FUTURE TRENDS IN HUMAN – MACHINE INTERFACE

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ABSTRACT: *As the power of modern computers grows alongside our understanding of the human brain, we move ever closer to making some pretty spectacular science fiction into reality. Imagine transmitting signals directly to someone's brain that would allow them to see, hear or feel specific sensory inputs. Consider the potential to manipulate computers or machinery with nothing more than a thought. It isn't about convenience -- for severely disabled people, could be the most important technological breakthrough in decades Intelligencemeets artificial intelligence*

A person using the MAIA BCI to control a wheelchair, for example, only has to think about going straight ahead or turning left and the chair follows their command. However, they do not have to worry about colliding with obstacles – even moving ones such as people – because the wheelchair itself monitors and reacts to its environment. "A user can tell the chair to go straight ahead, but it will not just randomly roll in that direction if there is a wall or a flight of stairs in the way," Researcher notes. "What we have done is combine the intelligence of the person with the artificial intelligence of the device."

In a sense, the artificial intelligence embedded in the chair acts much like a human's subconscious. People, for example, do not consciously send commands to every muscle in each leg in order to walk and do not think where to step to avoid an obstacle – they do it subconsciously. Similarly, a wheelchair-bound user of the MAIA BCI simply has to send the signal to go in a certain direction and the chair figures out how to get there. But the user always stays in control!

1. INTRODUCTION

The area of Intelligent Interfaces is one of the most heterogeneous research subjects dealing with computers that exist. In this area, people from vastly different disciplines and research areas within disciplines meet, debate and collaborate. The term is so wide that people will shrink from it in practice - survey articles have been written about intelligent tutoring, adaptive interfaces, explanations or multimodal dialogue, but no survey article tries to address the whole area of intelligent interfaces. Even though all of these areas can claim to develop intelligent interfaces, none of them address this aspect specifically.

If the work in this area is so widespread and diverse, one may ask whether there is any reason at all to give it a specific name. Wouldn't it be better to avoid the notion of intelligent interfaces altogether, and continue to investigate these areas in parallel, with their different focuses?

I believe that there is an added value in the notion of intelligent interfaces, in that it captures a set of problems and ideas that are shared between all these more specific research areas. Firstly, the term provides a common framework of reference for a large group of research directions, but it is also defines a set of research issues that are worth pursuing in their own respect, without being artificially constrained by an application area or a specific technical solution

CHARACTERISTICS

The first issue is that the area is inherently cross-disciplinary. A normal, "good" interface cannot be called intelligent, if it does not involve some technology that reasons about "doing the right thing". Similarly, a novel mechanism for dialogue management or presentation generation does not constitute an intelligent interface, unless it has been combined with some principles for what constitutes a good interface design given this novel reasoning mechanism.

A second issue is that the area of intelligent interfaces is concerned with the development of systems that really work. For example, an abstract model of human collaboration may be useful for sociologists, but if it cannot be put to use in the design of an interface or the development of a dialogue manager, it falls outside the area of intelligent interfaces. Similarly, several models of inference used in artificial intelligence assume infinite rationality; this is useful only as a (bad) approximation of the reasoning capacities of a computer system, and will not do as an approximation of human reasoning in a user model.

Finally, the research area of intelligent interfaces is neither solely application-driven nor technology-driven, but both. New interface designs may be developed to accommodate new technological developments, but research on interface technology can be motivated by novel application areas and interface designs.

STATE OF ART

1. Application areas for Intelligent Interfaces

2. Tools and Techniques for Intelligent Interfaces
3. Design Considerations for Intelligent Interfaces

1. Application areas for Intelligent Interfaces:

Some typical application areas that can be characterized this way are intelligent tutoring, intelligent help and information filtering.

Intelligent Tutoring. A "tutor" is a program that aims to give a personalized "education" to a user in a specific domain of knowledge [Shute and Psotka 1994]. The tutor program may need to infer the user's understanding of the domain through analyzing the user's performance on test problems. The advice can be given by actively intervening, and suggesting alternative courses of actions, or passively, by answering explicit user's queries. In both cases, the answers can be tailored to what the system perceives as the user's needs and misunderstandings. Passive tutoring is often done in the style of "critiquing", where the user first suggests a full solution and the system then judges this solution, points out errors and suggests alternative solutions.

