Ganesh Arumugam & Team5 Project: HearMe

## The Boston Home, Dorchester MA

Boston Home is a not-for-profit specialized care residence for 96 adults with advanced Multiple Sclerosis and other neurological diseases. The typical patient age at this facility is 57 years and there patients have a wide variety of motor impairments. Most patients are on motorized wheel chairs, and have some form of weakness in their arms. The patients have some form of speech impairment ranging from mild impairments to swear impairment and around one third of the patients have swallowing disorders. **Reason:** 

Our project's target users are speech impaired people, adults who stopped speaking after sometime in their life. So we wanted to explore this place and get details about our target users. The place is 30 minutes from college and one of our team mate (Mansoor) had been working there over a period of time. So this created a perfect platform to explore the place and approvals were given in quick time. The speech pathologist, A was very helpful and identified people whom we can interview for our project. He was also interested in the project and also offered us assistance for arranging future visits for our team.

## **Interview questions:**

- 1. Has using this device impacted your life in any way?
- 2. How often do you speak on your own rather than using your device?
- 3. Is there anything you would change about your device?
- 4. Can you remember a time when you were unable to carry out a conversation through this device?

5. On a score of 1 to 5, 1 being unsatisfied and 5 being totally satisfied, how satisfied are you with how long it takes to find the right sentence you want to express during a conversation?

## **Ethnographic Field Notes:**

**Date:** 01-28-2013 **Site:** 2<sup>nd</sup> floor, Boston Home **Time:** 12:30 P.M. – 2:45 P.M.

When we arrived at Boston Home, we were given a warm reception by A. We introduced ourselves and he took us to his office on the second floor. It was a small room with 3 desktop systems and few lockers. He gave us a brief introduction about Boston Home and handed over few forms to sign before meeting the people. The forms were based on HIPAA (Health Information Portability and Accountability Act) and we signed it. He explained about the device group meeting happening once every month where all the people using devices get along and shares their experiences of using the device.

We actually wanted this type of setting to explore how people are using AAC devices for their communication. It was a blessing in disguise that we were able to observe a small group of people using their device on this particular day with the help of A.

But there was half an hour left before the group meeting could begin, so A asked whether we want to interview a person before it. We were all set and said yes, we would like to start our work. So we moved into the hall way and into a room where we met F.

Some background information about F, he was paralyzed for 10 years from neck down and could speak without using any AAC devices. He has some background information about computers and his brother is a computer engineer, who builds customized software applications for F. A introduced us and gave a brief overview about our project. F accepted the request and said a big "Hello" to us in his own voice. We asked him to operate the computer and perform a task. F obliged happily and started speaking with his own voice into the microphone. F was looking at the TV mounted on the wall, since it acts as a screen both for TV as well as a computer monitor. F opened custom software (gmail) which was speech recognition software and built on windows. F ordered the system to move down three places to read a particular email. The system prompts him whether to proceed or cancel. F said yes and the email was read aloud to him. F can then reply to the message using a 25 second long voice message. He asks to scroll down in a message and system was scrolling the message at a slow pace.

So F basically uses his voice to perform his tasks. Certain things were evident during this interaction,

- His voice was not continuously loud, so system at times could not recognize the words he spoke.
- He could not interrupt the system when a task was being performed. An example, F has to wait till the system completes performing his previous task (like reading an email).
- F was clearly frustrated when the system did not respond properly to his commands.
- The system showed a '?' whenever his voice was feeble or not understandable by the machine.
- The software closed abruptly thrice, when F was trying to perform a task.

Analytical inference from the above passage would be summarized in the following way, Since his voice level was low, we can use an amplified output as an input to the system. We can customize the screen for him showing his previously completed tasks. And have a simple system that works robustly at all conditions to perform a task. Since if we can avoid frustration, I think we have won half the battle of helping these people use this system in a better way.

F was using computer for a year and he feels happy that he can use the system like regular people. He informed us, that his brother is working on a customized skype. He is generally tired and can't use system for no longer than an hour. He feels very satisfied with the current software. This can be because of the reason that his brother is building these customized software and based on his experiences.

