

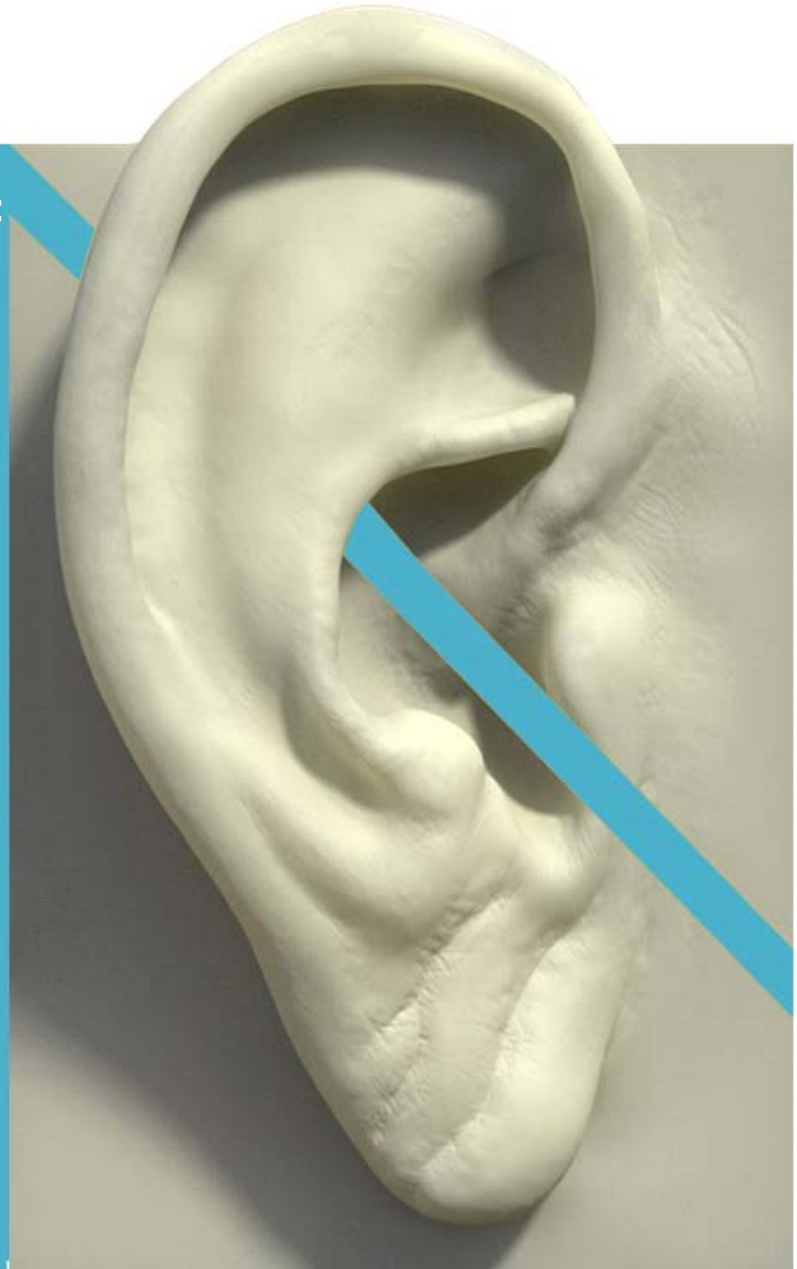
Degree project (Stage 1)

Mobile Phone for deaf

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1. Abstract

Telephone is a technology which is developed for the hearing people. The people who are deaf and mute are completely ignored by the technology developers and the stakeholders.

But over the last few years, mobile phone is hugely adopted by the deaf and mute users for text messaging. Even in India the SMS (Short Messaging Service) is becoming popular among the deaf and mute users because it is the only way of communication available for them. Still the technology exist is very limited which is again not being developed for the deaf and mute users.

The aim of project is to conceptualise the mobile phone which will solve the problem of communication and also create an interface which will give a feel of communication.

The project went through the understanding the basic need of deaf and mute users, study of existing technologies, concept generations and then finalising the concept.

“Not being able to see isolates you from objects. Not being able to hear isolates you from people”

--- Immanuel Kant (18th-century German philosopher)

2. Introduction

One of the basic need of human being is to communicate with each other.

Current scenario is that, for the communication purpose, the deaf person depends on the sign language and lip reading together, using both will create a complete sense of communication. Whereas the deafened and hard of hearing people uses hearing aid accompanying with lip reading to communicate, it is also depends on the severity of hearing disability.

The above ways of communication are something which user always belongs with them! I am including hearing aid also as it's like a part of body for the deafened and hard of hearing people.

But as far as mobile telecommunication concern, text messaging in mobile phone i.e. SMS (Short Messaging Service) is used by deaf users, that is the only way of communication available for them.

Therefore, the aim of this project is to,

‘Design a mobile phone device for the profound deaf and mute user who are English literate.’

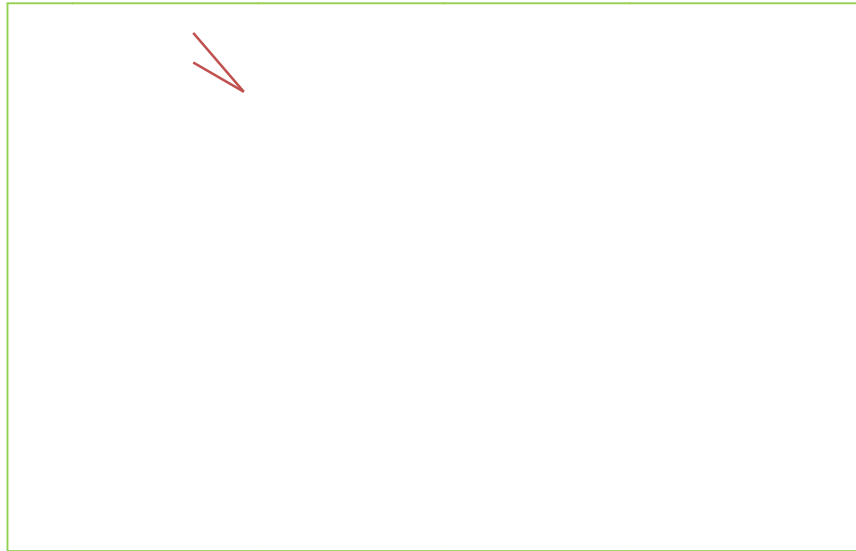


Fig. (3a) Data collection during initial stages of project

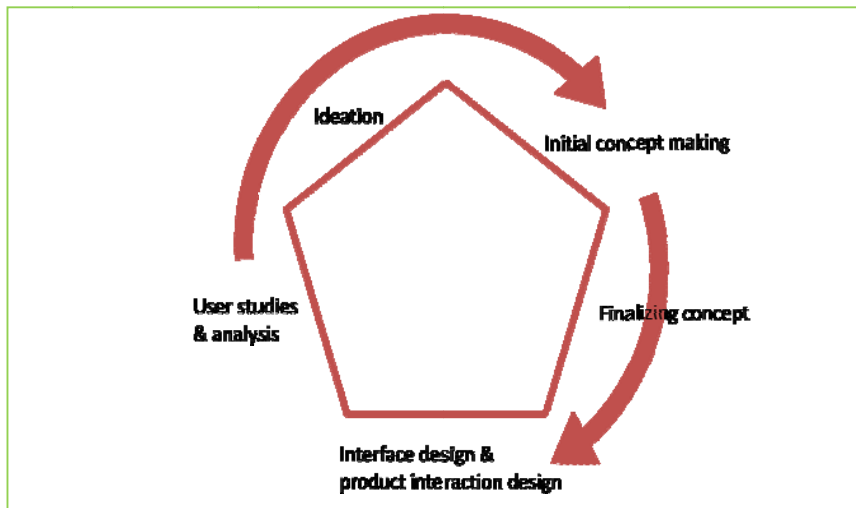


Fig. (3b) Stages followed after data collection

3. Methodology

The methodology followed during this project, starts with the data collection, Which I divided into three major the areas [Fig. (3a)] as mentioned below,

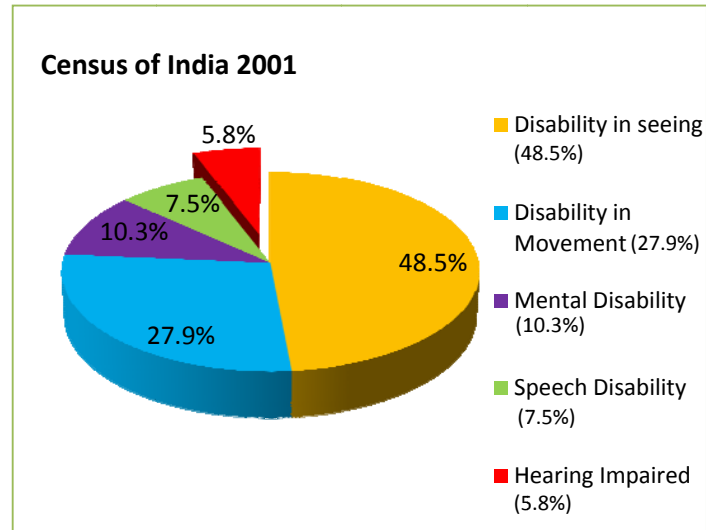
- Understanding the users
- The process of communication
- Adaptive technology

Studying and analysing each part gives project a different wisdom to focus on the problem and come with a most suitable solution.

Large part of time of project was spent to understand the user and their limitations during the communication through user studies. After that I spend my time for market survey i.e. the existing technologies available and which can be beneficial.

Later stages of project are divided into the following parts [Fig. (3b)],

- User studies and analysis of data
- Ideation
- Initial concept making
- Finalizing concept
- Detail interface design and product interaction design



Disability	Population
Disability in seeing	10,634,881
Disability in Movement	6,105,477
Mental Disability	2,263,821
Speech Disability	1,640,868
Hearing Impaired	1,261,722

Fig. (4a) The disability population of India according to 2001 Census

4. Understanding Users

For this project understanding user and their limitations during the communication was the key.

Large percentage of time was spent on understanding the user and their disability during the communication. Therefore, early stage of project i.e. data collection involve in-depth study related to the people who are hearing impaired.

There are technologies available in the crude form and need to be used for the benefit of the huge population which is suffering from one or more disabilities and In India, the number is nearly equal to 21,906,769 people i.e. 2.1% of the total population, according to Census of India [Fig. (4a)].

The people who are suffering from deafness are more than 1million and people who are suffering from speech disability are more than 1.5 million [R4a].

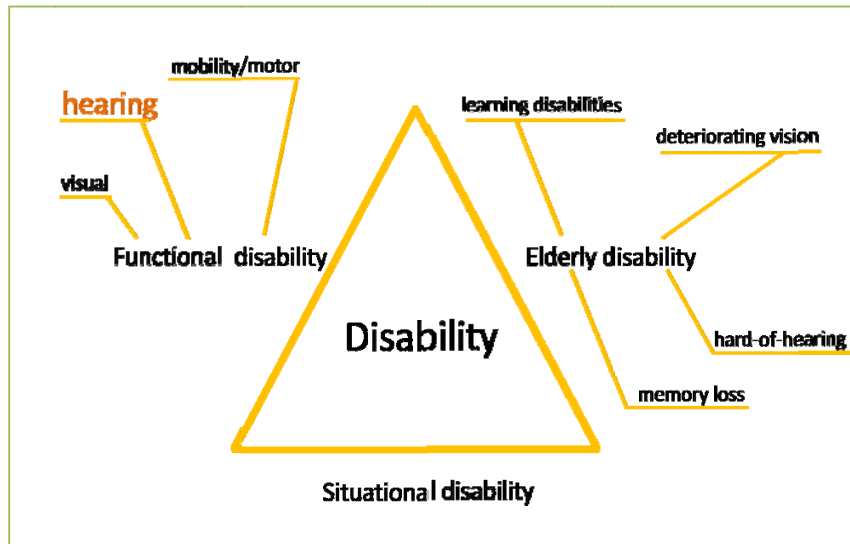


Fig. (4b) Categories of disabilities

4.1 Hearing impairment

Functional disability caused due to physical, mental or sensory disability, which again majorly classified into visual, hearing and mobility disabilities.