Intelligent Help. A "help" system aids a user in performing a specific task [Breuker 1990]. Help is very similar to tutoring, but the main objective for a help system is to get something done, and not to make the learn something. Another difference is that many tutoring systems will lay out specific tasks for the user to do, in order to diagnose his or her misconceptions. A help system must act upon whatever information it can gather from the user's own choice of interactions with the system. A help system can either give help about the functionality of a computer program, or about some computer-independent task (repairing a car, for example). As with tutoring, help can be active or passive.

Information filtering. In open information sources such as the Internet, it is comparatively "cheap" to distribute information to a very large group of recipients. For recipients, this means that they are flooded with large masses of information, and find it hard to extract the information that is really relevant or interesting to them. Users need help in selecting the information that is relevant to them, but the problem is that they do not know what is out there.

Information filtering techniques and information retrieval in general, aim to find structure in the available information that can be used to aid users in navigating the information space and selecting the information that is relevant to them. The task is called "filtering" when the information space is rapidly changing. Information filtering tools may rely on text or image processing, but may also log the reading patterns of groups of users, to determine what kind of users are interested in a certain piece of information.

2. Tools and Techniques for Intelligent Interfaces

Most computer tools and techniques that are used in intelligent interfaces stem from the artificial intelligence field. There are two main areas that come into play: user modeling and natural language dialogue.

- User Modeling:

The term "User Modeling" is used in two different meanings. In software design methodologies, it is sometimes used to denote the analysis of the prospective users of a computer system to be developed. In the research area of intelligent interfaces, it is used to denote a model of the user that the system maintains, and adapts its behavior to. This is sometimes also called 'system user modeling'. In some literature of user modeling for intelligent interfaces, it is also required that the model is explicit, so that it can be easily inspected and modified. In this view, a bunch of switches in the program that determine what certain inputs our outputs will look like, do not constitute a user model. This is a somewhat awkward distinction, since it may be possible to maintain a very explicit model of the user during development, that decide which switches are needed and what effects they should have, but that do not motivate an explicit user model in the actual program.

- Natural Language:

Research on natural language dialogue is directly inspired by the thought of getting a computer to carry out a human-like dialogue. Since people are able to interact with each other in natural language, it should be natural and easy to interact with a computer in the same manner. The research has many facets, ranging from the literal interpretation of natural language sentences to recognizing the focus and topic shifts of natural dialogue

3. Design Considerations for Intelligent Interfaces:

The roots for research on interface design for intelligent interfaces lie mainly in cognitive psychology -- the theory of human thought. Intelligent interfaces are intended to be adapted to the user's way of thinking, and to some extent understand how the user thinks.

Intelligent interfaces may provide both active and passive adaptations to the user's needs. These may require different interaction metaphors to be understood by the user. If the prevailing interaction metaphor is that of direct manipulation, the system must behave rather passively, and let the user maintain the initiative and control of the interaction. The intelligence of the system may show only in the set f options that the system suggests, for example. Examples of a very passive intelligent interface are the adaptive prompts suggested in. Their system presents a completely standard direct manipulation interface, but in addition to the normal interface, the system maintains a small menu of the three or four most useful "next actions". This menu is continuously updated, and may provide shortcuts to the user's next action. On the other hand, if the system is to take a lot of initiative, make active suggestions of may interpret the user's queries or commands differently in different situations, this can be conveyed through an "interface agent". In this situation, the user will perceive the interface agent as a conversation partner, rather than a useful tool. This mode of interaction has sometimes been called "indirect management"

SPEECH UNITS:

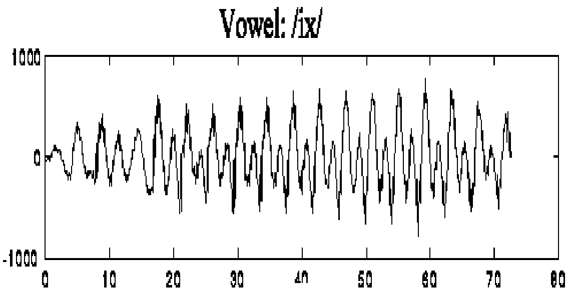
The choices of speech units determine the storage memory required and the quality of the synthetic speech. Some possible units are described in the table given below. The number in the bracket under the column "quantity" is the sufficient numbers of sub word units describe all English words.

