Assignment M1:

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***Abstract*—Keyboards are currently the most common electronic input device people use when typing text on a computer. Despite the large number of users worldwide, the keyboard designs only target the English proficient speakers. Although it is possible to change the language of typing on a computer, the keys on the keyboard only show the English letters. This poses a huge burden on people who desire to type letters of a different language. The current project aims to investigate this issue, find the needs of the user, propose new ideas to efficiently re-design the keyboard layout, and finally evaluate them systematically.**

1 PROBLEM SPACE

Keyboard is known as the most commonly used electronic input device (Pradeepmon et al., 2016). A large number of keyboard users come from various non-English speaking countries. These people use different languages to communicate through text. Originally, keyboards were designed to accommodate text entry in English. To date, keyboards are still being designed and developed in the original format and fail to include non-English letters.

The problem with not having language-specific letters on the keys of a keyboard occurs in different contexts. For instance, individuals taking remote classes in a foreign language face this problem regularly since they are required to communicate and deliver homework assignments in a language different from English. Another context example is when bilingual or multilingual people attempt to write a personal email or a work-related document in different languages. Using a keyboard with English letters to type non-English letters can impose a great cognitive load on the individual. In this situation, one either must memorize the non-English language-specific letters for the keys or attach stickers that show the desired language's letters on top of the keys. Memorizing letters can increase the risk of the error when typing on the computer. It also requires the user to get engaged in a task that requires a great amount of attention. Attaching language-specific stickers to the keys however eliminates this need. The problem with the

stickers is that they can only show letters for a limited number of languages. Another issue with the stickers is that they will either wear (which makes the letters fade) or get loose (which causes losing the labels and the keyboard looking dirty with the remaining adhesives) over time.

2 USER TYPES

This project covers a broad range of users. These users include everyone who uses a keyboard for typing on a computer. The individuals included in the study are required to be adults, with the age over 18 years old. These individuals should not have physical or mental impairments. The subjects are required to be able to communicate at least in two languages in writing. The participants require to have a basic knowledge about typing on a computer using a keyboard. The motivation of the participants to get engaged in the task is to use a keyboard to type text in different languages in different contexts (e.g., work-related, school-related, or personal emails and documents).

3 NEED FINDING PLAN 1

In this section, naturalistic observation is discussed as the first need finding plan. The steps required to find the needs of the user via natural observation are as follows: 1) observation and taking notes, follow the steps user takes and write down all the details, 2) summarize the detailed notes and create an abstract, 3) repeat this process for a number of sessions for the purpose of gathering more information, 4) ask my partner to do naturalistic observation and take detailed notes, then compare them with mine, 5) try to come up with questions to investigate further in the interviews.

The first step is observing the targeted audience naturally during their daily life activities and taking notes. My plan is to gather information on people when writing text on the computer using a keyboard and, in a language, different from English. For this, I am planning to observe people in different contexts. For example, I can observe my coworkers typing on their keyboard in French when communicating with our company's branch in France. Another context that I am planning to perform my naturalistic observation in is the school that I am studying at. In my school, people are coming from different countries and speak a wide range of languages such as Portuguese, Spanish, and Farsi. I can observe them while they are sending emails to their families back home. Some of my

friends also work for international companies, located in their hometowns. They prepare documents in their native language every day. My plan is to observe them when working on these tasks. I will do my best to write down all the details in the format of bullet points. My goal is to collect information on the following: 1) how much time it takes for them to initiate writing after changing the computer's language from English to another language, 2) are they memorizing the letters or not, 3) do they look at their keyboard while typing or they just fixate their gaze at the monitor, 4) do they switch often between looking at the monitor and the keyboard's keys compared to when writing in English, 5) do they use sticker labels on their keyboard's key, 6) if yes, are the stickers in good condition?

My second step is to boil down the observed points. I am planning to find similarities between people who type in similar languages and highlight those in my abstract. I will also try to find similarities between the contexts and highlight those as well. For example, I aim to find similarities between people in the context of creating work-related documents. This way, I will be able to group people who have similarities and be able to better interpret the gathered data.

My third step is to repeat the information gathering process in different contexts and at different times. This will give me a broader view of the user's needs. I will conduct my observation at different times of the day (e.g., morning, noon, evening, night).

My fourth step is to ask my partner and one of my friends to follow the aforementioned steps for a day or two and write down their detailed observations. I will then be able to compare my notes to theirs and investigate whether they had similar observations to mine. This will also enable me to observe more accurately and realize some possible missing points in my observations. I will therefore include those points in my following observation notes. I will also discuss the possible biases to adjust my questions.

My fifth step is to review the information acquired again and try to come up with some questions that would help me better clarify user's needs. My plan is to first generate as many questions as I can. This enables me to include questions that cover different aspects of the contexts as well as the differences between the individuals. After that, I will try to reduce the number of questions based on their similarities and review them to avoid biases.