The early data collection was divided into the three major categories [Fig. (4b)],

- Functional disability
- Disabilities due to age
- Situational disabilities

Disabilities due to age happens as one age older, it's natural to acquire disabilities like memory loss, hard of hearing, learning disability and poor vision.

And situation disability is something if someone unable to perform certain task under particular surrounding conditions or under certain physical conditions. [R4b]

E.g. *a person who forgot the spectacles at home will find it difficult to work on the computer.* OR

Lighting conditions at the work place may cause temporary disability of vision.

Degree of deafness	Deafness level (dB)
Mild	- For children: between 20- 40 dB
	- For Adult: between 25- 40 dB
Moderate	between 41- 55 dB
Moderately severe	between 56- 70 dB
Severe	between 71- 90 dB
Profound	90 dB or Higher

Fig. (4c) Different types of hearing impairment

Hearing disability or hearing impairment or hearing loss is full or partial decrease in the ability to detect or understanding sounds. [R4c]

Hearing is limited to frequencies between about 20 Hz - 20,000 Hz (20 kHz), with the upper limit generally decreasing with age.

According to the references, hearing impairment is divided into major 5 categories [Fig. (4c)], which are

- Mild deafness: *unable to hear soft sounds, difficulty understanding speech clearly in noisy environments.*
- Moderate deafness: *unable to hear soft and moderately loud sounds, considerable difficulty understanding speech, particularly with background noise.*
- Severe deafness: *some loud sounds are audible but communication without a hearing instrument is impossible.*
- Profound deafness: *some extremely loud sounds are audible but communication without a hearing instrument is impossible.*

The deafness level is further associated with the sound frequency. Considering the auditory frequency range between 20-20 KHz, some people may be deaf towards higher frequency (above 20 KHz), some may be to low frequency and so on. This is mostly related to the occupation and age related deafness.

The deafness/ hearing loss may be caused due to many causes; the most common **causes** are,

- Childhood illnesses
Spinal meningitis and rubella/German measles are the most common examples
- Pregnancy-related illnesses
Such as rubella/German measles or dependence on drugs/alcohol
- Injury
A severe blow to the head can damage the hearing
- Excessive or prolonged exposure to noise;
- Heredity
Scientists involved with the mapping of the Human Genome Project have identified approximately fifty (50) "deaf" genes to date, and they are working on identifying the remaining 350 "deaf" genes
- Aging
Progressive deterioration of hearing in older people, which is a natural part of aging process

Deafness and muteness are directly associated. People may be deaf but need not be mute. They are mute because they are deaf, thereby, do not know what 'sound' is and hence cannot mimic the sound through vocal cord. A good percentage of people or children have intact vocal cord but may be during birth or later causes they may lose hearing ability.

4.2 User studies

After studying and analysing all things theoretically, the more important was to spend time with the deaf users.

For that, I have conducted a user study during which I spend time to observe the kids learning in the deaf school.

The aim of first user study was to understand, how the Deaf and hard of hearing people learn to communicate with each other during their early ages. Therefore, the initial study was restricted to children and teenagers.

The user study was conducted at,

***Vikas Vidyalaya For the Hearing Handicapped,
Dadar (W), Mumbai- 400028.***

I started from junior KG class where 4-5yrs. kids take basic language class and then 2nd grade class, 4th grade class & 7th grade class[Fig. (4d)], to understand that how from basic communication learning, Deaf learn to communicate and understand the complexity of subjects and language and how with learning they tends to progress in communication.



[Fig. (4d)]User study at Deaf school



[Fig. (4e)] Basic language classroom

During basic language class [Fig.(4e)], the deaf kids taught by using a sound amplifier, headphones and mike which is kept in front of the mirror where teacher individually teach each deaf kid. Teacher uses mike to communicate with the kid, through the amplifier and headphone.

Teacher also uses,

- Breathing techniques [Fig.(4f)]
The speed of breath, rhythm of breath to understand how much air needs to exhale to pronounce the particular word
- Touch [Fig.(4g)]
Creating gesture over body to make deaf kids understand the rhythm of sound words, where to give more intensity and flow of pronunciation of the words and sentences...etc.

By spending time in school, with different grade classes; I understand that, the kids from the junior to senior class were good at reading and writing. They take help of lip reading and hearing aid to understanding their teachers.

In junior classes Teachers encourage kids to use their hearing ability more, rather than depending on to lip reading. But I observed that with age kids were getting more and more depending upon the sign language and lip reading.



[Fig. (4f)] Teaching using breath



[Fig. (4g)] Teaching using touch

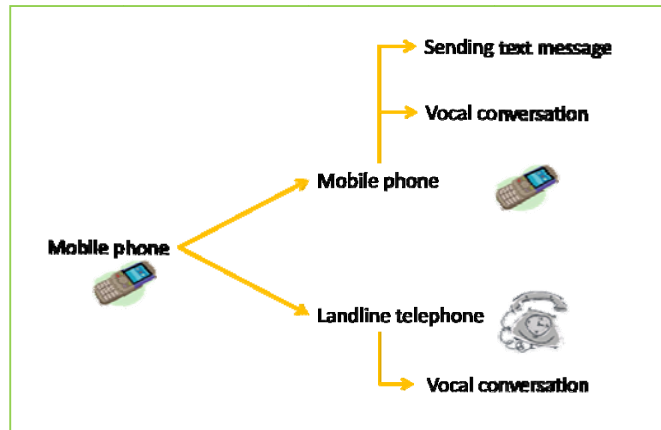


Fig. (4h) Normal way of communication

4.3 Current telecommunication scenario

After understanding how deaf user learn to communicate, I started collecting data what are the ways of communication used by the deaf users.

If we see from telecommunication point of view,

The figure depicts the normal ways of communication are 'mobile to mobile phone communication' and 'mobile phone to Landline telephone communication' [Fig. (4h)].

In mobile to landline phone communication, it's only possible to have a vocal conversation which is useless for deaf users (depends on the severity of deafness).

Whereas in mobile to mobile communication, it also allows text messaging and it is popular among the deaf users.

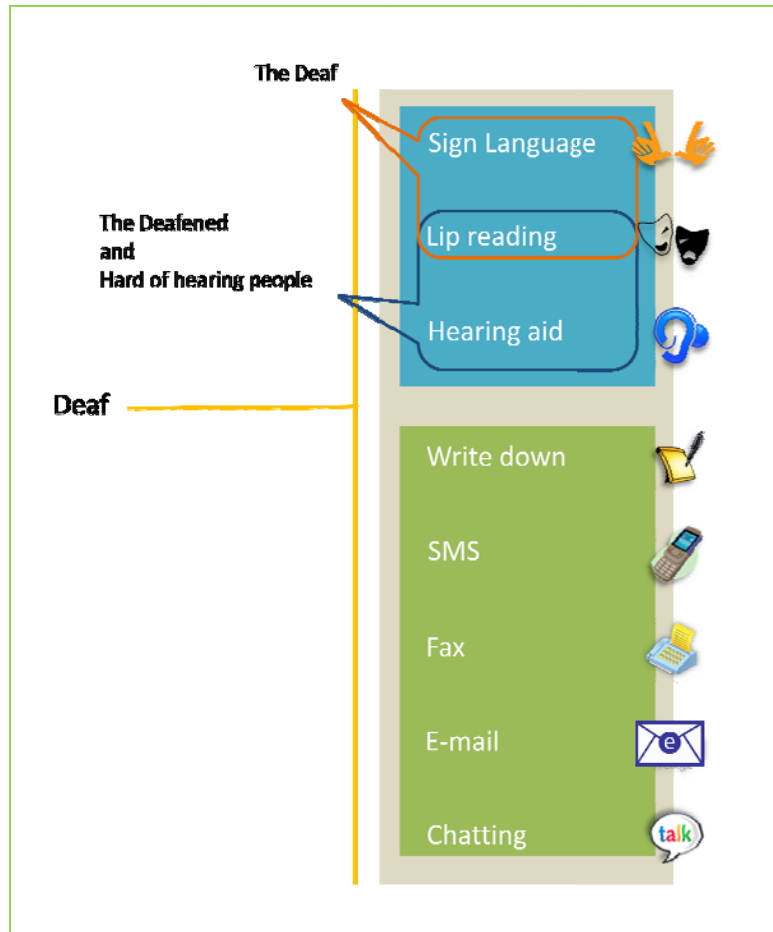


Fig. (4i) Ways of communication used by Deaf person

4.3 Ways of communication

For the communication purpose, the deaf person depends on the sign language and lip reading together, using both will create a complete sense of communication. For the profound deaf user, hearing aid gives them environment awareness, but they cannot participate in the vocal conversation

Whereas the deafened and hard of hearing people uses hearing aid accompanying with lip reading to communicate, it is also depends on the severity of hearing disability.

The above ways of communication are something which user always belongs with them! I am including hearing aid also as it's like a part of body for the deafened and hard of hearing people.

Also other ways of communication are like write on the paper, using mobile for text messaging, Fax, E-mail or Chatting through internet. [Fig. (4i)]

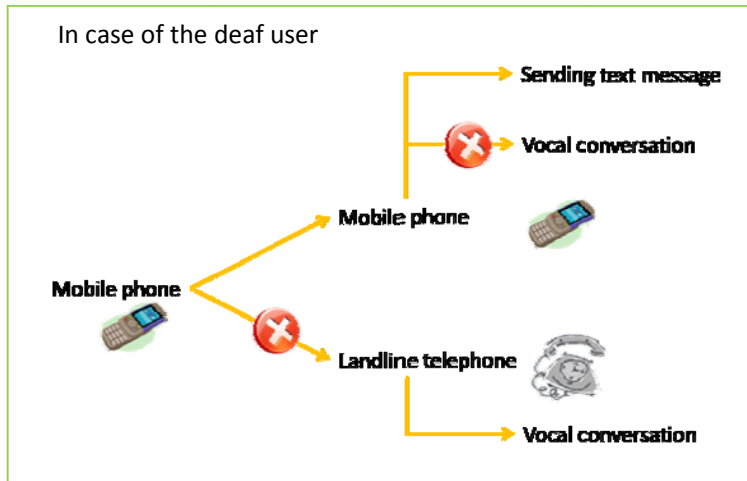


Fig. (4j) Limitation of use of the telecommunication devices

After this I conducted a second round of user studies in which I tried to get the data about how the deaf user use telecommunication devices.

For this user study, as it was difficult to directly communicate with deaf user therefore; the best way was to communicate with Deaf school teachers and family members of deaf person and they have given me the insights about the lifestyle of the deaf person.

