# UNIT 4: CRITICAL EVALUATION OF COMPUTER BASED TECHNOLOGY

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### 1.0 Introduction

This unit briefly describes some uncommon technologies associated with human computer interaction. These are innovations that improve upon the user interface, particularly those innovations benefiting the disabled. Technologies such as the phonetic typewriter, the ear cons, the auditory icons, the recognition and gesture devices for the disabled and the elderly are described.

### 2.0 Objectives

By the end of this unit, you should be able to:

- Describe multi-modal, multi-media and multi-sensory systems
- Appreciate the speech and the Phonetic typewriter interfaces
- Understand the Ear cons and Auditory Icons as important components of multi-modal systems
- Know that Recognition and Gestures Devices are essential for the Elderly and Disabled

### 3.0 Main Content

### 3.1 Multi-Sensory Systems

Here, more than one sensory channel are involved in interaction as in sounds, text, hypertext,

animation, video, gestures and vision.
They are used in a range of applications particularly for users with special needs and virtual reality.
The components of Multi-Sensory systems are: Speech, Non-speech sounds, Handwriting, together with their applications and principles.

Usable Senses
The five senses: sight, sound, touch, taste and smell are used by us every day and each is important on its own Together, they provide a fuller interaction with the natural world
We can ideally utilise the Computers to use all the available senses but this becomes practically impossible because computers rarely offer such a rich interaction.
We can use the sight, sound, and sometimes the touch senses, but we cannot yet use the taste and smell.

## 3.2 Multi-modal and Multi-media systems:

Multi-modal systems
These use more than one sense (or mode) of interaction as in visual and aural senses. For example, a text processor may speak the words as well as echo them to the screen
Multi-media systems
These use a number of different media to communicate information. For example, a computer-based teaching system may use video, animation, text and still images; different media all using the visual mode of interaction. These may also use sounds, both speech and non-speech. Of course two or more media now use different modes.

### 3.2.1 Speech

Human beings have a great and natural mastery of speech which makes it difficult to appreciate the complexities but it is an easy medium for communication
Simple terminologies used to describe speech:
The structure of speech is called phonemes and there are 40 of them. The phonemes as basic atomic units that sound slightly different depending on the context they are in, the larger units of phonemes are the Allophones. Allophones are the sounds in the language between 120 and 1 30 and are formed into morphemes. The morphemes are the smallest units of language that have meaning.Prosody is the alteration in tone and quality. They are also variations in emphasis, stress, pauses and pitch. They impart more meaning to sentences.Co-articulation is the effect of context on the sound. It transforms the phonemes into allophones. Syntax is the term used for the structure of sentences while semantics is the collective term used for the meaning of sentences.

### 3.2.2 Problems in Speech Recognition.

Different people speak differently because accent, intonation, stress, idiom, volume, etc. differ. The syntax of semantically similar sentences may also vary while background noises can interfere.
People often "ummm....." and "errr ..... " but words are not enough - semantics are also needed. It requires
intelligence to understand a sentence because context of the utterance often has to be known as well as information about the subject and speaker. For example, even if "Errr I, um, don't like this" is recognised, it

is a fairly useless piece of information on its own.

### 3.2. 3 Speech Related Human-Interaction Technologies.

The Phonetic Typewriter

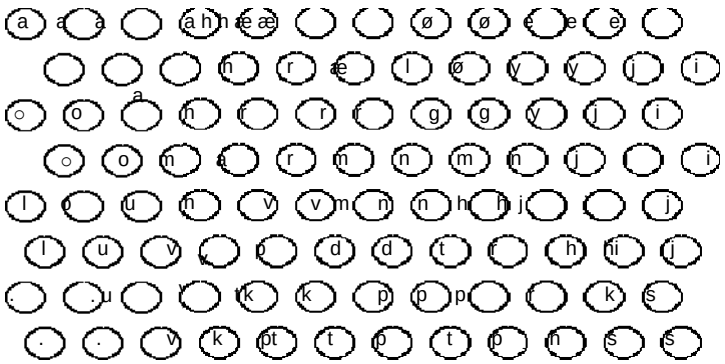
This is developed for Finnish - a phonetic language. This machine trained on one speaker, will generalise the training to others.

A neural network is trained to cluster together similar sounds, which are then labelled with the corresponding character.

When recognising speech, the sounds uttered are allocated to the closest corresponding output, and the character for that output is printed.

It requires large dictionary of minor variations to correct general mechanism.

The Phonetic Typewriter



Usefulness of Speech Recognition:

It is useful for a single user or in a situation in which limited vocabulary systems exist, for example in a computer dictation.

In the public and open places of limited vocabulary systems, it can work satisfactorily e.g. in some voice activated telephone systems.

For the general user with wide vocabulary systems, problems do occur.

Its great potential value however manifests when users hands are already occupied as in driving or during manufacturing particularly for users with physical disabilities.

Another advantage is its lightweight and its use as a mobile device.

Speech Synthesis

This is a generation of speech. It is useful because of its natural and familiar way of receiving information.

It is successful in certain constrained motivated to overcome problems.

applications when the user has few alternatives and is particularly

However, it has its own problems similar to speech recognition particularly in prosody. Additional problems can arise from intrusion calling the need for headphones particularly due to noise in the workplace .Its transient nature is a problem when it becomes harder to review and browse.

Few examples occur in screen reades that read the textual display to the user e. g. as utilised by

visually impaired people. Also in warning sig als of spoken information sometimes prese nted to pilots whose visual and haptic skills are already fully occ upied while flying.