4 NEED FINDING PLAN 2

In this section, conducting interviews is discussed as the second need finding plan. The steps required to organize the interviews is as follows: 1) identifying the individuals, questions, and the context of the interviews, 2) review the possible biases in order to avoid them in the interview questions, 3) prepare open-ended questions having the goal of mostly listening to the user, 4) organize the different sections of the interview, 5) practicing the interview with my partner.

The first step that I am planning to do is identifying the individuals, questions, and the context of the interviews. Based on the information I acquire from the first need finding plan (i.e., naturalistic observation), I will select the individuals to be included in the interviews. In order to diversify the individuals, I will do my best to include people typing different languages (e.g., Spanish, French, Farsi), in different contexts (e.g., work-related, school-related, and personal). Also, I will use the questions that I came up with during the process of my naturalistic observation.

The second step is reviewing the questions to make sure that no biases are included. I will make sure that I ask exactly the same questions from all individuals participating in the interview. I will also try to avoid the objectives that might hint to any biases. Also, I will make sure that I ask questions with a natural vocal tenor as certain vocal tenor or inflections might imply a presumed answer. In addition, I will try to maintain my body language neutral to avoid establishing a mood that can possibly project on the conversation.

The third step is preparing open-ended questions. For this purpose, my plan is to include as many questions as I can in one. My goal is to make the question itself as short as possible while maintaining conciseness. On the other hand, preferably, I will select the questions that encourage the participants to talk about the task difficulties as well as the contexts that create problem for them. My plan is to proactively listen to the participant and take notes of the details.

The fourth step is to conduct the sections of the interview in an organized manner. This means that I will write an introductory section to give the participant an idea about the context. My plan is to come up with a good flow of the questions. This means asking questions about their demographics first. I will then ask more questions about the keyboard itself and follow up with the different

contexts for the problem. I plan to have a concluding section to sum up the participant's ideas.

The last step is practicing the interview. After polishing the interview questions, I am planning to do mock interviews with my partner and a friend who uses keyboard to type two different languages in a computer. This not only enables me to rehearse my words and acts, but also realize possible pitfalls that may still exist in my interview questions. At this stage, I will ask my partner/friend to let me know if they feel any type of bias in either the words that I am using or in my body language.

5 NEED FINDING PLAN 3

The data acquired by the natural observation and performing interviews might not be as broad. Even spending hours of works, one can only collect data from a limited number of participants. Although the gathered information and data is detailed using the aforementioned methods, it is still required to collect broader data. This is if great importance for the current study since it has a large number of audiences coming from different contexts and backgrounds. Therefore, studying the needs and receiving feedback from many participants would be highly beneficial. In this section, conducting a survey is discussed as the third need finding plan. The following steps are planned to be taken to collect the information required via surveys: 1) Identify and design the questions, 2) identify the groups and individuals that can be asked to do the survey, and 3) practice.

The first step is to determine the most informative questions to ask from the survey participants. I believe the first two steps of my need finding plan (i.e., naturalistic observation and interviews) will provide a strong background in order to identify the survey questions. My goal is to list the collected information as bullet points and group them together. I will then examine what information is missing for me to get a clearer picture of the user's needs. For example, at this stage, I think it is beneficial to ask questions such as the following: How much time you spend on a keyboard in a day to type in English? How much time you spend on a keyboard in a day to type in other languages? What method(s) you use to type something on a keyboard in a language different than English? The next phase for me is to make my question list as short as possible for the purpose of not exhausting the participant answering the questions. Also, there is need to re-read

the questions several times to make sure that they are not only addressing the missing data of interest, but also are clear, specific, concise, expressive, usable, and, unbiased as mentioned in the lectures.

The second step is to identify the target groups and individuals for conducting the survey. My plan is to prepare the survey questions in the format of a Google sheet. This way, I can not only embed my desired question format (i.e., radio buttons, checkbox), but also share the survey with a large number of people on the internet. The initial plan that I have in mind is to share the link to the survey with my fellow classmates at Georgia Tech and Simon Fraser University (where I am also studying at) and ask them to complete the survey. This already give me information from broad audience. My classmates at Georgia Tech, are computer science students who fit in my inclusion criteria. They are very familiar with typing on a keyboard. They are students or employees working for different companies and in different contexts around the globe. It is highly likely that they have experience using a keyboard to type in languages different from English. The same is true for my fellow classmates at Simon Fraser University in Canada. A large number of people in Canada, including students, communicate at least in English and French. There are several individuals who speak other languages as well and use keyboards to type and communicate with others. In addition to my fellow classmates, I am planning to share the survey with people at my workplace. There are a few people who use emails to communicate in Spanish to the company's branch in Spain. These people use standard keyboards to type their emails in Spanish.

The third step that I am planning for is to practice the survey with my partner and a few classmates or colleagues for the following two purposes: 1) to examine whether I can collect the information that I am interested in, and 2) to resolve any possible grammatical or formatting errors.

6 REFERENCES

1. Pradeepmon TG, Panicker V v., Sridharan R. Hybrid estimation of distribution algorithms for solving a keyboard layout problem. *Journal of Industrial and Production Engineering*. 2018;35(6):352-367. doi:10.1080/21681015.2018.1508080