After inputs from the teachers and family members and from my own observations, I understand that;

Profound deaf person cannot take part in direct vocal telecommunication as it is not possible for them; they may be assisted by either their friends or family members. Or else they use text messaging for mobile to mobile communication. [Fig. (4j)]

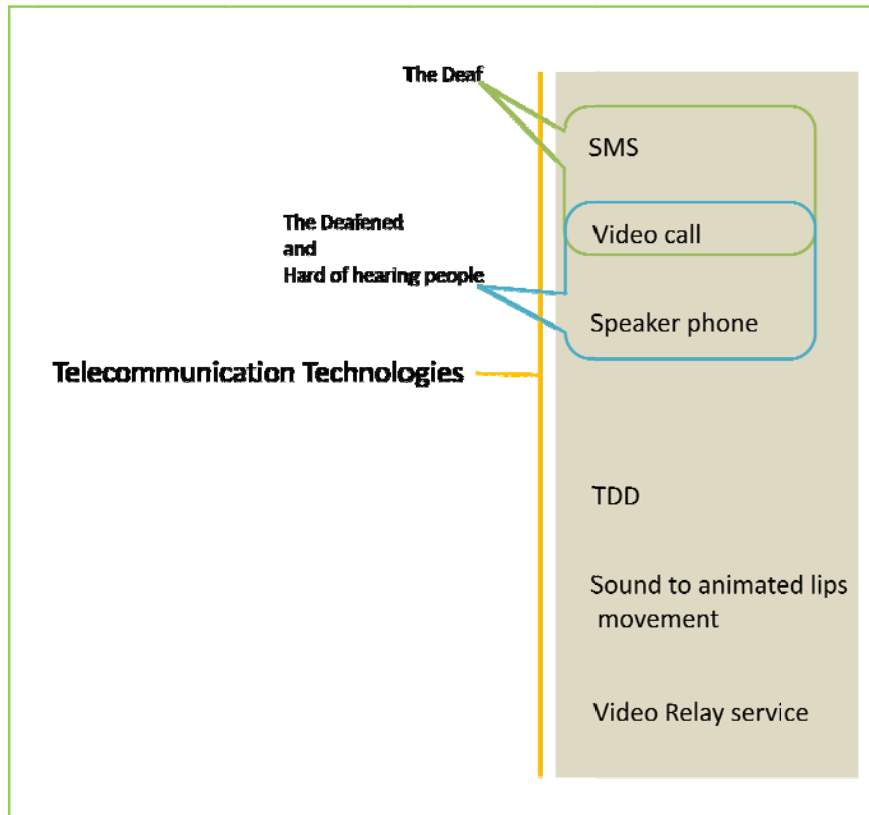


Fig. (4k) Telecommunication technologies available for deaf users

4.4 Market Survey

After studying the user and their limitations to communicate in real time as well as during using telecommunication technology, then I decided to work and check, what are the possible existing technologies available for deaf users and I come across following few available technologies [Fig. (4k)].



Fig. (4l) Telephone type writer

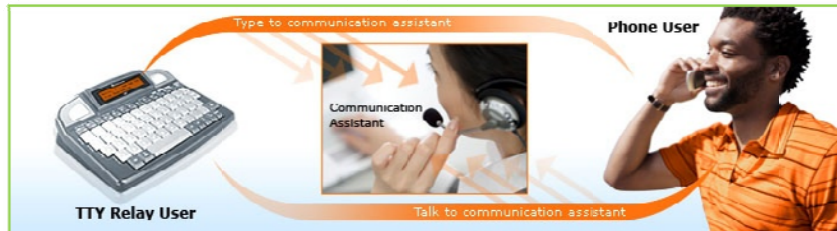


Fig. (4m) Human relay service

TTY (Telephone Type writer):

It is telecommunication device for deaf (TDD) is an electronic device which is of size of a laptop used for text communication via a telephone line, used when one or more of the parties have hearing or speech difficulties. [Fig. (4l)] [R4d]

It is equipped with the full size QWERTY keyboard and also having a small LED or LCD screen to show the typed text. It is also have a small printer to take the print of text communication.

The text typed by the user is send to other user via telephone line, which is then accepted by the same or compatible device.

In some countries like England, there is human relay operator service provided specially for the deaf and hard of hearing peoples by which they can communicate with a hearing person.

[Fig. (4m)][R4e]

Disadvantages:

- It is time consuming
- It needs a human relay operator to assist during communication
- Privacy issues: as the communication is happening through the intermediate person.

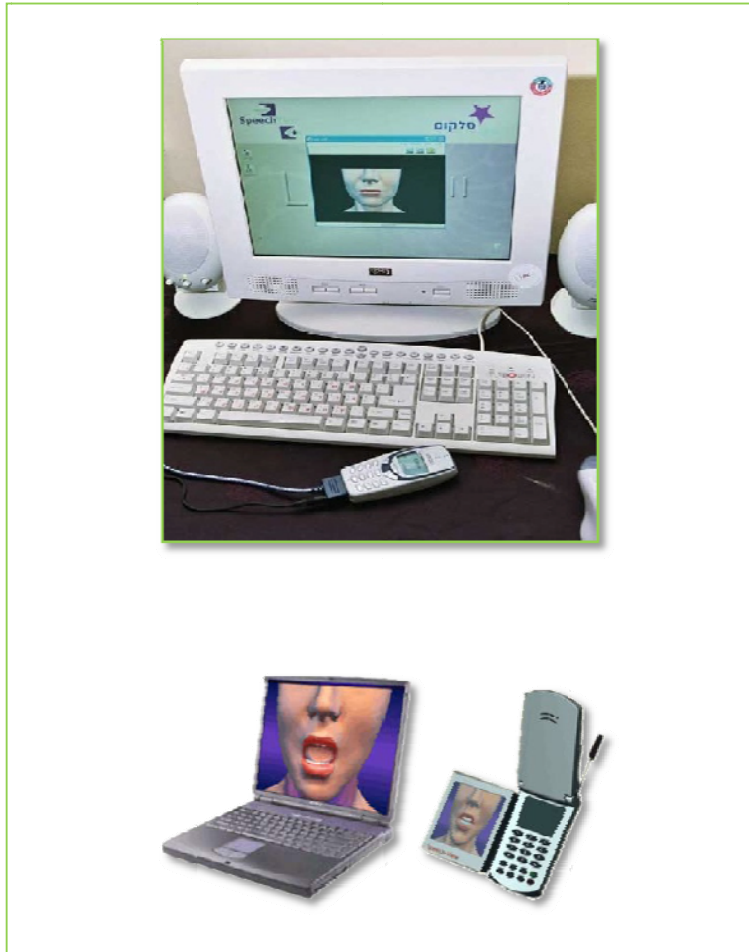


Fig. (4n) Sound to animated lips technology

Sound to animated lips movement:

It is technology developed by the Israel's largest phone company called **Cellcom** worked with another company called **SpeechView**. These companies come with the software solution, which benefits deaf and hard of hearing user in telecommunication. [R4f]

The software name is **LipCcell**, which is installed on the PC or laptop, and mobile phone is connected to it. Incoming call will activate the software and then that software converts the incoming speech/voice into the animated face lip movement. This animated face is then shown on mobile phone screen, which shows lip movement, so that deaf user can read the lips. [Fig. (4n)]

Advantages:

- Software is language independent. User can switch to slang, mixed words or mixed languages at any time.

Disadvantage:

- Results shows that lip reading alone gives nearly 35% of accuracy, but this software uses changing colour range for cheeks and nose which benefits deaf user. Even after practice this gives nearly 85% of accuracy. [R4f]
- Still it is not a mobile technology. It needs a PC to process the rendering and animation.
- This technology is assumes that deaf user are good at lip reading.



Fig. (4o) Video relay service

Video relay service:

This is video relay service which allows the deaf user to make phone call to hearing person through the help of relay operator. This technology needs PC, webcam and internet connection. It's like a video conferencing. [R4g]

The Deaf person sitting in front of a PC which is connected to a webcam and internet connection, will make a phone call through a relay operator which then connects to the desired hearing person who is using the similar setup. The deaf person use sign language and relay operator will decode them for hearing person and when hearing person speaks that will be converted into sign language by the relay operator for the deaf user. [Fig. (4o)]

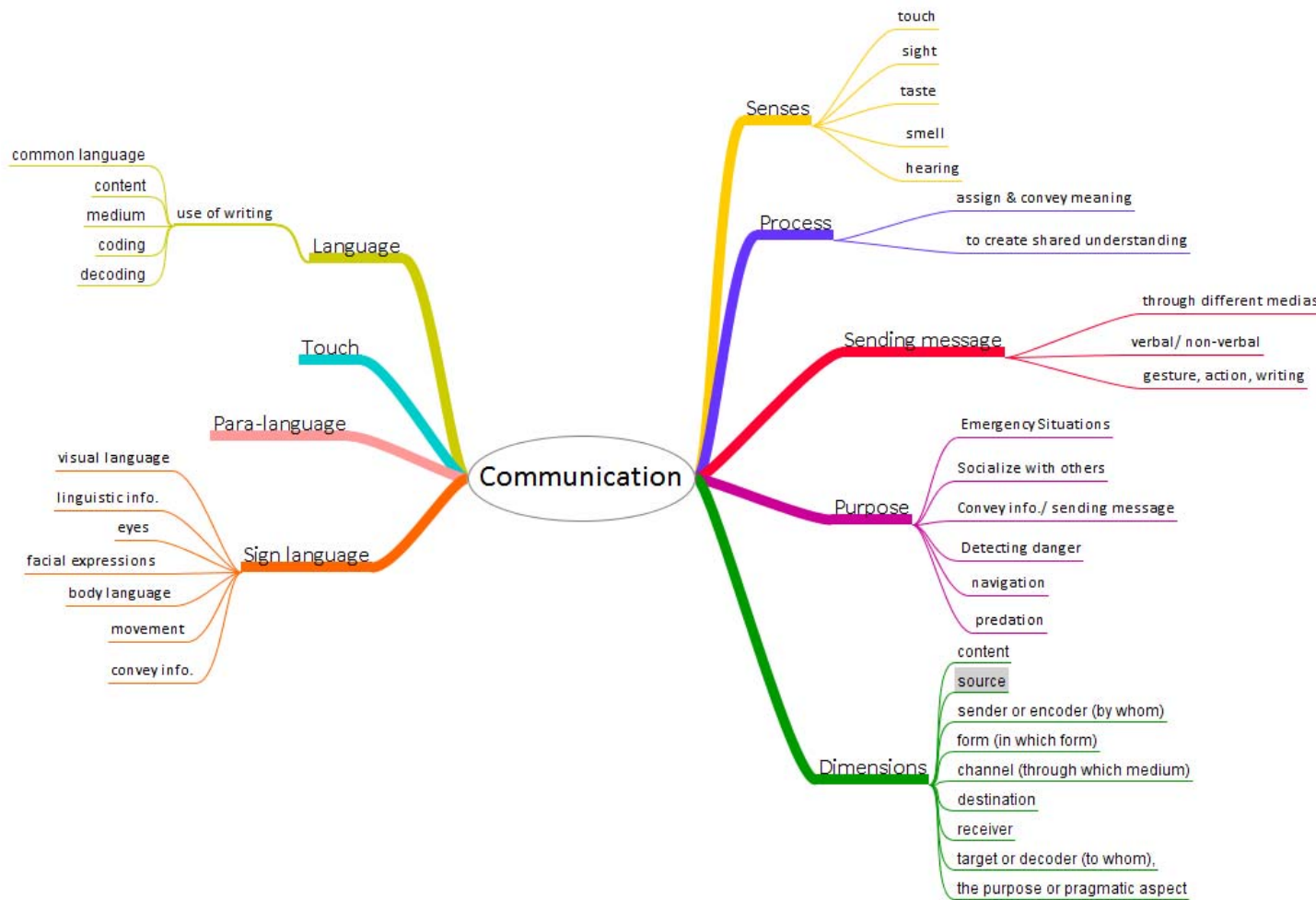
Advantages:

- It involves no typing and reading for deaf user.
- Even an illiterate deaf person who knows sign language can able to communicate.

Disadvantages:

- This technology needs a human relay operator to understand and convey the meaning of the sign language.
- Still this is not a mobile technology.
- Privacy issues: as the communication is happening through intermediate person.

5. Ideation



Ideation started with basic understanding of communication.

After studying the different aspects of communication, I have created a mind map for 'communication', which has given me the all the possible dimensions and keywords to explore.