SPEECH PRODUCTION AND ACOUSTIC-PHONETICS:

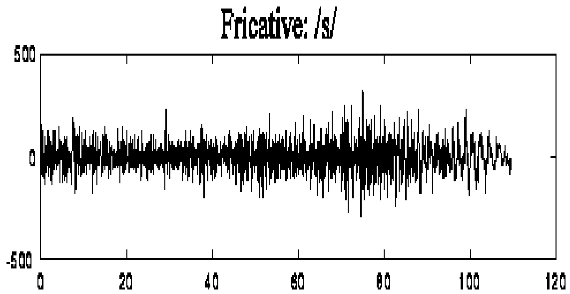
The English phonemes can be classified according to how they are produced by vocal organ. An understanding of speech production mechanism will help us to analyze the speech sounds. Acoustic phonetics is the study of the physics of the speech signal. When sound travels through the air from the speaker's mouth to the hearer's ear it does so in the form of vibrations in the air. It is possible to measure and analyze these vibrations by mathematical techniques studied in physics of sound.

SPEECH UNITS:

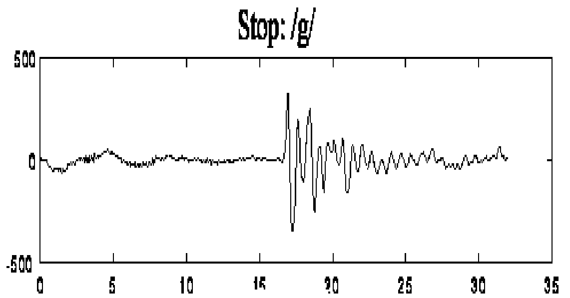
Listener into a sequence of words and sentences converts the acoustic signals. The most familiar language units are words. They can be thought of as a sequence of smaller linguistic units, phoneme, which are the fundamental units of phonology. We will use ARPABET symbols in the rest of this paper. The easiest way to understand the nature of phonemes is to consider a group of words like "hid", " head ", "hood", and "hod". All these words are made up of an initial, middle, and a final element. In our examples, the initial and final elements are identical, but the middle elements are different. It is the different in this middle element that distinguish the four words. Similarly, we can find those sounds, which differentiate one word from another for all the words of a language. Such distinguishing sounds are called phonemes. There are about fifty phoneme units in English. The following figure shows a segment of vowel /ix/. The quasi-periodicity (almost periodic) of voiced speech can be observed.



Fricative sounds are generated by constricting the vocal tract at some point along the vocal tract and forcing the air stream to flow through at a high enough Velocity to produce turbulence. This turbulent air sounds like a hiss e.g. /hh/ or /s/.

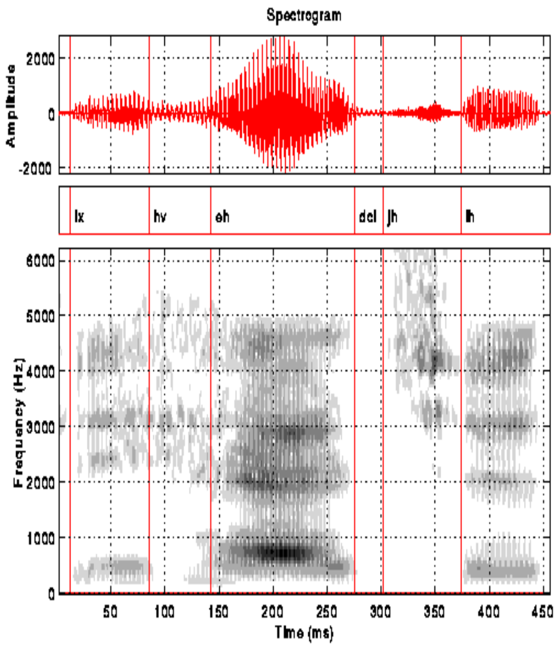


Plosive or stop sounds are resulted from blocking the vocal tract by closing the lips and nasal cavity, allowing the air pressure to build up behind the closure, and following by a sudden release of it. This mechanism produces sounds like /p/ and /g/. The following figure shows the stop /g/. The silence before the burst is the stop closure.