### 3. 3 Sounds

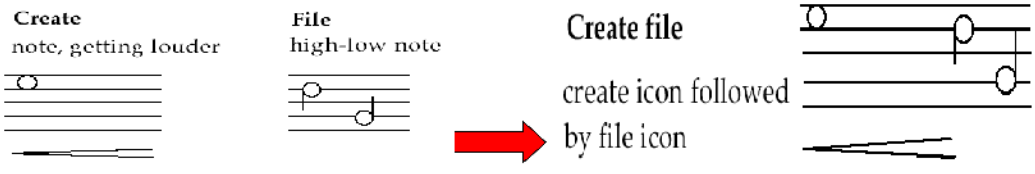
Non-Speech Sounds:
These are bongs, bangs, squeaks, clicks etc. that are commonly used for warning and alarms. Fewertyping mistakes occur here with key clicks. It is also useful in video games that become sound.Unlike speech, it is language and cult ure independent.
ninteresting without

Non-Speech Sounds provide dual mode displays in information presented along two different sensory channels. It provides redundant presentation of information in the resolution of through information in another. It is mbiguity in one mode good for providing both transient and background status information e.g. Sound can be used as a redundant mode in the Apple Macinosh. Also, almost any user action (file selection, window active, disk insert, search error, copy complete, tc.) can have a different sound associated w ith it.

Auditory Icons
These use natural sounds to represe t different types of object or action. Natural sounds have associated semantics which can be mapped onto similar meanings in the interaction e.g. thr owing something away such as the sound of smashing glass.
Problem sometimes arise because n t all things have associated meanings.
Additional information can also be p esented on muffled sounds if object is obscred or action is in the background. The use of stereo allow positional information to be added.

Examples:
SonicFinder for the Macintosh: Here,
items and actions on the deskt and moving files produce a dragging op have associated sounds. For examp le, fol sound.
ders have a papery noise
Copying sound gives a sound of a lig progress of the copy.
Big files have louder sound than small

Earcons
These are synthetic sounds used to cid being poured into a receptacle while rising pitch indicates the ler ones.
Convey information. They comprise structure d combinations of notes
or motives that represent actions an d objects. Motives are combined to provide rich information.
Compound earcons are multiple mot ives combined to make one more complicat ed earcon



Family ear cons

Here, similar types of earcons represent similar classes of action or similar objects .The family of "errors" would contain syntax and operating system errors. Earcons are easily grouped and refined due to compositional and hierarchical nature.

It is harder to associate with the interface task since there is no natural mapping.

3.4 Recognition and Gestures Touch recognition:

Comprises:

i. Haptic interaction made up of cutaneous perception that provide tactile sensation and vibrations on the skin

ii. Kinaesthetic comprising movement and position and force feedback.

Touch recognition also include information on shape, texture, resistance, temperature, and comparative spatial factors.

Examples of technologies on touch recognition include electronic Braille displays and force feedback devices e.g. Phantom that recognises resistance and texture.

Handwriting recognition

Handwriting is another communication mechanism which we are used to in day-to-day life The technology of handwriting consists of complex strokes and spaces.

The handwriting is captured by digitising tablet through strokes transformed to sequence of dots. Large tablets available are suitable for digitising maps and technical drawings.

Smaller devices, some incorporating thin screens are used to display the information. Such include PDAs such as Palm Pilot and tablet PCs.

The problems associated with handwriting recognition are personal differences in letter formation and co- articulation effects.

The breakthroughs in this technology is the creation of stroke not just bitmap found in special 'alphabet' like Graffeti on PalmOS

The technology is usable even without training though many people prefer to use the keyboards!

Gesture technology;

This can be found in its various applications such as in gestural input - e.g. "put that there" and sign language.

The technology comprises data glove and position sensing devices such as MIT Media Room.

Gesture provides the benefits of natural form of interaction by pointing.

It enhances communication between signing and non-signing users

The problems with gesture interaction are that it is user dependent due to the variable nature of each user. Issues of co articulation are also considered as problems.

### 3.5 Devices for the Elderly and Disabled

The development of Technology on Human Computer Interaction has helped users with disabilities as follow:

Visual impairment: Use of screen readers and Sonic Finder

Hearing impairment: Use of text communication, gesture and captions

Physical impairment: Use of speech input and output, eye gaze, gesture, predictive systems (e.g. reactive keyboard)

Speech impairment: Use of speech synthesis and text communication

Dyslexia: Use of speech input and output

Autism: Use of communication and education devices

Older people use disability aids, memory aids, and communication tools to prevent social isolation

Others:

Children use appropriate input and output devices for education, games and fun.

In solving cultural differences, the influence of nationality, generation, gender, race, sexuality, class, religion, political persuasion etc. are affected by the interpretation of interface features. e.g. interpretation and acceptability of language, cultural symbols, gesture and colour.

## 4.0 Conclusion

Since the basic goal of HCI study is to improve the interactions between users and computers by making computers more usable and receptive to the user's needs, there is continuous research in human- computer interaction that involves exploring easier-to-learn or more efficient interaction techniques for common computing tasks. This includes inventing new techniques and comparing existing techniques using scientific methods.

## 5.0 Summary

Uncommon technologies associated with human computer interaction include consideration of the multi- modal and multi-media systems that incorporate speech recognition and synthesis, the phonetic typewriter, sound interface facilities, recognition and gestures mechanisms. These facilities particularly aid the elderly and the disabled to effectively and comfortably interact with the computer system.

## 6.0 Tutor Marked Assignment

1. What are multisensory systems, their components, and their relevance in the design of interactive systems?
2. What is speech Synthesis and how is it valuable to the computer user? Give two examples of its application.
3. Distinguish between an auditory icon and an earcon. Explain the limitation of their applications.
4. Explain the three types of Recognition and Gestures mode of interaction. Mention areas where each is effectively applied.

S. Mention any 3 devices that aid the elderly and the disabled in human computer interaction.

## 7.0 Further Readings / References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