[See, Fig. (7a)]

Fig. (7a) Mind map for communication

User group

Before entering into the ideation process, I divided user group into major two parts,

- Those who are born deaf are called The deaf person. They are also mute (depends on the severity of deafness.)
- Those who loose hearing in later life are called as the deafened or the Hard of hearing person.

After that I decided my focus user group, Profound deaf and mute people.

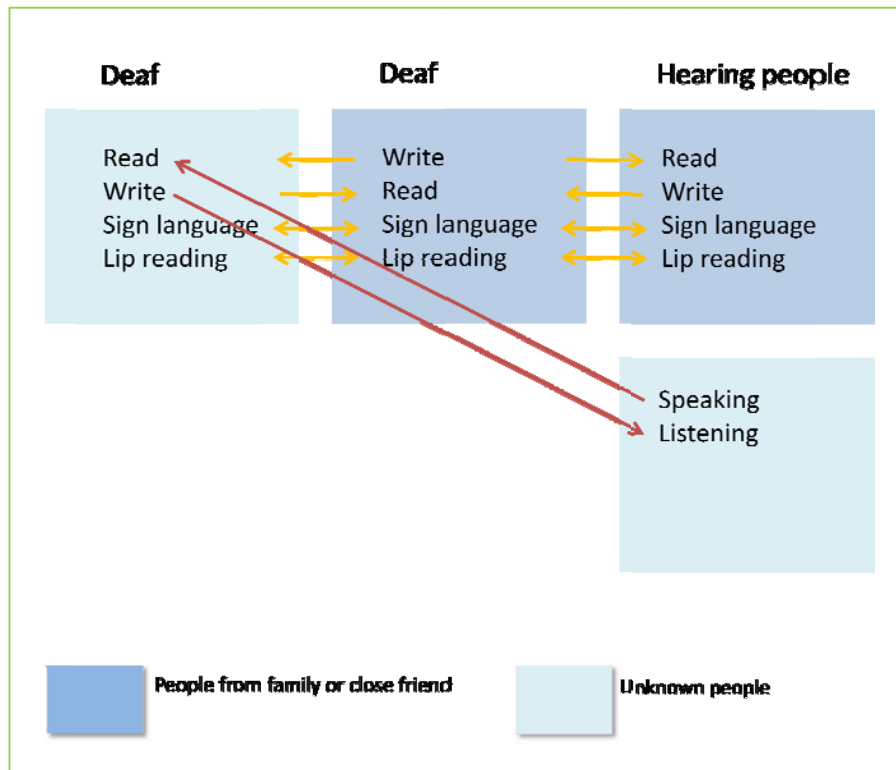


Fig. (7b) Ways of communication

Problem identification

After that I mapped down [Fig. (7b)] the possible ways of communication between

- Deaf to deaf communication
- Deaf to hearing person communication (person who is part of family or close friend)
- Deaf to hearing person communication (person who is unknown)

During Deaf to deaf communication and Deaf to hearing person communication (person who is part of family or close friend), they can communicate through

- Sign language
- Lip reading
- Read and write

But problem arises during Deaf to hearing person communication (person who is unknown), because he may not be knowing the sign language and lip reading. So the only possible ways of communication are

- Read/write
- Speaking of hearing person is converted into text, so that deaf can read it
- Writing of deaf user is converted into speech or sound for hearing person

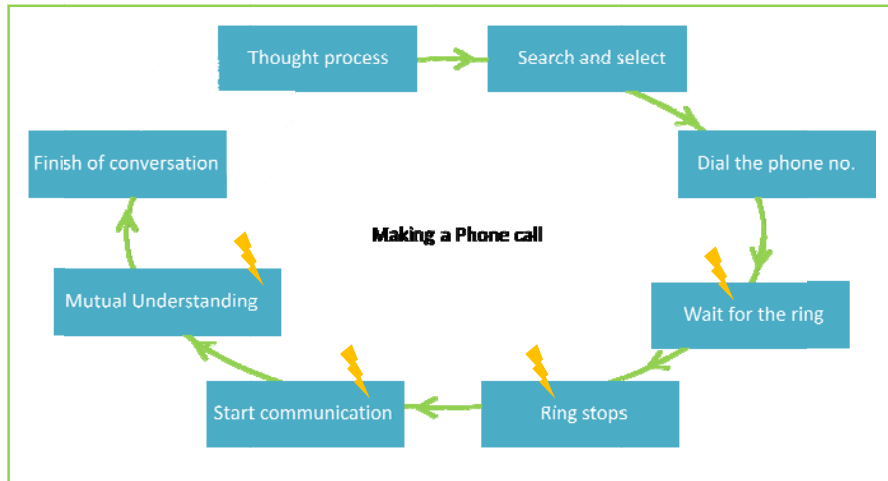


Fig. (7c) The steps involve in making a phone call

After identifying the problems, I analysed the major steps involved while making and receiving a phone call. [Fig. (7c&7d)]

During making a phone call, the problems for deaf user are

- The basic problem is to get the feedback of ring is going on at the receiving end or call is waiting or error in connection
- The next necessary feedback is that when the ring stops
- When to start the communication
- take part in communication by listening and speaking
- And the most important is the mutual understanding part i.e. the rules of communication, means when someone is speaking you should listen and vice-versa.

During receiving a phone call,

- Basic problem of feedback that deaf user is receiving a phone call, which is either a sound or fluctuating screen or vibration alert in case of mobile phones (if mobile is away from body and eye sight region then it's impossible know)

Other problems are similar to the problems during making a phone call which I have mentioned above.

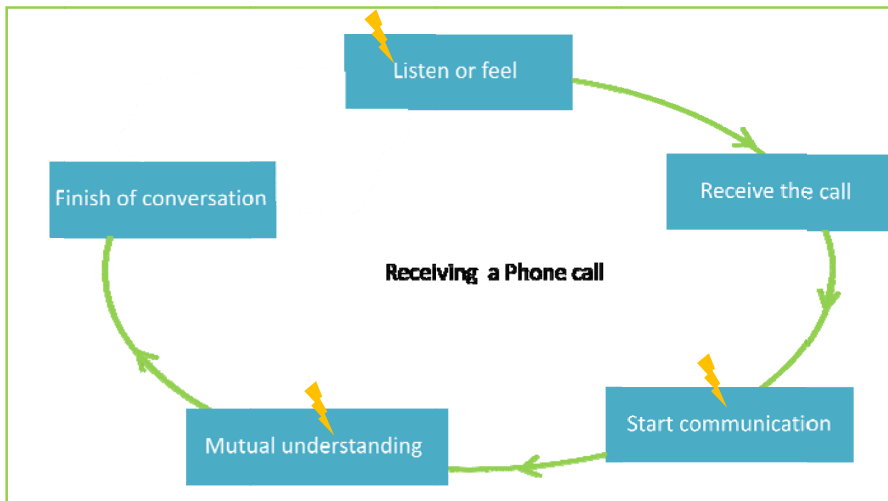


Fig. (7d) The steps involve in receiving a phone call

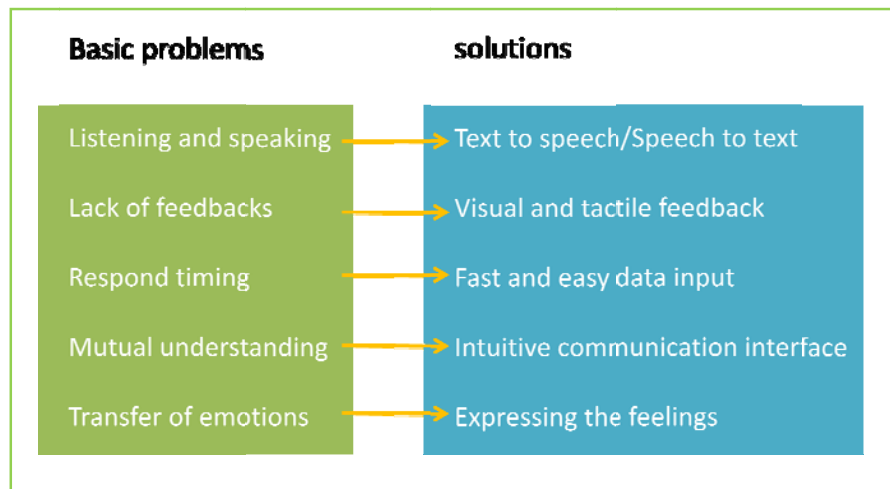


Fig. (7e) Basic problem identification and possible solutions

Problem identification and possible solutions

From the entire brainstorm and mind map [Fig. (7a, 7b, 7c, 7d)]; It was possible to list down the basic problems and the possible solutions [Fig. (7e)], which help me to create the concepts which will solve each of them.

The basic problems identified are,

- The problems related to speaking and listening
- The current technology does not give proper feedback as it is not designed for deaf users
- The communication has to provide the mutual understanding between the users
- The most important part of communication is to sharing of feelings

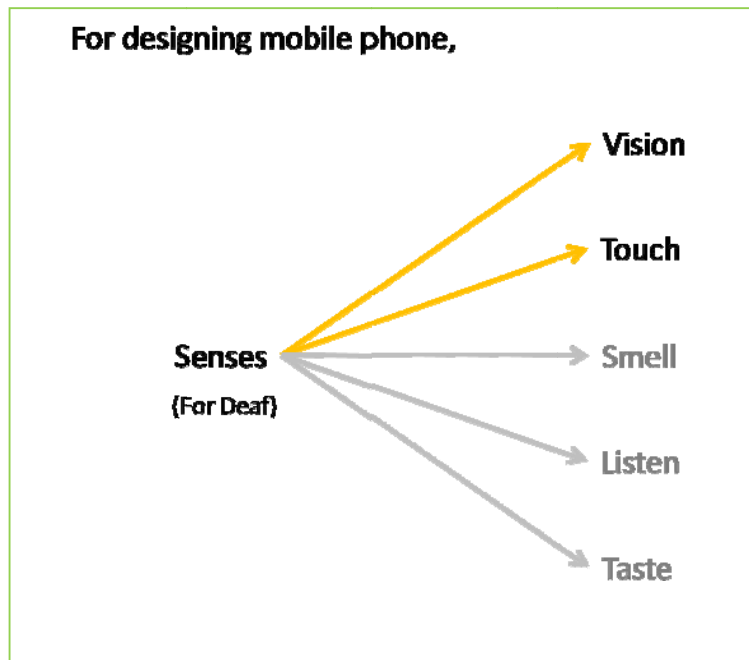


Fig. (6a) Use of Visual and tactile feedbacks

6. Concept development

After identifying the basic problems, I started making the concepts which fulfil the communication need of deaf user through a mobile phone device.

For making the concepts, it was important to keep in mind the user limitations, that what are feedback should be given so that the user can use his senses, to know and use the mobile phone. It also included the consideration of technology limitations, like we can use smell/scent as a feedback, but technology will too complicated and which is at very basic level of development.