The group meeting was due as soon as we completed our session with F. When we came out of the room, we saw a heavy rush in the hallway, since everyone was navigating in their wheelchairs to their respective sessions. It was a clean place and each person was assigned a care giver. The caregivers were always wired and constantly running from one room to another. The rooms for these people were spacious and had a TV and desktop and pictures of their family. We could even spot a lot of toys, sports banners, etc. So basically each person has some interests and hobbies. The group meeting room was on the end of the hall way and was bigger and each person arrived with their device.

A headed this meeting and started addressing their concerns. A speech during this meeting struck me, "We want to just communicate and don't want fancy devices" by M. Since most of the devices are always on, the charge on these devices were low. A never wants to switch off devices, since these people can't switch on, on their own. There was a range of devices on display from Dynabox, Ipad, Amplifiers, Windows tablet. Ipad apps like Verbally, Assistive Chat, System Chat (text to speech) were used by these people. Ipad output is very low and needs amplifier as it cannot be heard in a dining room. Using a stylus was termed easier for Ipad users and they just use the inbuilt keyboard. Most of the phrases were stored in alphabetical order and not based on the frequency. There were a lot of menus to navigate in Dynabox to say a simple "Hi". Since these people really suffer a lot to create a sentence, if it turns out an error before completing the sentence, it really hurts them. These people use their eyes, small hand movements to select their options on the screen. So a careful home page layout and easy customizable screen for every person was needed. And feedback/help buttons is a must on device used by these people. And these people hardly speak on their own for communication. It created a huge setback in our project. We initially planned to use these people voices for communication and helping them to avoid AAC gradually.

#### Date: 02-06-2013

## **Site:** 2<sup>nd</sup> floor, Boston Home

## Time: 11:30 A.M. – 12:45 P.M.

The second visit was well planned as we had to split into two groups and interview one person each. I had to interview R who was in mid-40, short and having a slim figure. He was operating the computer when I entered and was surprised to see me. I explained the purpose of my visit and he smiled. He said a proper "Hello there" like normal people. The person R speaks with amplifier and uses no AAC devices. He uses a left finger to operate the mouse as well as the keyboard. I asked him to use his computer.

He adjusted his wheelchair went near the mouse (a special kind of mouse designed for him) and moved it on the desktop. He was using the normal keyboard and desktop of Windows 7. He clicked on the Firefox icon and instead of double clicking it, he searched for the enter key on his keyboard. After a long search, he hit the enter key and the browser was open. He moved the mouse to the history button and clicked on it. During this action, he coughed heavily and was unable to control the mouse.

I asked him whether he needs a specialized keyboard and he replied 'No'. And also asked him about how he knows to operate a computer. For this the answer was special, "I learnt to use it on my own." I inquired whether he would like speech recognition software that accepts his commands and performs tasks. He replied "I would certainly want it." Since the door was open I could not hear his voice properly and he was struggling to speak longer sentences. He wanted to enquire something about me, but could not understand it. There was a universal intercom in every room, where caregiver can transmit a message to his patient. So his voice was too low due to these external noises. He even understood this and smiled.

Short sentences were clear and he takes a long pause to complete a sentence could be the inference of this observation. Regarding the software usage, we can build similar software like that of F involving speech synthesis to perform daily tasks. He certainly knows to use a computer since after any selection and hitting enter key is known to computer people. In fact he exclaimed happily when I proposed the speech synthesis software for performing his tasks. He also had large texts on his computer and this could be because of his near sightedness. Since he is comfortable in using normal desktop, he can be one of several people whom we can use to test the project prototype.

#### **Implications for design:**

- The system should be robust and customized to every person needs is one major observation. Since frustration and anger sets in if system is not working based on their actions.
- It should be simple and help them in communication as pointed out by one speaker in the group discussion. It need not do fancy things and just need to cover the basics.
- Another striking behavior exhibited by people who can speak through amplifiers was that, they do not want to use any AAC device for communication.
- So our target group now changes to people using Amplifiers since people using AAC were not able to speak completely. They completely relied on device for communication.
- We need to work on speech synthesis and it should help them to do some basic tasks like reading email and browse the web.

