Human computer interaction

Natural language for human computer interaction

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List of Acronyms

HCI - Human Computer Interaction
PIN - Personal Identification Number

I. INTRODUCTION TO HCI

Human - computer interaction is all about how to design and implement interactive computer systems and how it effects on users. There are input devices and output devices in computer systems, which take inputs from user and give outputs. These are the channels which user interact with the computer. Human - computer interaction is still under development and it never ends. With the development of the technology, people are always adapting to different interactive channels because the user experience is a serious concern from the perspective of the user.

Human - computer interaction methods has been developed from physical components to touch enabled displays and the future of human - computer interaction methods will be replaced by virtual reality, augmented reality, language interfaces and many more innovative technologies.

II. USE OF NATURAL LANGUAGE FOR HCI

Natural language processing is in use from few decades in different levels. During this period natural language processing has been improved significantly and it was a huge contribution to improve the human - computer interaction. By using natural language for human - computer interaction, we can reduce the complexity of doing things with computers, but we have to make sure, we have a better natural language processing mechanism which is similar to the way of human - human interacts using natural language. Because human - human interaction is an effortless and effective communication and gives a hope to expect an effortless and smooth human - computer interaction in future. We can identify two major types of natural language, as spoken language and sign language.

III. ADVANTAGES OF USING NATURAL LANGUAGE FOR HCI

A. Reduce the cognitive load of the user

The most common way of interacting humans with computers is, giving inputs using a keyboard and click or point using the mouse, and see the output on a digital display. This is perfectly fine when using a very simple computer application, which requires one or two clicks to do the task. On the other hand, the user should know how many clicks are there, where to click and what is the order or if it requires keyboard inputs, user should know what to enter and what to do next. Simply this process needs the support of human brain in order to work properly. When it comes to complex computer applications or machines with complex inputs, it is so hard to remember each and every step with necessary information. This cause to increase human errors when using these systems and this increase the time consumption of the task.

When using natural language for human - computer interaction, we can reduce the cognitive load of the user. Because when using natural language, user has to communicate with the computer or machine over the language interface and explain his expectation in the similar way, which he does human - human interaction. This reduces complex navigations like, going through multi-level menus, clicking on dialogue boxes, checking checkboxes and giving keyboard inputs. So, the user doesn't need any special training

or knowledge in using the system, other than the ability to handle the natural language.

B. Enable interaction regardless of disability

We are living in a diverse world and everyone is not similar in every aspect. The global disability population is 10 percent and it is nearly 650 million people. In the current level of human computer interaction, it makes so hard or impossible to interact with computers for this group of people, because, most of the time it requires physical interaction. Natural language interfaces can play a huge role in enabling human - computer interaction for disabled persons.

The disability also has different levels like, blind but can hear and speak, deaf but can see and someone may be suffering with disabled hands or legs. For these different levels, natural language interfaces can implement in different ways. If someone has ability to speak we can implement a spoken natural language interface which allows him to speak. As well as if someone cannot speak but, he knows the sign natural language, for him we can implement a sign natural language interface which allows him to interact with computer or machine using the sign natural language. And if someone don't know the sign natural language and suffering with speaking disability, he may use a text based natural language interface, which allows him to interact with the computer as simple as having a chat with a friend on an instant messenger. These methods may allow them to point out directly what they want to achieve with the machine or computer, instead of navigating through complex menus and steps.

C. Reduce the environmental impact and health issues

Global annual electronic waste production is nearly 40 million metric tons and developing countries are collecting and recycling this waste as a service and getting an economical benefit. Since most of the people do not follow recycling practices properly, this leads to serious health problems and high degree of environmental pollution. There were nearly two billion personal computers around the world in 2014. Each of the computer comes with a monitor, keyboard and a pointing device like, touchpad or mouse. If we implement a natural language interface, we can replace nearly six billion input and output devices with it. And this may help to reduce the massive electronic waste around the globe.

As well as there are many factories around the world, which do manufacturing and assembling electronic devices. If we replace input and output devices with a natural language interface, we can stop manufacturing billions of devices and this may help to save energy and environment for the future.

Nowadays computer related injuries are common among computer users. Mostly people are getting hand, wrist and arm pain because of bad positions of using mouse and keyboard. If we implement natural language interfaces, people don't need to use their hands at all and they can keep their hands free and relax when working.

IV. CHALLENGES IN USING NATURAL LANGUAGE FOR HCI

A. Less shared context

In human - human interaction, we do not try to understand the conversation, by just getting the meaning of words. We are learning things during the entire lifetime and getting experiences on different things. So, we have some level of shared context and each and every moment we update our knowledge base, we do this even during a human - human conversation. There are many ways to tell the same thing using different words, and there are different meanings for the same word based on the context. In such situations we consider human behavior and reactions to understand the exact meaning of the conversation.

But in human - computer interaction, we do not have that big shared knowledge base and the knowledge base of the computer or natural language interface is not updating in the speed of humans update their knowledge base. This makes so hard to continue the human - computer conversation over natural language interfaces. Since the current generation has more understanding in interacting with computers and machines, they are trying to adapt their language to be compatible with natural language interface during the conversation. But when the human - computer conversation becomes unnecessarily complex, user

may give up on using the natural language interface, because it is not that user friendly.

