Human Computer Interaction (In English)

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WAYV: Braille Assistive Gloves

Good day, BraveON. Welcome to your HCI session. I'm Aditya, and we'll be talking about WAVE. WAVE stands for Wearable Assistive for Your Vision, and it is a wearable club developed for the visually impaired to learn and understand Braille a bit easier and a bit faster. We have all seen elevator buttons with these random dots at the bottom. We know it's used by the visually impaired to read and write, and we also know it can come in handy But the one question we all ask is, how do they read it? The same question Mania, my partner, and I have been asking each other is, how do they read it? Because there's not enough teaching assets present in India that helps visually impaired learn Braille faster and in a more intuitive manner.

The government in itself has been flushing down funds and has been trying to incorporate them into the inclusivity cloud by introducing support in regional language, by introducing Bharti Braille. But have they been any fruitful? Well, their implementations were not. And that is where we saw the gap and we wish to fill in. Wave is a wearable glove that mimics a braille script.

A braille script has six dots in total, three on the left and three on the right. The same is replicated by the glove as well. There are three flex sensors on your left hand and three flex sensors on your right hand. When I gesture or when I fold my finger, the voltage on my sensors fluctuate. The fluctuation is recorded as a gesture, a combination of which goes to my English alphabets.

Once I have my alphabets, it goes to my instructor website. What's an instructor website, you may ask? Well, the instructors in this era face difficulty in finding teaching assets, the lack of which hinders their growth. They are unable to connect at a deeper level with their students because of the traditional teaching assets used, like the braille slate or the braille board. That is why we have incorporated an instructor website. The instructor website has two modes in total.

There's learning mode and there's practice mode. In learning mode, I learn how to type alphabets like A, B, C, and numbers from 1 to 100. And in my practice mode, I practice what I learned, meaning I learn how to write alphabets, I learn how to write words,

phrases, and at times even sentences depending upon my learning curve. While this is a user's interface, on my instructor's interface, I'll be able to see the progress rate of my student, the accuracy rate, the user latency, and user competency. These are some of the parameters which are essential for an instructor to understand, to understand their students at a deeper level, in fact.

So we gave special emphasis on these factors. An instructor will be able to see the learner's growth over time, meaning where is the user facing difficulty? Where is the student facing difficulty? Or where does the student actually not understand what's happening? As and when the student progresses, the accuracy rate shows the progress as in time periods. Each time period suggests an entry. Each point of the graph also shows that accuracy rate, which the instructor can use to track and understand the student better. When creating or when devising a product for people with disability, there are a few things you need to keep in mind.

First and foremost is accessibility. Is the user able to access the products and its features without much strain on their part? Secondly is understanding. Is the user really able to understand what the product really is doing and how is it helping them? These are some of the key questions Mani and I kept asking each other. And from there on, we kept branching these questions into further sub questions. We ensured the product is accessible by ensuring it's comfortable and the interfaces are simple enough.

We made sure to complete any task you will need minimum number of clicks. If I am at the instructor website and I'm at the learning mode, I want to switch into my practice mode because I'm done with my course. I know alphabets from A to Z suppose and now I want to practice with words or phrases or sentences. I can just give a voice command saying practice mode and the website by itself switches into the practice mode, or I can just select one of the options on the interface and switch into my required or desired modes. We also made sure it's inclusive, meaning since it is a variable, we need to ensure it fits everyone.

There are hands of different sizes and hence we need to take care of that. We made sure the glove has a stretchable material that helps adjust to different hand sizes. Further, we also ensured that the material is breathable. Since the user will be wearing it for a prolonged period of time, we need to ensure that it is comfortable enough. It is breathable enough.

Since the user might perspire a lot from their hands, it should be sweat absorbent. It is made of cotton, which helps the user wear it for a long period of time. Next, we understood that the users are visually impaired and hence they have no idea where the

gloves really are or what the product really is. So we made sure the connections are made really tight and really nice. A well-connected circuit has been made to ensure there's no disturbance in between if the user even tries to, even by mistake, touches the wrong parts.

Today we have brought to you the MVP of our product. MVP stands for Minimum Viable Product. If we say it in layman terms, it is the product stripped off of its potential editors, but what remains is the fundamental verticals. meaning today you'll be seeing the glove with its proper fundamentals, meaning the flux sensor, the microcontroller, the buzzer, and the button vibrators. What are they for? Well, the buzzer helps us understand whether an input or an output has been confirmed.

When I flex my finger or when I gesture, the buzzer beeps, which signals that yes, my input has been confirmed. It also beeps when my board or my microcontroller has established a connection with my computer. We have button vibrators fitted on the underneath side of the glove, which helps us nudge the user on which finger to fold and when to fold. Suppose for alphabet A in braille is the first dot. The glove and its button vibrators, on the first finger, the button vibrator vibrates, which helps us notch the user saying, yes, now you need to fold the first finger for alphabet A.