Stephen Flaherty, CS5340 Homework I2/T2

Team 5 (Mansoor Pervaiz, Zhichun Ye, Ganesh Arumugam)

Topic: Developing technology to assist dysarthric speakers with communication.

#### Setting: The Boston Home, Dorchester MA

Founded in 1881, The Boston Home serves adults with advanced Multiple Sclerosis and other progressive neurological diseases. Exceptional clinical care, compassion, and innovative programs have earned us the designation "Center for Excellence in Long-term Care" from the National Multiple Sclerosis Society. The Boston Home is the only facility of its kind in New England and only one of a handful nationwide. (source: <u>http://www.thebostonhome.org/about-us/</u>)

#### Rationale:

This location has members of our target population-people with speech impairment who may use an assistive communication device. Approval for the visits was obtained from Boston Home staff in advance and we were given clearance to interview residents identified by the speech therapist. Several team members had visited the site previously and we had refined our initial questions with instructor feedback. I had not attended the site before and this was my first visit. We were there to conduct interviews with four or more residents that had been recommended to us by a contact at the home. Interview questions:

- 1. Has using this device impacted your life in any way?
- 2. How often do you speak on your own rather than using your device?
- 3. Is there anything you would change about your device?
- 4. Can you remember a time when you were unable to carry out a conversation through this device?
- 5. On a score of 1 to 5, 1 being unsatisfied and 5 being very satisfied, how satisfied are you with how long it takes to find a sentence you want to say?

#### Field notes:

The team arrived around 1130am at the home and we split into pairs to conduct interviews with four residents who had been recommended to us by Alex, the speech therapist at the Home. Mansoor and I met with two residents in their rooms and conducted 15 minute interviews with them. Both residents were scheduled for meal time after our interview, so we did not want to keep them too long.

The first resident we met was W. He was in his bed watching TV when we arrived. He was receptive to our presence and we exchanged greetings. We explained the purpose of our visit and introduced ourselves. He has labored but mostly intelligible speech. We had to ask him to repeat his answers or questions several times, but we could converse with him the majority of times.

W does not use an AAC device. He has no interest in using one. When asked about the need for help with speaking, he replied that he can just talk louder when needed. We asked if he gets tired when talking for long periods or when talking loudly, he said that he did not and he only talked loud when he had to. He appeared a bit defiant about not using an AAC and was adamant in his ability to be able to communicate with people. We asked him about his use of technology and he mentioned an audio book player attached to his TV cart. He reports having used this device for 6yrs and he was very satisfied with its performance. He uses the device every day for an hour. He is able to press the play button himself when he is in his wheelchair. His favorite author is Janet Evanovich, and his favorite book by her is *One for the Money*. There is nothing he would change about the device, which was a roughly 6 by 8 inch unit with large buttons for Play, Rewind, Forward, Stop and a Power button. The unit was bolted in a vertical position on the side of his cart about three feet off the ground.

W appeared to have some use of his hand and he stated that he is able to feed himself though he does have some difficulty swallowing. When asked if he had any difficulties eating he said sometimes he did, but usually he did not need any help. If was having a problem while eating he would drop his utensils to alert the staff that he was in trouble. It was not clear what his diet was or what kind of food caused him problems. He mentioned that he used to use a computer but did not do so anymore. He made some grasping movements with his hands during conversation but it was not clear how much dexterity or strength he had. He did not appear able to get out of bed himself and had a motorized wheelchair. He stated that he was not getting up today, but the response was garbled as to the reason why and we did not press him for details.

The next resident S was in her wheelchair when we entered her room. S was very animated and readily engaged with us. Again we introduced ourselves and explained our purpose. She appeared to have limited use of her left side and did everything with her left hand. She was able to speak in a somewhat deliberate fashion but we could understand almost everything she said. She appeared to grow tired from the effort of speaking as the interview wore on, something she confirmed when I asked her. She does not have an AAC and does not want to use one. She stated that she does not have swallowing difficulties and is able to feed herself with no difficulties. We did not discuss diet with her.