So the after the research and data collection about the available technologies, I come to the conclusion that [Fig. (6a)],

All the feedbacks should be given either,

- Visually
- With tactically

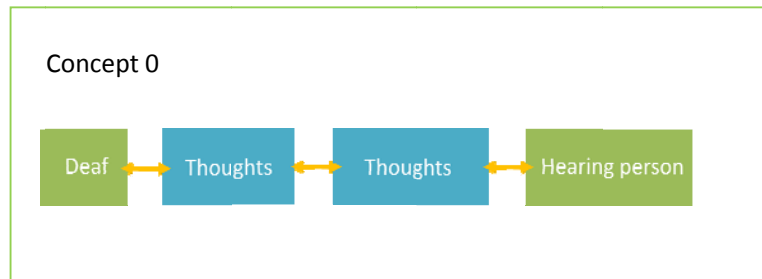


Fig. (6.1b) Concept 0

6.1 Initial concepts

Concept 0

The first concept which strike in my mind which I am labelling as Concept zero, is that; the thought of deaf person can be transferred into other person's mind directly to have a communication and vice-versa. But practically it is not possible and still it is in its very-very initial research phase. [Fig. (6.1b)]

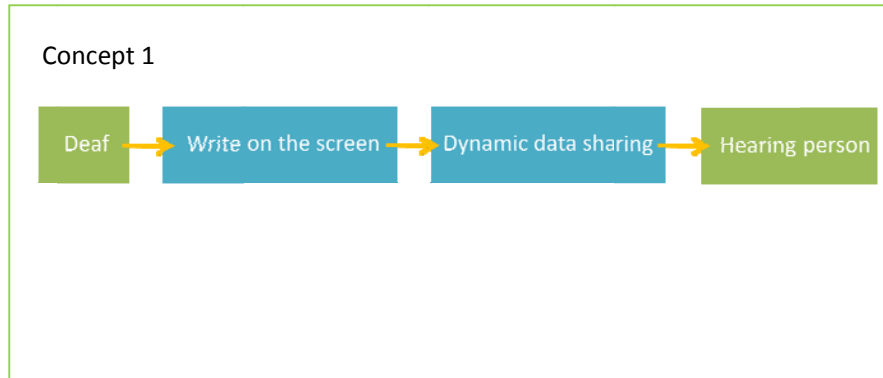


Fig. (6.1c) Concept 1

Concept 1

The concept is that, a communication device will be with touch screen on which deaf will create gesture, symbols or write and that will be dynamically shared in real time by the hearing person who is also carrying the similar device. By this way they can communicate with each other. [Fig. (6.1c)]

Advantages:

- Any common language between the users can be used.
- Need not to type through keys

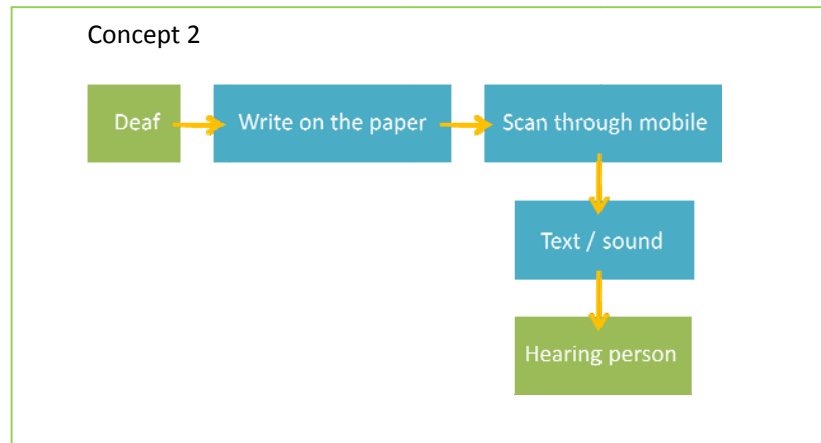


Fig. (6.1d) Concept 2

Concept 2

This idea I got from the fax machine, in which the content is being scanned from paper and being converted into the electric signals which are then transferred through the telephone line and again printed on the paper.

It is very natural to write on the paper. Therefore, the concept is that the mobile device will be with a scanner which will copy the data written on the paper and then converted into the digital signal. After that it will be converted into text and/or sound for the other user. [Fig. (6.1d)]

By this way, deaf user will communicate to the other user.

Concept 3

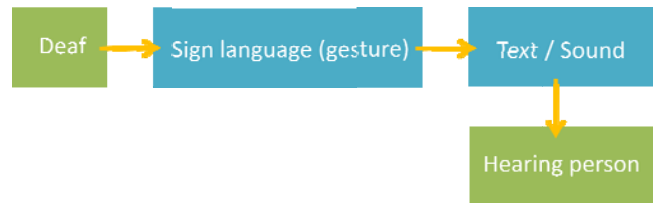


Fig. (6.1e) Concept 3

Concept 3

The concept is that, the mobile phone will be able to decode the sign language of deaf user into 'the text and sound' for the hearing person.

The deaf user will be with the gloves which are equipped with sensors. The positions of the fingers and the hand will be co-ordinated mathematically in the three dimensional space by the mobile phone. So that mobile will have a complete knowledge of the fingers and hand movement and then the gesture will be decoded by the mobile phone, which will be sent as text/voice to hearing person. [Fig. (6.1e)]

Advantages:

- No typing involved
- Deaf user can communicate in the language, they are good at!

Disadvantages:

- Sign language is not all about the finger and hand movement, it also involve the eye movement, eyebrow movement, facial expression, body language and also the direction pointing to body parts or directions.

The above concept may be developed by using a camera sensing the hand and finger movement and also noting the facial expressions and body movement. But decoding facial expressions and body movement is impossible for any well developed existing technology.

Existing technology:

It can be used as a video conferencing and then it is possible to have a communication to the user who knows sign language.

This technology exists in 3G mobile phones but telecommunication service provider in India does not provide this service due to lack of bandwidth [Fig. (6.1f)].



Fig. (6.1f) Video call through the 3G mobile phone

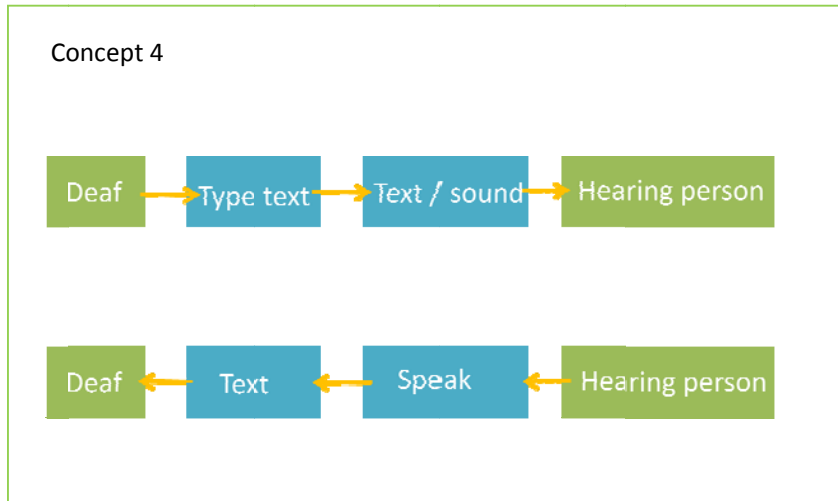


Fig. (6.2g) Final concept

6.2 Final concept

The basic technology used will be

- Text to sound
- Speech to text i.e. speech recognition

The deaf user will type the text in his mobile phone and that will be converted into sound/text for hearing person.

When hearing person will speak, his voice will be recognised by the mobile phone and converted into the text, which will be displayed on the mobile phone, so that deaf user can read and understand the message. [Fig. (8.2g)]

Advantages:

- Deaf user can communicate to the hearing person through mobile phone without relay operator
- Mobile to landline phone communication is also possible

Disadvantages:

- Speech recognition technology is there but still it is not mature enough to provide error free typing
- When deaf user will type, the other user need to wait for the reply.
- Text to sound creates jerkiness in the voice, which is not a good user experience to listen.

Existing technology:

Speech to text:

A company called Nuance came up with technology called mobile dictation system. It uses software called 'Dragon Naturally Speaking 9'. It is very efficient for data input. In which you can create SMS and E-mail through your voice. It is quite fast as compared to any other data input method. It is nearly 10 characters per second.

Ben Cook, who holds the Guinness World Record for fastest entry of a 160-character standardised message on mobile phone. Cook's record was 42.22 seconds. The new record created by Nuance dictation software is 16.32 seconds for the same 160-character standardised message on mobile phone. [Fig. (8.2h)][R6.2a]

There are many well known software companies like IBM-CDAC, Telisma, Onmobile and IIIT-HP labs who come up with the Indian language speech recognition software. TeliSpeech is now available in 10 Indian languages which is nearly 85% of official languages. [R6.2c & R6.2d]

- Indian English,
- Hindi,
- Indo-Aryan family: Gujarati, Marathi, Punjabi and Bengali.
- Dravidian family: Kannada, Telugu, Tamil and Malayalam.

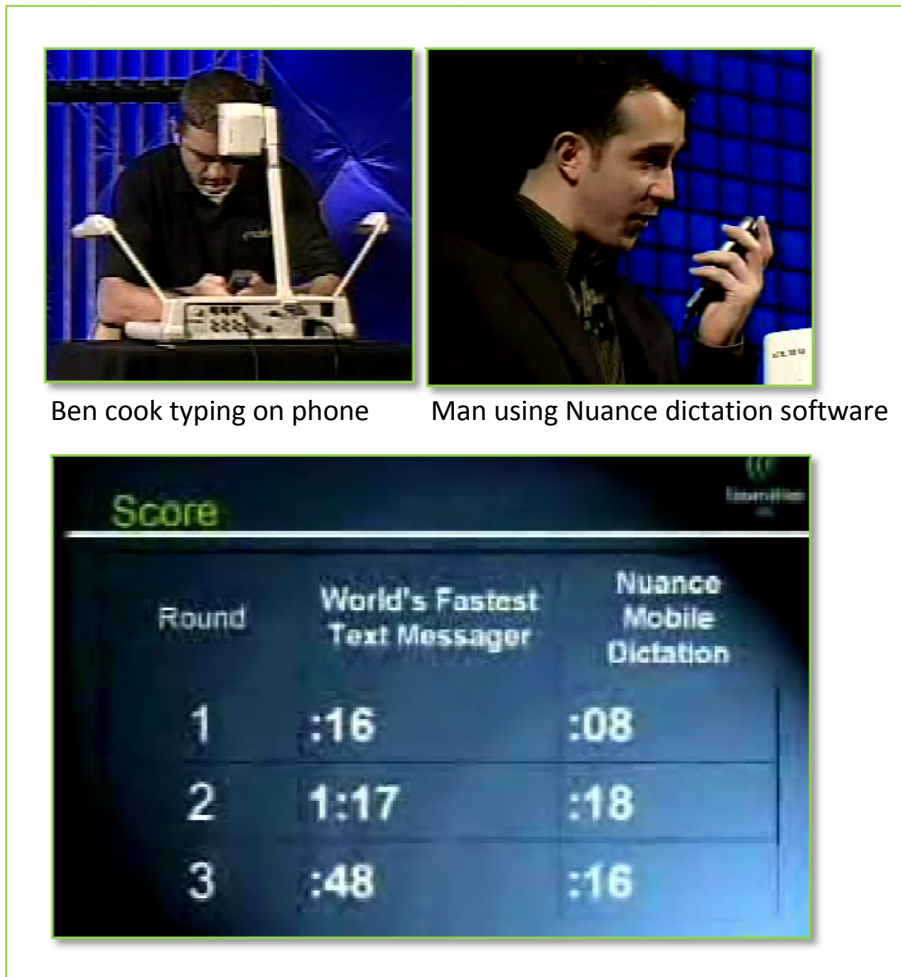


Fig. (6.2h) Images during competition [R6.2b]