Well, we didn't think that's enough, so we added more. We added constant audio guide, meaning any gesture I do or any movement I do, I'll be supported with my audio feedback. When I give any input, There's an audio feedback which says whether I'm correct or whether I'm wrong. In case I'm correct, it says, good job, great or excellent. Words of affirmation to promote the user's courage.

And then it says, okay, it's time to move on. Your next alphabet is A, so and so. In case I'm incorrect, My audio feedback says, you may be incorrect, but you can try once again. You're almost there. If you make these changes, you'll be correct.

It is important to be polite with them since they are still in their learning phase and they're really sensitive to changes. So we had to make sure all the feedbacks are really loving and really promoting instead of being really strict and arrogant. Now I invite Mania here to show the glove and its features. Hello everyone, I am Mania and I am going to show you the MVP of Wave. So this is what the glove looks like.

Now the braille script has six dots. So we have mapped it as 1, 2, 3, 4, 5, 6, mimicking the braille script. So for example, A being the first dot, we will nudge the first finger and show that this is what A looks like. So we have used flex sensors and button vibrators on the fingertips and buzzer to nudge the user with the answer script. So this is what the glove looks like.

We have added six lens sensors on six fingers to nudge. When I bend this, my voltage changes and it matched to the corresponding alphabet in the screen. Now below every flex sensor we have added a button vibrator that will nudge the user for tactile feedback. It will vibrate whenever I insert an input or the computer tells me to bend this finger. Along with that for auditory and sensory input I have added buzzer over here.

It will tell me when my output is correct, my input is incorrect or when I have connected my glove to the computer. So this is Vape, our glove. We have placed six flat sensors on six different fingers and on each fingertip there's a button vibrator. So for our haptic guidance and we have also placed a buzzer for the auditory guidance. Now I'll teach you how it works on the laptop.

The finger mappings are one is your left ring finger, two is your left middle finger, Three is your left index finger. Four is your right index finger. Five is your right middle finger. Six is your right ring finger.

Voice commands are now active. As soon as I connect my glove to any device, it will tell me which finger is mapped to which letter or which number. And then while it is telling, it will vibrate so that I get an haptic guidance for it. And it will then prompt me that My auditory input is on. So let's start with learning mode.

Learning mode. Switching to learning mode. Let's start with letter A fold one for A. After saying learning mode, it will switch to my learning mode and prompt me to fold one for A.

So. It is correct. Now try B fold one and two. After every correct letter, it will give me encouraging words like good, you are correct and then move on to the next letter. It is correct.

Now try C fold 1 and 4. It is correct. Now try D fold 1, 4 and 5. Now let's see what happens if I do an incorrect letter. It is incorrect. Please fold 1, 4 and 5 for D.

So I have folded wrong for D. So it will tell me that you are incorrect and tell me the right mapping to do it again. So this is what learning mode is. It will tell me from letter A to Z and numbers 0 to 100. Now let's move on to the practice mode. Now I can change modes from my laptop as well.

So just by clicking on select mode, I can change it. Switching to practice mode.

Practice word, VAT, VAT. A. T. Start with 1 and 2 for B. Now practice mode has words, phrases and sentences. So right now it has told me a word bat. Now I have to do it according to its guidance.

So 1 and 2 for B. B. A. T. Excellent.

Completed bat. Practice word cat. C. A. T. Start with 1 and 4 for C. Again after every correct word, it will tell me that you are done correct and then move on to the next word. Now along with that on my screen I have progress rate and error heatmap. My progress rate tells me the accuracy as to how nicely and how accurately I am moving my fingers and the error heatmap will see how many times I have done one letter wrong.

So right now I did D once wrongly. So it has a red bar on D which shows that I have done D wrongly for once. So this is what a wave is. Now that you have seen the MVP shown by Manya, you must be able to make out how a product meant for the people with impaired abilities should be made. We need to make sure that they are comfortable while using it. They shouldn't face any difficulty because they have enough problems.

We need to make sure that any tasks they do should be done really easily and with minimum amount of effort. You must have seen the entire prototyping phase that we had gone through from making the lo-fi sketches, finalizing lo-fi sketches, then going from hi-fi, finalizing hi-fi, and getting to the final product. Getting to the final product does not mean the end. The process goes on and on until you are satisfied with it, not just you, but the users especially. You must have seen that we have laced our product with haptics, with tactile feedbacks and audio guides.

Why? Because when I'm moving from a traditional equipment to something that is specialized or a bit different, like our glove, the target users might face a bit difficulty or might be frightened of moving on. We have ensured it is easy for them to make that shift, that leap of faith from the traditional products to our wearable glove. We hope this session was helpful for you to understand how prototyping or how product development happens and how we should go about it while developing something for people with disability. Thank you.