S was very interested in using her computer. She spent much time writing in word and also liked to use the Internet and would Skype with one of her family members in Pittsburgh on occasion. She wanted internet access in her room so she did not have to go down the hall to the machine that was connected. She also wanted to learn how to use Dragon software so she could write faster. She currently has to use only her left hand to do all tasks and she feels very slow. She mentioned that she one time was writing up a list of complaints about the food and she was not able to get the list ready in time for the meeting with the food service director and administrators. She felt bad that she was so slow and had to wait for the next meeting to give them the list. She wants to be able to use speech recognition software to help her write, use email more, and explore things like Facebook and playing computer games. She was also frustrated that she can't think of words fast enough or loses them when she is typing. She is very near-sighted and that make it hard for her to see the computer screen. She used to wear special glasses to help, but they are broken and getting Medicare approval to replace them was taking a long time. She would like a large monitor that she can see clearly.

She likes to read but noted that regular print is too small for her to read and the large print books are too heavy for her to hold.

My impressions of the facility were that it is very clean and quiet. The stairwells and corridors were spotless, as were resident rooms. It struck me as much cleaner than many of the hospitals that I have worked at. I also found it strange that we did not have to check in with anyone and walked past the front desk with a wave. No one asked us who we were or questioned why we were there. Staff members we did encounter were friendly and barely paid us much notice, and the other residents we saw did not seem concerned with our presence.

All the residents we encountered were in motorized wheelchairs or in their beds. Most were moving about freely on the floor between common rooms and private rooms. The rooms of the residents that we interviewed were filled with many personal items such as pictures and books. They also had different furniture (S had a computer desk and filing cabinet), so perhaps they are allowed to set their rooms up as they please, with the exception of the hospital beds. Each room has at least one large window. It was a very pleasant environment for long term care.

The Home itself is a mix of old and new architecture, and has a 125 year history. The website chronicles a number of upgrades and addition to reach the current capacity of 84 residents. The building is situated on a hill overlooking an expansive lawn and you get the feel of a country estate as you approach. The Home has won prestigious awards for long term care and my impressions are that it is a well-run facility. We did chat briefly with one administrator who asked us about our program and it we had to do a thesis. She recounted stories of her own thesis defense with two advisors who had opposing views, so pleasing one would earn a rejection from the other.

#### Implications for design:

Based on these interviews and the previous visits by the team, we discovered that there are few people using AAC devices except those that are unable to speak. People with speech impairments that can speak, even with significant difficulty, do not want to use an assistive device. It is unclear whether this stems from a stigma of relying on a device, pride, denial or some combination of these and other psychological factors. As a result of the interactions with these residents, we are shifting our focus to using speech pattern recognition to augment their daily needs. For example, we could help S open her email or word processor through voice commands, navigate to her favorite web locations or launch Skype to connect with family. We could assist W with controlling his book playback unit or allow him to control a pure digital format of such a device (possibly allowing him more reading options). We would seek a very simple user interface, and small number of commands initially to provide proof of concept. Since this is a change in tack for us, we need to do background research in this area to see what has been done already and if there is work we can build on.

#### Name: Mansoor Pervaiz

**Team Name:** Team 5 (still in process of figuring out a name)

**Target Setting:** The Boston Home. The assignment did not ask for a description about the target setting, however, it is posted on Piazza with our proposed questions.

**Reason for choosing the target setting:** I have had prior experience of observing patients with motor speech disorder at Riverside Industries (www.rsi.org). It aims to empower people with disabilities and provide them employment opportunities. I realized that people with speech impairments get frustrated while using Dynavox partly because of their motor impairments. Dynavox is an assistive communicative device, which allows the user to tap on the icons on the screen to formulate a sentence and then synthesizes the speech for the sentence. However, for the purpose of this class we could not go back to Riverside because of the commute, and we chose Boston Home, which has quite a few residents with speech impairments. We went in with a very definite project idea in mind. We were hoping to confirm that people using a dynavox would benefit more from a limit speech recognition system, which would be tailored to their impaired speech. We believe that the caregivers of the patients understand their impaired speech as they are tuned to it and because they are only using a limited set of sentences and utterances for communicating.