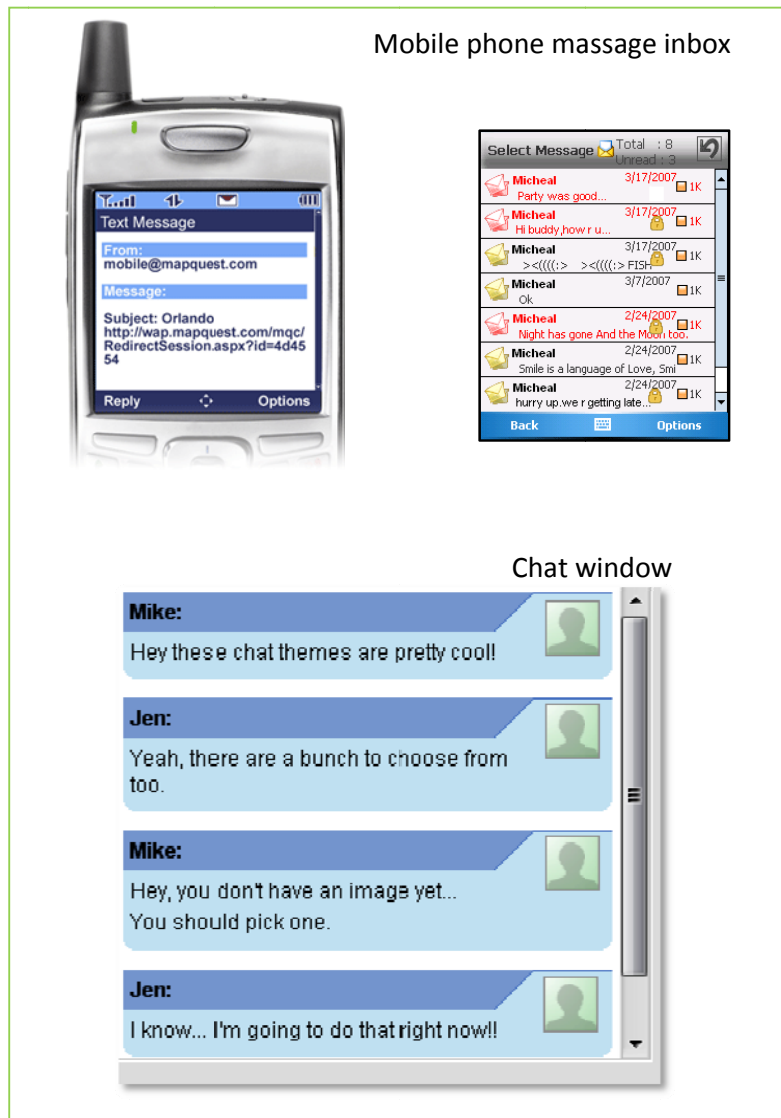


Fig. (6.2i) Message inbox and chat window

Basic interface

The current scenario is that deaf user uses SMS to communicate with each other, which leads to series of SMS. Each SMS save as a different message in the Inbox. Opening each message and relating each message to previous SMS is time consuming.

The concept is that to use the chat window interface where two users can communicate. Also, it will create a feel of continuous communication. Also it will be easy for user to see the past conversation by scrolling. [Fig. (6.2i)]

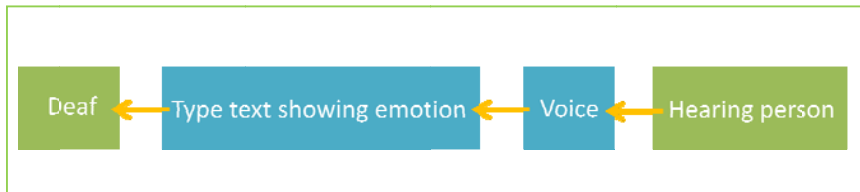


Fig. (6.2j) Visual representation of expression through Typography

Sharing of feelings

When we speak, the voice contains the emotions and feelings in it.

To bring this valuable aspect in communication,

When hearing person will speak, his voice will be recognized by the mobile phone to convert it into the text also it will recognize the emotions in the voice. [Fig. (6.2j)]

There is no technology available which will recognize feeling in the human voice but still the loudness, weakness in the voice which can be visually represented on deaf person's mobile screen

For visual representation of expressions through Typography,

Bold, black font - showing strong voice or loudness in voice

Medium - showing normal voice

Light - showing whispering, small voice

Italics - showing lazy, weak, ill person's voice

If somebody is speaking slow - extended font, more line spacing

If somebody is speaking fast - condensed font, close or overlapping lines

For clear and strong voice - bold font

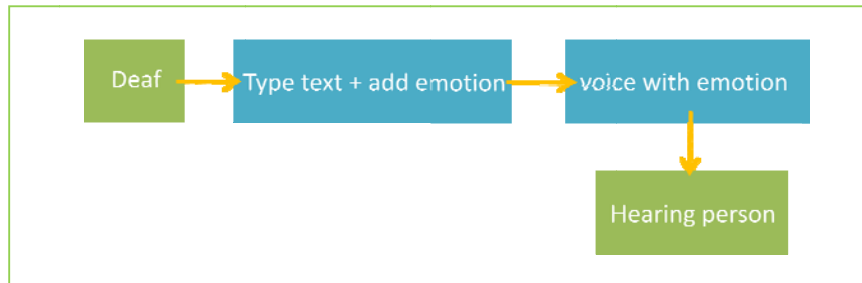


Fig. (6.2k) Sharing of expressions

Sharing of feelings

When deaf wants to express his feeling and expressions, he can simply select the desirable text and by going into options he can add emotion. When this message will be send to hearing person, he can listen voice with that emotion. [Fig. (6.2k)]

Feedback device

The basic feedback any deaf person need while using a mobile phone is the alert that he is receiving a phone call, in current scenario, vibrator and fluctuating screen gives alerts about the same. But when phone is away from the body and from eye sight, it's impossible for them to know about the incoming call.

The concept is that, a body worn device which is connected to mobile phone with Bluetooth can alert user through vibrations.

This device will be in the form of wrist band which will be having a small screen, two buttons and two navigation keys. [Fig. (6.21)]

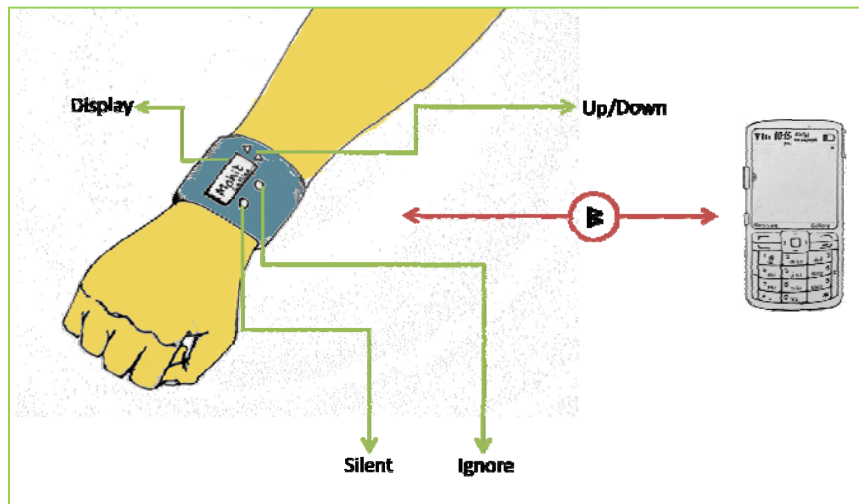


Fig. (6.21) Feedback device

The device which will give feedback of incoming phone call through vibrations and also it will do

- Display caller's name
On screen user can see the number and name of the caller without touching the mobile phone.
- Send quick templates without touching mobile phone
User can send the quick templates from the wrist mounted device, in case he is busy or under situation where he cannot use mobile phone. With the two navigation keys user can browse the list of templates and he can select and send with other two buttons.
- Silent or ignore the call
User can make call on silent which will stop the vibrations in the wrist device without ignoring call, with one button and with another button; he can reject/ignore call.
- Alarm and reminders
User can also use this device to set the reminders and alarm and he will get vibration feedback through the same.



Fig. (6.2m) Kindle by Amazon.com

Visibility issues

For a deaf user, all the communication is happening only through reading on the screen.

Therefore, the screen resolution and clarity is a major issue here. The color screens are not effective when used in sunlight and also the fonts and background contrast is very important.

So it will be better to have a black and white screen or if color screen is being used then the fonts and background color must be chosen with utmost care.

There are few existing products which are meant for reading on the screen like

Ex.

Kindle is an e-book reader for reading embedded books promoted by Amazon.com available in USA. [Fig. (6.2m)]. It uses 4 level greyscale electronic paper screen. [R6.2d]

Some current mobile fonts, 16pt size:

Series 60 Sans - Nokia

The quick brown fox. **The quick brown fox.**

San-Serif - Sony Ericsson

The quick brown fox. **The quick brown fox.**

Segoe Condensed - WM 6

The quick brown fox. **The quick brown fox.**

SynergyBasic - Motorola

The quick brown fox. The quick brown fox.

Droid - Google Android

The quick brown fox. **The quick brown fox.**

The quick brown fox. The quick brown fox.

The quick brown. The quick brown fox.

Fig. (6.2n) Fonts used by the leading mobile phone companies[R6.2e]

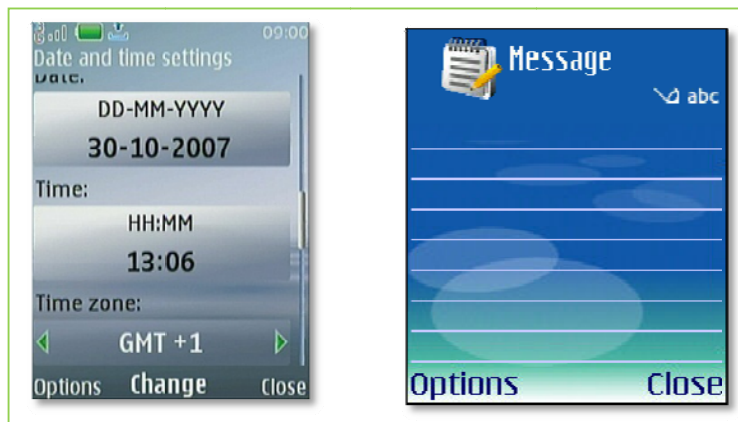


Fig. (6.2o) Different font sizes

Visibility issues

For a deaf user, all the communication is happening only through reading on the screen.

Therefore, the interface should be such that it should help user to change font size easily between upper and lower limits. A special hardware button like in normal mobile phone it is for increasing-decreasing volume level, the same can be used to increasing-decreasing the font size.

User might need to change the font size due to surrounding conditions or due to the situational disabilities.

Variation in the font size will depends on the screen size and resolution. The current trend in the mobile phone is of 240x320 pixel resolution. And these screen uses font heights of 16, 20 and 24 pixels [Fig. (6.2o)]. This equals a point size of 16, 21 and 25 in Photoshop.

The different fonts used by the leading mobile phone manufactures are noted [Fig. (6.2n)] [R6.2e].

Fast and easy data input

The communication from deaf side is happening by typing through the keyboard. Focus of my project is not to find the way of efficient data input keyboard, but still software or hardware interface should be such that it should help user to put less efforts.

It means efficiently data input, so that it will minimize the waiting time for the user who is on the other side of call.

For this I put two concepts,

Concept A:

Concept is that let user create their own language through symbols.

- Symbols can created through finger gesture on the touch screen or on touchpad.
- Each user will create his own set of symbols.
- He needs to remember only his set of symbols.
- User can assign word, phrase or sentence to each symbol.

These symbols can also help in browsing the mobile phone or for opening particular application in menu (it's like shortcut).

Just create gesture input on the touch pad and it will create text output on the screen. [Fig. (6.2p)].

