waiting in the denominator for his next entry.

In conclusion, provided that Larry has a program with equation entering functionality, it is likely that using macro's and scripts that he would be able to bind various keys so that they run appropriate macros.