Interview Questions: We had the following interview questions prepared for this exercise:

- 1. Has using this device impacted in your life anyway? (Grand Tour Question)
- 2. How often do you speak on your own rather than using your device?
- 3. Is there anything you would like to change about your device?
- 4. Can you remember a time when you are unable to carry out a conversation through this device?

5. On a scale of 1-5, 1 being unsatisfied, 5 being totally satisfied, how satisfied are you with? How long it takes you find the right sentence that you want to express when you are having a conversation?

## **Field Notes: (Summarized)**

Session 1: -1.5 hours interviews with 3 Residents, each starting with a demonstration of how they use their technology.

-1 hour observation of a group session "The Device Group"

Session 2: -45 minutes of interviews with 2 Residents, just interview no demonstration of technology

## *(because of the schedule and time limitation for the speech pathologist)*

**Resident-1** had severe motor impairment and was unable to perform any fine motor control from her hands. She was only able to use one of her arms and her speech was quite intelligible. She conducted three demonstrations because the interview, first showed how she used the assistive phone technology by calling her brother, second she showed how she use the computer through "Dragon Naturally Speaking" to write emailed and word documents and third she showed how she used her ipad (again by using dragon software).

She controlled her computer through commands like "wake up", "go to sleep", "open Microsoft word". Her major problem with the system was the she would forget that the system was still in "accepting command mode" and she would be talking to someone else and end up with a lot of text in her email. Also while using her touch screen on the ipad she was having difficulty in reaching farther parts of the screen and was double tapping instead of a single tap due to her tremor.

She said "I wish the computer could know when I am not speaking to it", "Why is this going to the next option", "I only touched once"

**Resident-2** was severely motor-impaired and her hands were balled into a fist. She demonstrated how she used her computer to check websites, write email and use skype. She used the Microsoft speech recognition system and moved her mouse by using commands like "mouse grid" to convert the whole screen into a grid and then selecting (and re-selecting) the portion of the grid by speaking out the grid number.

Her other noticeable commands were "Strike that", "Spell that" and "delete para". Her major issue was she could not see the number in mousegrid when she was fine-tuning the movement of the mouse. The more she spoke in a short time her voice would get weak and breathy and the computer would make mistakes. She said: "I wish the computer understood me better".

**Resident-3** had severe motor impairment and didnt even have a joystick on his wheel chair. He was controlling it with touch buttons right under his fingers. He was using a speech recognition system (built by his family member), which allowed him to control his TV channels and computer (to check emails). His system read the emails aloud and would record which voice (for 20 seconds) as a voice attachment for a new email. He did not need to write his emails.

"The Speech Group" is a group session once every month. In this session residents with speech devices come to practice, request for cleaning and tune-up, and just general conversation with the speech pathologist. This observation, however, started with the speech pathologist introducing everyone two us and telling about each individual device that they were using. The devices were speech amplification add-ons, dynavox, and ipad (with necessary assistive software on it). The whole group welcomed us (my team) with a "Hello" from their device. One thing worth noticing was that they the people using the dynavox were unable to speak at all, and they needed the speech pathologist's help to formulate "Hello" on their device. Half of the residents in this group session were unable to speak, and others who

were speaking were quite intelligible. The motor impairment varied from complete function of the arms and hands to being able to not being able to move the hands at all. The latter would interface with technology using a puff system (their breath) or chin button.

**Note:** The following residents were not using any speech devices or assistive technology as a result there was no demonstration to observe. These were straight interviews but I had to change my interview questions here because my original interview questions were invalid.