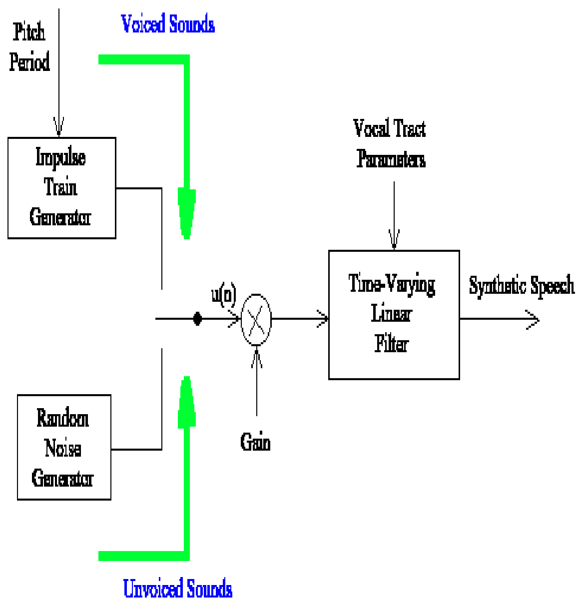
2. ACOUSTIC PHONETICS ANALYSIS OF SPEECH SIGNALS:

Based on the knowledge of the speech production mechanism and the study of acoustic phonetics,we are able to extract a set of features,which can best represent a particular phoneme. One of the popular techniques is the spectrogram,which describe how the frequency contents of a speech signal change with time. Suppose we have a signal,which is sampled at 16Khz, the typical steps to compute the spectrogram are described as follows. The speech is blocked by Hamming window with duration of 256 samples. A 56-point FFT(fast Fourier transform) is applied to each windowed speech. The power spectra in dB are plotted. Horizontal bars in the spectrogram display the format frequencies while the vertical lines there indicate the pitch period(i.e. the inverse of the fundamental frequency).



SYNTHESIS METHODS:
Synthesis can be classified by how they parameterize the speech for storage and synthesis.

1. Waveform Synthesizers
2. Terminal Analog Synthesizers
3. Articulaticulatory Synthesizers
4. Formant Synthesizers



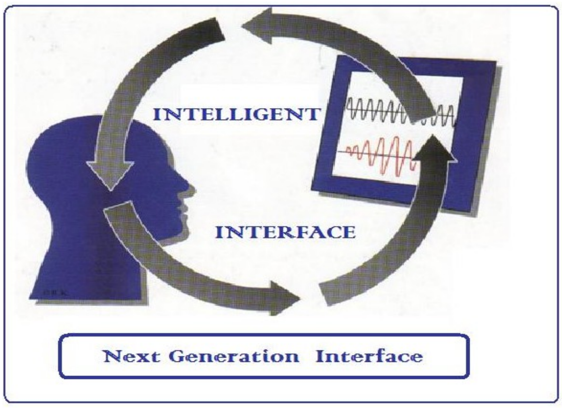
<u>Speech Synthesis model based on LPC model</u>

<u>SCOPE:</u>

Typically, we require of an intelligent interface that it should employ some kind of intelligent technique. What, exactly, counts as an intelligent technique will vary over time, but the following list is a fairly complete list of the kinds of techniques that today are being employed in intelligent interfaces:

- **User Adaptively:** Techniques that allow the user - system interaction to be adapted to different users and different usage situations.
- **User Modeling:** Techniques that allow a system to maintain knowledge about a user.
- Natural Language Technology: Techniques that allow a system to interpret or generate natural language utterances, in text or in speech,
- **Dialogue Modeling:** Techniques that allow a system to maintain a natural language dialogue with a user, possible in combination with other interaction means (multimodal dialogue),

Explanation Generation: Techniques that allow a system to explain its result to a user.



3. CONCLUSION

- The definition of intelligent interfaces is as ambiguous as the definition of Artificial Intelligence. However, it is possible both to scope the area of research for Intelligent Interfaces, and to find good reasons to pursue this research area. The research area is inherently cross-disciplinary: we must both strive to make technological advancements in interface generation, and develop novel interaction principles aimed to perfect the human - computer dialogue.
- Today, technology is developing rapidly, now so a new technology is knocking the door which highly related to interfacing the brain. Now we don't require making commands to computer and other devices now they are intelligent enough to understand our need without asking us. This new approach is nothing but based on intelligent interface.

Simply
Intelligent Interface
Make User –System Interaction In
Intelligent Manner.

5. REFERENCES

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