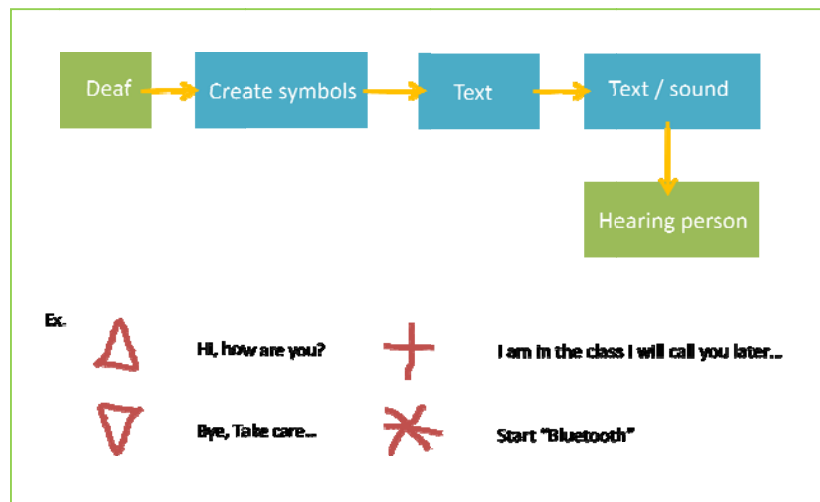


Fig. (6.2p) Use of gestures on touch pad for fast data input

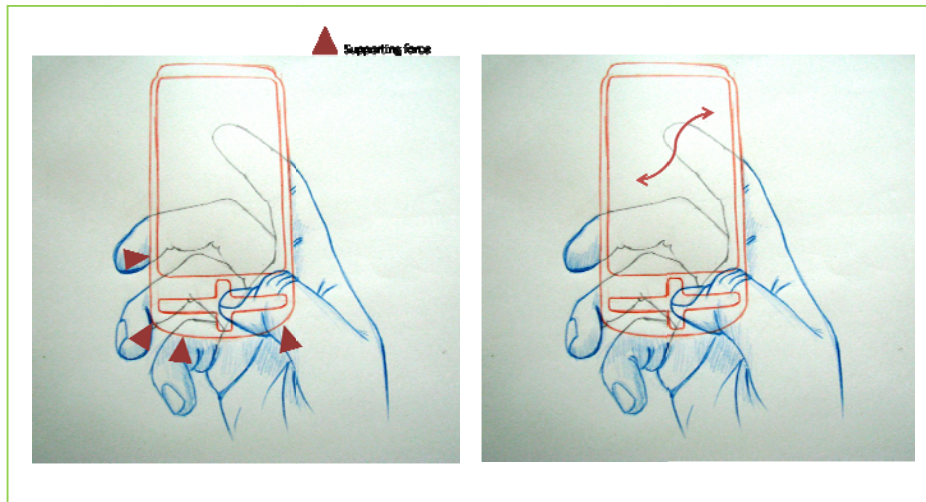


Fig. (6.2q) supporting forces

Use of 1st finger for making gesture

If we see the hand position behind the mobile phone and the supporting forces for holding the mobile phone, the 1st finger is free.

Therefore with 1st finger it is possible to create the gesture on the touch pad which is provided on the backside of the mobile phone.

[Fig. (6.2j)].

Concept B:

For Fast data input,

The words or sentences which are frequently used by the user can be stored and prioritize on the basic of frequency of use, or

The words or sentences which are frequently used by the user in an ongoing conversation can be temporarily AUTO stored by the mobile device and when user will type the initial few letters, it will give the quick matches to the same. [Fig. (6.2k)].

User need to select from the choices, rather than typing the whole sentence or words.

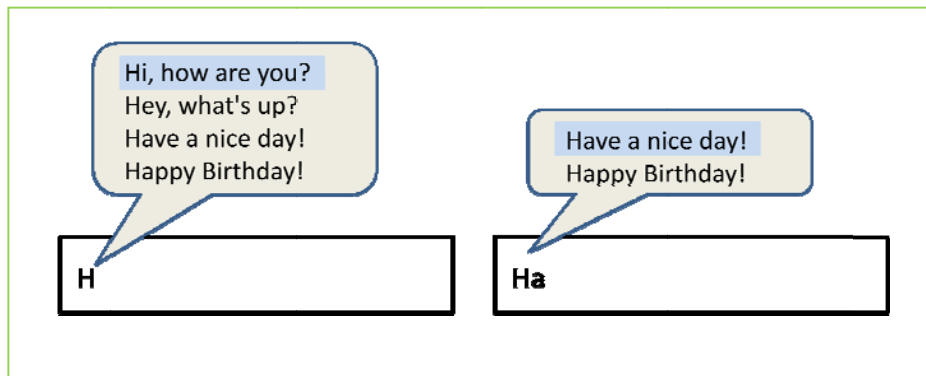


Fig. (6.2r) Concept for fast data input

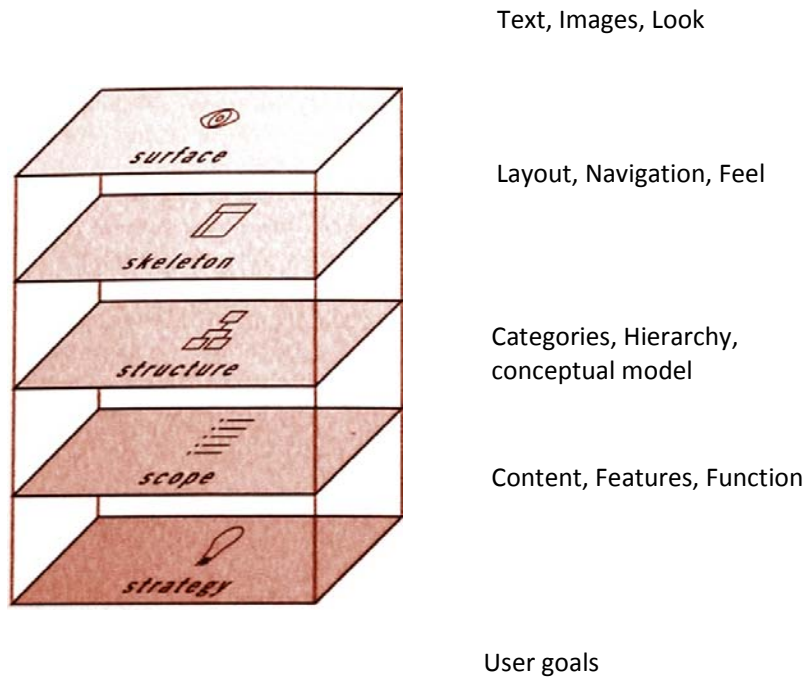


Fig. (6.2s) Elements of user experience [R6.2f]

Interface design

During interface designing, I feel that, software interface design and the product interaction design both should go hand in hand. Only software interface will proved to be useless if product interaction will be ignored.

During this project, product interaction and software interaction both are worked together, keeping their relationship in mind.

For interface designing,

I followed the Jesse James Garrett's method i.e. 'Elements of user experience'. [Fig. 6.2s][R6.2f]

After finalising the concept, I started with the strategy plane, defining the user goals and those are,

- Communication by reading and typing text
- Sharing of expressions

Then I moved to the scope plane where the content and the features which will help to fulfil the user goals are brainstormed,

Ex.

- Feedback system
- The type of interface
- Applications like record call, alarm, reminder, etc.

After brainstorming the feature and content, the next step was to see what user need while using the mobile phone and accordingly all the feature and functions are categorised.

The hierarchy was developed according to the user need, while using the phone or using particular operation, so this was the structure plane.

From this data, information architecture is prepared [fig. (6.2t)]. It was prepared only keeping in mind, the communication part and the feature related to the making and receiving the phone call. All the options and feature are sorted and chunked according to the operation related. This had helped me to create the menu and the options on the screen during the particular operation.

Then the next plane was skeleton plane, which includes the navigation and feel of the overall interface.

From the information architecture, I moved on to make the navigation and layout of the overall interface.

The placement of features on the screen such that user can relate then with the physical device.

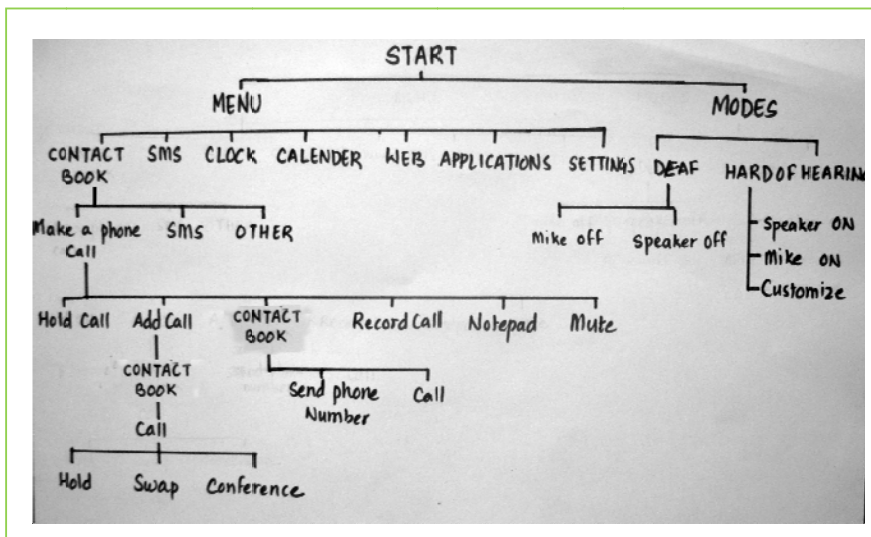


Fig. (6.2t) Information architecture

After sorting & chunking of the options and feature, next step was to categorize them into the different postures. This will make software design more efficient and more tuned.

There are three types of application postures [Fig. 6.2u] [R6.2g],

- **Sovereign posture**

In this posture application covers the entire screen. So it is possible to give large UI controls. This posture is used for the applications which are used for extended period so that user get used it. Here speed & efficiency is more important. Colours are muted.

- **Transient posture**

These are the programs which appears and goes from the screen after solving the purpose. Here less UI controls are given so that they will be clear and easy to understand.

- **Daemonic posture**

These programs are nearly invisible on the screen. They do things in the background.