**Resdient-4** had mild to severe speech impairment and was severely motor impaired. However, the only technology he used was an audiobook player. The device was built around the impairment and had multiple buttons but one large red button, which the resident used to play the audio books. The resident was insistent that he did not need a speech device because he was able to speak and would like to use his own voice.

**Resident-5** had mild to severe speech impairment and used a computer normally. She had received training on how to use the computer and she used it for emails, skype, taking noted about her eating habits and writing official letters to the facility. She used the computer in her room as well as in the lab. However, she had a difficult time using the computer (particularly skype) because she was unable to see the screen properly due to her sight impairment. She was hoping to be trained on the Dragon Naturally Speaking software so that her emails and documents could be composed quickly.

## **Implication on Design**

 Residents who were using assistive devices, either were intelligible and just need amplification of their voice or were unable to speak at all which makes our original design idea useless for this target population. Therefore, we need a different technology implementation to help them.

- 2. Residents usually have visual impairments, which makes it difficult for them to see normal text. Residents mentioned their inability to see large text, their font sizes on their computers were set to a larger font and the customizations in their rooms had large fonts. Our visual interface should follow the same approach.
- Residents voice used to get too weak in longer conversations, which was noticed in all interviews, so that voice input should only have short decision trees to get them to talk less.
- 4. Residents had mild to severe motor disorder, so if there is a touch interface it should not involve moving across the whole screen.
- 5. Patients like to use skype and have difficulty in comprehending the smaller text and buttons. This is because skype is built for normal users, so a technology intervention here might be able to provide assistance to people with speech impediments and visual and motor impairments.

#### **Tentative proposal discussion**

We were hoping to find patients / residents who would:

- 1. Mostly be understandable only to their caregivers
- 2. Would be using a selected set of sentences to their total communication

However this was not the case, and based on our observations we are changing the direction of our technology. We are proposing to have an alternate interface of skype (which will use actual skype on the backend) for this target population. The interface of this skype will be designed with the target population in mind and will use pattern recognition for speech input to control skype. Moreover, this software will further allow the users to start application of interest and visit favorite webpages with voice.

# **T2:** Ethnography

Zhichun Ye, Team 5(Developing voice recognizing system to help people communicate) Settings and Rationale:

Founded in 1881, Boston Home is a non-profit specialized care residence for 96 adults with advanced Multiple Sclerosis and other neurological diseases. It is the only facility of its kind in New England and only one of a handful nationwide. We choose this location because it has our target population-people, who may use the assistive communication device: most patients there are on motorized wheel chairs, and have weakness in their arms; around half of the patients there have speech impairment ranging from mild to swear. Approval for the visits was obtained from staff in advance and we were given clearance to interview residents identified by the therapist.

## **Refined interview questions:**

- 1. Has using this device impacted in your life anyway?
- 2. How often do you speak on you own rather than using your device?
- 3. Is there anything that you would like to change about your device?
- 4. Can you remember a time when you were unable to have a conversation through this device?
- 5. On a scale of 1-5, 1 being unsatisfied, 5 being totally satisfied, how satisfied are you with how long it takes you find the right sentence that you want to express?

## Field notes:

We arrived there around 1:00pm. P1 was the first resident we met. He was watching TV when we walked in. We introduced ourselves and explained our purpose. P1 had labored speech but could express himself well. He has been using a customized voice control Gmail system developed by his brother and he showed us the system. There was a screen used as the monitor of computer on the wall, an x-box as microphone under the screen and a mouse beside it. The

therapist told we could use the mouse to control the system in case P1's voice wasn't recognized. The Gmail interface on the screen was simple, with a button and an input bar on the top, emails listed below in larger font size. He controlled the system by calling "move down #", "send email", "back", "scroll down", etc. Every taken in command and selected email would be read out. While doing so, system can't take in any new commands. We waited for 4 minutes until the first email was totally read. Then he tried "move down one" and "close the window" for 3 times but none were recognized. He seemed frustrated and asked us to help him to complete the task.