B. Vocabulary problem

Based on the country, based on the region, the vocabulary of human - human interaction may vary. Even within the same country, people may use different vocabularies in different areas. But in a human - human interaction with different vocabularies, it does not make the conversation harder. Because in such a case both parties may adapt to each other or may interact with a common context.

The diversity of vocabulary makes natural language interfaces more complex to build because less shared context and it will make the lexicon of language interface necessarily bigger. Since natural language interfaces give freedom to user to speak with his own vocabulary, it increases the risk of getting errors and conversation may get even more complex when both parties are trying to adapt and understand.

C. Privacy, security and social issues

Unlike traditional human - computer interaction methods, when people are using natural language interfaces, the language interface works as a gateway for each and every interaction. To improve the natural language understanding, the language interface developer or vendor may have to access conversation data and do continuous analysis. This leads to privacy issues since user shares almost every information about him or her in order to maintain a successful conversation between the user and the computer. As well as, companies may use this data to get competitive advantages, like for advertising purposes and market analysis. And also, this may allow them to analyze social trends, political trends and it may cause to social problems when third parties are trying to fix or act against social trends.

Natural language interfaces require serious level of security, because, if someone got unauthorized access to the language interface, that person can collect all sensitive information from website credentials to credit card information of the user. Apart from that this may cause to expose intellectual properties or business secrets of the user and if he is doing a serious business, competitors may use these unethical methods to reveal business secrets. As well as these security issues may cause for life threatening incidents like smuggling since everything about the user is open and exposed over the language interface.

V. FUTURE OF HCI WITH NATURAL LANGUAGE

A. Unrestricted natural language interfaces

In future there will be completely unrestricted natural language interfaces. So, people can speak with the device in their native natural language regardless the country or region. As well as future natural language interfaces may more intelligent to understand the user input based on the context, pronunciation and personalized vocabulary. Future devices with natural language interfaces may build with some general knowledge to interact with the user, but when user uses it, the device may learn things faster from user inputs and shared common contexts. This may allow users to have personally trained devices which feels more comfortable for users when interacting with the device and by the time the device may become a family member, which knows past, present and has ability to predict the future.

B. No more complex interactions

Future devices do not need multiple input and output devices, which are required in present devices, like digital displays, keyboards and pointing devices. If we can improve natural language interfaces as we expect, we can completely remove all input and output devices and include hardware components which are required to function a spoken natural language interface, basically user will interact with only a mic and a speaker or in case of a gesture natural language interface only a camera and a display. As well as with the natural language user can point out what he need exactly and, no need to go through complex navigations.

Since future natural language interfaces are more intelligent user can give complex tasks to devices and mind some other work. For example, if user want to send an email to the office informing the user is sick, he just has to ask the computer to send, the computer and natural language interface may collaborate and write the content and send it to the relevant person. Not only that, user may ask his car to drop him to office

and take his child to school or user may ask his juice making machine to make a juice which contains vitamin C, which is sweet but without adding sugar, so the machine should understand the context and it should have some shared knowledge with user. For all these scenarios user even does not need to touch the device, just have to issue the voice command or gesture command as he interact with some other human.

C. High degree of accessibility

Since we can build adaptable natural language interfaces, we can provide accessibility for everyone. This is not only targeted on disabled persons but also children, old people and anyone who don't have computer literacy or any other required knowledge which requires to operate a system or a device. Since everyone in the world have some level of literacy to handle their natural language, nobody will fail to use future devices. It only requires to have some level of literacy in spoken natural language or gesture natural language.

As well as this may help blind people to give up on legacy writing systems like braille and use the equal interaction method as others. Since future natural language interfaces and devices are more intelligent, people do not have to worry about mistakes, which may occur when using devices. The device or system itself will guide the user to achieve the task completely without any mistake. This may allow users to access and use devices, without having prior knowledge on process or subject which is he is going to work.

VI. SECURITY BY DEFAULT

In current systems and devices, the main security check is provided by comparing the password, PIN, face or thumb. And this is an additional step to the user before proceed with his main task. In case of using password or PIN, he need to remember it and enter carefully. If somebody got his password or PIN, that person may easily access to his sensitive information. This can be prevented by using thumb or face verification, but still it is an additional step for the user on each and every time when he is doing a task. And current systems and devices do not have the security check enabled by default, the user has to configure it or he can leave it unsecured if the configuration looks complex.

When using natural spoken language interfaces, security check is not complex and it can enable by default. In future the device can authenticate user from his voice, by analyzing his voice deeply. To implement this can get the support of deep learning and neural networks. So, no need additional step for the security check as soon as user starts to speak the device may authenticate and identify the user. And also, this will help to profile a single device for different users, for example the car can have different profiles for each family member. As soon as the driver speaks, the car will detect the user profile and adjust seats, adjust side mirrors, adjust air condition temperature, tune the radio and ignite the engine. If unknown person gets into the driving seat, the car won't start for him, because his voice is unauthorized. This can consider as a moment which we improved human - computer interaction with built in security with the support of natural language interfaces.

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