Ex. Battery indicator, SMS alert icons in mobile phones

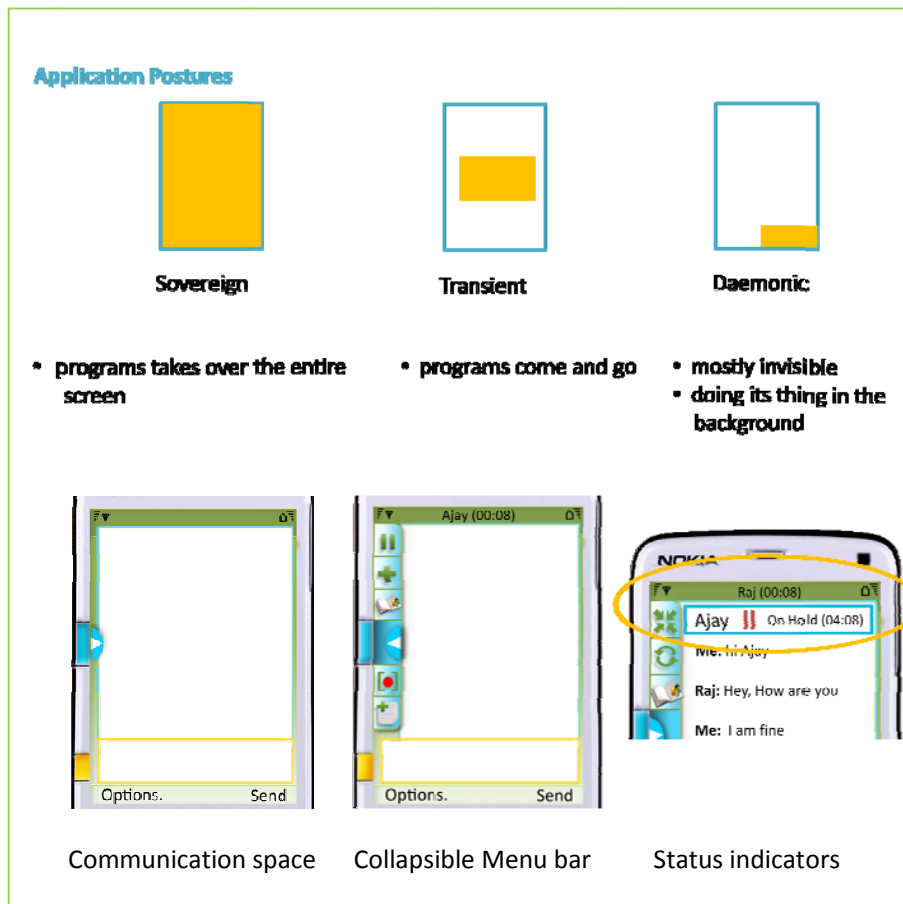


Fig. (6.2u) Application postures

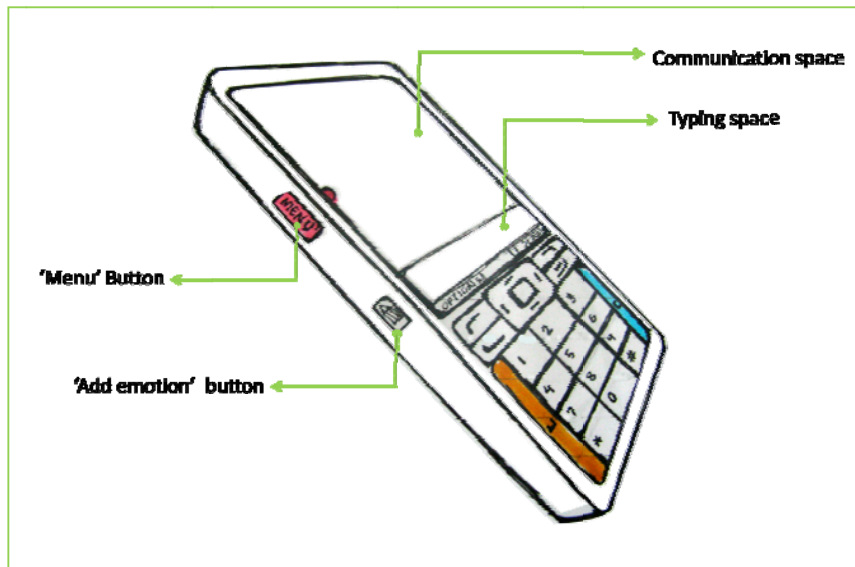


Fig. (6.2v) Division of spaces of mobile phone screen

After dividing the applications into the postures it was very clear to put the programs into the layout. Then I divided the screen in the spaces, because of the following additional reasons [Fig. (6.2v)],

- The space will be defined, so the user can relate them to them to the features and the options
- It will help user to create the conceptual model
- It will make consistency of use and user will not find difficult to search for the options
- It will also help user to related spaces on the screen to the physical buttons [Fig. (6.2u)],

Ex.

- i. *Menu button at the side of the mobile phone will be related to the communication space*
- ii. *Add emotion button will be related to the typing space*

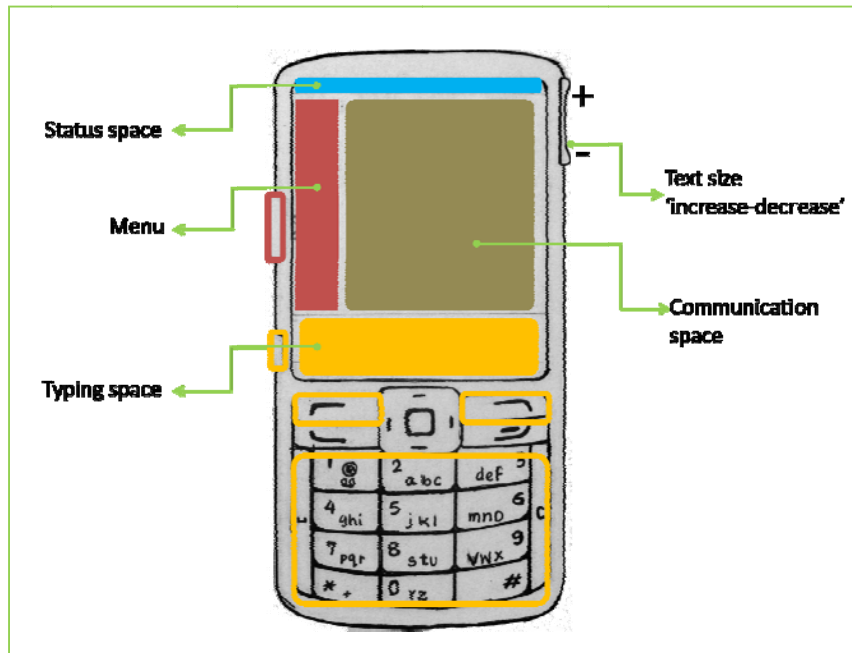


Fig. (6.2w) Division of spaces of mobile phone screen and buttons

The division of spaces will be [Fig. (6.2v)],

- Status space
It is a space where notifications will be displayed
Ex. call duration
- Communication space
It is a space where all communication will be displayed.
- Typing space
It is a space where user will type the text where it will be pre-checked by the user to minimise error before sending.
- Space for menu
It is a space where user can view the tools and options ONLY related to that particular application the user is using.

7. Scenario

8. Final design

This is the final concept which is designed for single hand use.

The motto behind is that, all communication is happening through the text input; therefore it is not desirable for a mobile phone device to engage both the hands. In day to day life situation we carry things, which may also engage our hands, so if the operation will be two handed then it's impossible for a deaf person to communicate.

There are many advantages and disadvantage involved in both the concepts, like if the mobile phone will be of two handed activity then the data input speed will be increased as both hands involved, Which also minimize the respond timing for deaf user.



Fig. (8a) Single hand and two hand activity mobile phones

Mapping & Affordance

The typing space is white and the font will appear will be in black, which will give maximum contrast, hence more readable.

The placement of menu button and add emotions button mapped according to the software interface. As well as, the color and the shape of the menu is choose in such a way that user can relate them. [Fig. 8b]

Ex.

- i. Blue color menu button is related to communication space
- ii. Yellow color button is related to typing space

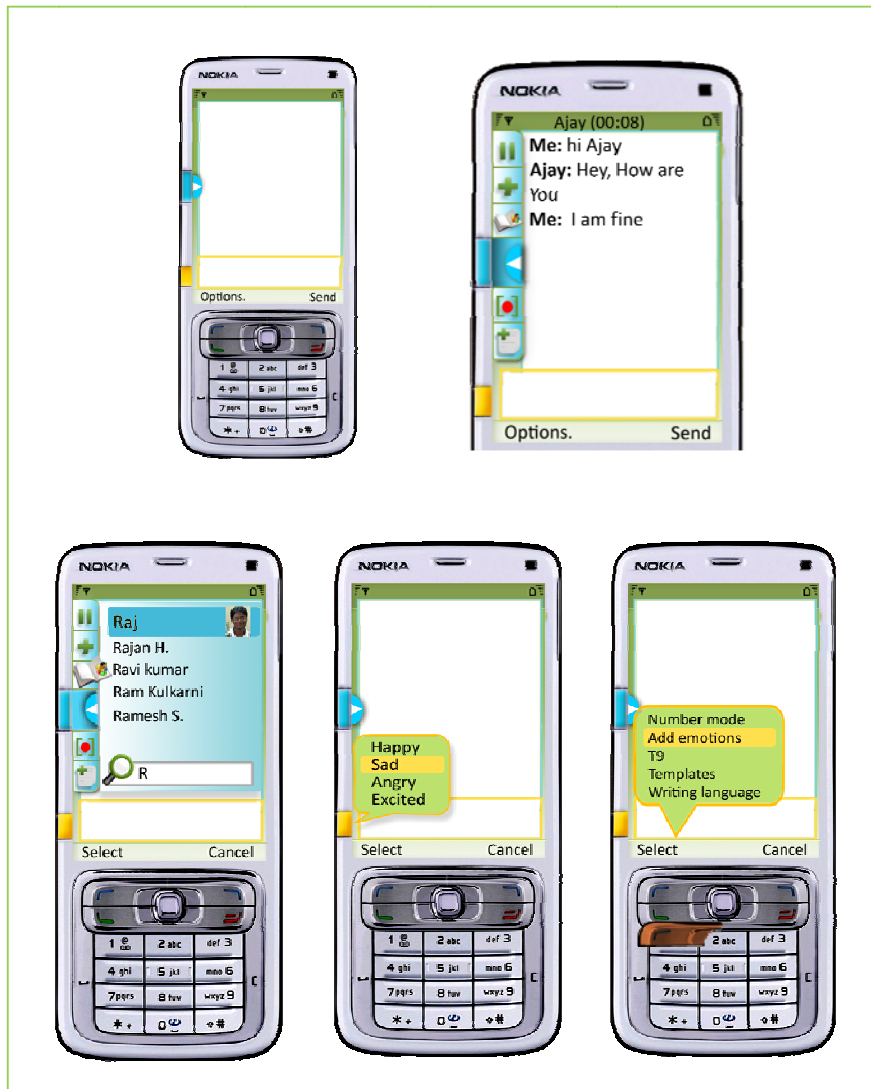
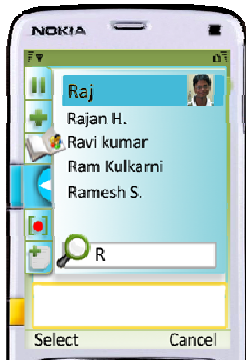


Fig. (8b) Single hand and two hand activity mobile phones



Pause call= For holding the ongoing call

Add call= For making new call

Contact Book= For making new call or for sending the number from contact book

Record call= For recording the call that will save the conversation into the text file.

Note pad= For making notes without sharing with the another party during ongoing call

(Menu bar during making a conferece call)

Menu bar



Mearge call = For converting call into conference call

Add call= For swaping between the calls

(Menu bar after making a conferece call)

Feedback

While making the phone, mobile will give the feedback of ring through text as well as through the symbols and colors. [Fig. 8c]

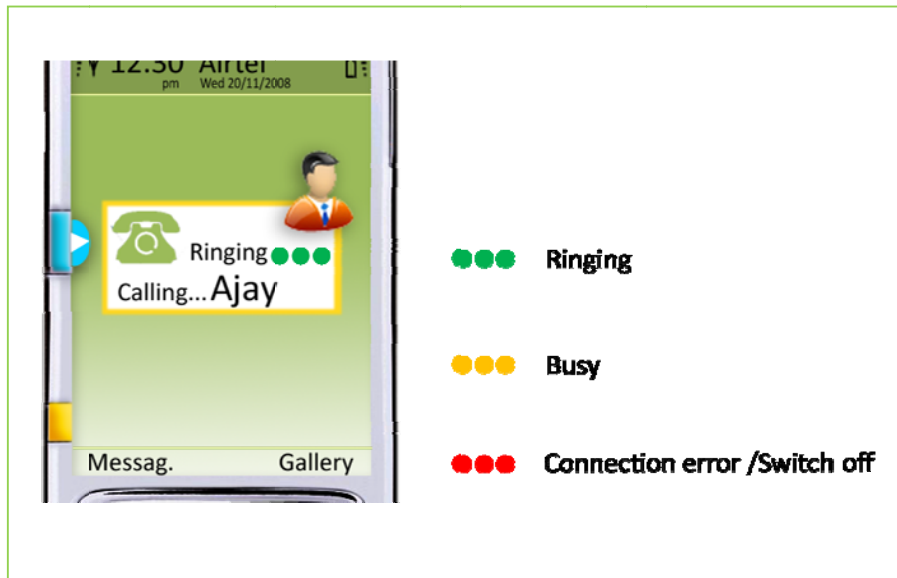


Fig. (8c) Feedback of ring while making a call

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