We conducted the structured interview with him since he's using AAC system and has intelligible speech. He's been using this system for one year, and it has improved his life because he can do things that regular people do. However, we noticed he need speak loud and may easily get tired after a sequence of commands. We guessed it might because the microphone can't capture weak voice. He admitted it happened sometime when his voice can't be recognized and he need ask the front desk for help, but he still gave 6 out of 5 of satisfaction for the system. We thought it because it's his brother who customized the system for him thus he didn't want to make more requests. But since he showed frustration when his voice wasn't recognized and said "Come on" several times during that tedious email, there did exist space for improvement. One of them will be the implementation of "quit" command. As the session is starting, we didn't ask him in more details. We thanked for his cooperation and headed to the session.

This group session is held once a month to help residents communicate and use AAC devices. There were 7 residents and 2 therapists. The therapist gave introductions about each resident and their devices. All residents used motorized wheel chair, three used iPad, two used DynVox, and two didn't have AAC device. P6 wasn't quite satisfied with her device because of the charging problem and it took her effort to turn off the microphone each time in the elevator

because of the noise it made. Later they used AAC devices to say "hello" to us. P2, P3, P4, and P6 generated it well; P8 made a typo but corrected it, P5 and P7 made mistakes because of long options. Most time residents there were listening, some were laughing. We assume they couldn't speak verbally thus didn't talk too much. After the session, we had a close look of P2 and P7's device. Since their devices were typing-based and they seemed tired, we didn't keep them long.

We came back there several days later. We met P9 who was recommended by the speech therapist. P9 was sitting in front of the computer when we arrived and he could only control his left little finger. He showed us how to use his computer. There was a large mouse at the left of the keyboard, it seemed to be specially designed because it had a very big scroll ball in the middle, which he used to control the mouse position. The OS he's used was the normal Windows XP except for larger font size. Instead of doing the double click to open an application, he first clicked the mouse and then pressed the enter button. Each time he need adjust his wheelchair's position to make enough space for him to switch his left hand between the mouse and keyboard. He tried 3 times to open a particular webpage by "click and press" in the history drop-down menu but all failed. He was frustrated about this, so we thanked for his quick tour and asked him some other questions. Later on we found in Mozilla you can't open a webpage by doing this.

Since he didn't use an AAC device, we changed to semi-structured interview. He said he used computer every night and loved using the keyboard and mouse. He hasn't been specially trained and we guessed he might have access to this technology before otherwise he wouldn't know "click and enter" to open an application. When asked has he ever used any application on iPad to help him communicate, he said he hasn't but he'd like to try. Then we mentioned the idea of voice control system, he seemed interested and wanted to have that in his own computer. The confusing part was when asked has using computer helped him communicate, he repeat "I don't

know", several times. Most time we could understand his short sentences within 2-3 words, even in weak voice. But when he wanted to ask us something, he tried several times but we still couldn't understand. We tried to repeat his questions to see if we got the right one. After several rounds, he laughed, we thought this might be the signal that he is good at short sentences but can't perform long ones, then we thanked him again and he said "Thank you" to us.

## **Implications for design:**

- Except for those who cannot speak, or with very severe speech impairment, most residents there are not willing to using AAC device for daily communication. Even P9, who can only speak in very weak voice and limited words preferred to talk by himself. This suggests the direction change of our goal system.
- The Gmail system is customized for P1 with his voice pre-recorded; we can also use that prerecord scheme to train our system. For different person, we record and store their voice commands, and go into his database to search for the specific command when using it.
- 3. Systems that facilitate residents' basic social life (sending email, doing Skype) are popular. P1 said, "The Gmail system has definitely improved my life because I can do things that other regular people can, like sending emails and doing Skype." They also love to have a voice control system on PC, as P9 said, "I haven't used that before but I'd love to have one."
- 4. Since people with speech ability don't usually use AAC device, we are changing our project focus from developing a voice recognizing system to help people communicate to using speech pattern recognition to facilitate people's social life. Like use voice control to help opening email, searching favorite webpage, and doing Skype.
- 5. Most residents have very weak voice and no so good sight, we can have an amplifier to amplify user's voice as input and use large font size of our system interface.