TICKET VENDING MACHINE FOR THE VISUALLY IMPAIRED PERSONS

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Abstract

In the field of technology, every day new inventions are introduced in the society for promotion human beings life. By virtue of which all the citizens of society are facilitated according to their needs of life style. Most of the people from developed countries are benefited in all ways of life due to their nonstop efforts and struggle in the field of technology. However some are completely denied due to lack of awareness and lacking of technical education in the subject field. The handicapped people are not very well explored in each part of world, especially third world countries by the researchers. So we can claim it, for their weaknesses and so called interest to understand more about the handicapped people worldwide. To understanding about such people will provide us with opportunities to excel in the subfield. There is a big gap between the handicapped and society which causes to cut them off from society. This gap needs to be filled in, while carrying out researches in the desired fields. Our research area is related to ticket reservation machine for the visually impaired people, to make the process easy for them to buy ticket at their own from the ticketing machine. After studying different articles on the subject, it is proved that many inventions have already been done by researchers and others are in progress for helping out the handicapped people. We have presented screen prototypes of the interface of the ticketing machine for the visually impaired people. We collected many hardware devices as one kit which can be use in the machine for the visually impaired users. It will enhance their power of visual sense to perform tasks at their own. There are some principles to follow in building up any system for visually impaired or blind people. If followed these principles in true sense it will facilitate to make new interface designs for interaction with visually impaired or blind users in friendly way. In this way we can overcome the shortcomings between normal and visually impaired people, which will be a great achievement to serve the deprived people.

Keywords: Visually Impaired People, User-Centered Design, Human-computer Interaction, Ticket Vending Machine or Ticketing Machine or Ticket Booking Machine, Ticket Reservation Machine, User Interface, Usability
Acknowledgements

Ticket reservation machine is valuable addition in the field of informatics. We have put in our little efforts to explore and to develop new thoughts and ideas for up-gradation/improvement in the existence ticket reservation system for the visually impaired people.

We would like to thank our supervisors Ann Lind for her dedicated, proper guidance and cooperation throughout the thesis. Our heartiest thanks and respect are for our colleagues for their valuable contribution and support during the empirical study.

Borås March 2010

Baddar Rehmat and Muhammad Ishfaq
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1 INTRODUCTION

In the first chapter, we have described the topic in a manner to cover, what is the aim of our study? What are the genuine problems that we are facing at the moment? What are our main requirements? Having all this in mind we will be able to discuss it in different forums in order to reach the conclusion and suggest some measures to sort out the problems relating to our study. Depending on our study, we will choose some questions which will be related to the problems. We will also highlight the main purpose and the expected results within the given boundaries of our research work.

1.1 Background

About 314 million people are visually impaired worldwide; 45 millions of them are totally blind. The majority of visual impaired people are aged 65 years or older (WHO, 2009). In Sweden, about 175,000 visually impaired people are in between aged of 16 and 84. An estimated 13,000 of them are totally blind or have very slight residual sight. Despite of the disability, age, or sex; they are members of the society, where automatic vending machines are used by the general public. It should be able to use by everybody living in this society regardless of disability, age or sex (Hjalpmedelsinstitutet, 2009).

IT systems should be introduced and taught as a medium of teaching to make it convenient for people to fulfill their needs. The main focus of our thesis is on handicapped people, who are affected by the disabilities of visual impairments. They should be compensated with the latest equipment to overcome their shortcomings. In this era most of the people rely on computers for many different tasks. We can’t deny the fact that computers are an important part of our life. Most of the different application forms, offices, hospitals, booking systems, military assets and their records are computerized. Our IT systems basically can be seen as to have two different parts, one we called as independent IT systems and the other one is dependent IT systems. (Ceesay, Hammam, 2010). An independent IT system is a system which is not reliant on the users. A system that convey information in an ordinary way without users’ involvement e.g. systems that generate an invoice receipt to the customer. A dependent system is the system that is totally dependent on the users, and it will not move or perform the next step without the input from the users e.g. ATM machines or ticket vending systems, in which the users tells the system what to do. (Ceesay, Hammam, 2010)

In this modern era IT systems act as prominent participants between human beings and their requirements. We can say that no industry can survive or get distinction without implementing IT systems. The purpose of using IT systems is to save labor, time, resources etc. IT is an essential part of the human user friendly interface system which is helping the communication between the human and computer to be as smooth as possible. It is important that not to let the user to waste his/her time and efforts in trying to understand the system because it reduces the efficiency of system. IT systems which the users do not understand and have poor usability is said to be botched system.
If someone would like to buy a SJ ticket from Boras to Gothenburg, it is one’s own preference to use a ticket machine or buy it from a counter desk. The task he/she is going to perform is a self-service action, which means that the user should be confident enough to get the ticket at his/her own. If a person uses a machine to purchase the ticket, the person may fail to get the ticket because of some disability like physical, cognitive/mental, sensory, developmental, or some combination of these. Then special person needs external help to use vending machine. So today's ticket machine systems should be needed to enhance the technology for the special people. We are confident that the system will be improved through better, easier and user friendly interface. The user friendly interface will allow people to serve themselves without any assistance that is our aim and desire.

Many people who want to purchase the tickets would prefer to buy the ticket from machine. We believe that the ticket machine system does not always work to facilitate all the users including special/handicap people, because the machine is totally designed by keeping the normal people in mind and there is less support of the disabled people. If a disabled user wants to buy tickets from the ticketing machine, how could he/she buy from the machine which has been designed for the normal human beings? Some users believe the system (machine) to be a burden and prefer to buy their tickets at the information desk. The main reason for this is the users do not feel that they have control over the system while interaction with the system. User control is an important fact to be considered while designing an IT system. Users must feel that they have control over the system and have their own type/choice of dialogues; otherwise they may feel uncomfortable and uncertain about the system. There are many points that required to be accomplished for successful user control system. There should be potential to undo any act along with shortcuts and dialogs between users and system. The design should ensure to avoid the mistakes or errors. At the end it should be feedback from the user (Löwgren, 1993). The design of the system, in which the user has full control on all the system, is required. The ticketing machines should fulfill the requirements of all the users either they are normal or special. There are a big number of the disabled human beings living on this planet, which requires attention from interaction designers.

1.2 Statement of problem

The problem that our research will try to describe is that the disability is a complex phenomenon, which stops the disabled person to do the normal or daily routine works. The daily routine could be travelling or shopping etc, for travelling need to buy tickets which can be done online, from ticketing machines or directly from the ticketing desk. It is difficult for the handicapped persons to buy tickets either online or from ticketing vending machine so they would need external assistance to do so. We have decided to propose design principles of the user friendly interfaces for the blind or visually impaired people that could be implementable on the ticket reservation machines. The interface which can help visually impaired people to buy tickets without any assistance and allow them to act like independent users.

1.3 Purpose of the study

Disabled people have difficulties to use automatic ticket machines designed for normal people. The purpose of our study is to develop an understanding of the reasons of the difficulties and
investigation of design principles that could be used to develop ticket machines so that a higher degree of usability for disabled people is achieved.

The purpose of this study is to help out people and to educate them with knowledge about the design of automatic ticketing systems. It will provide guidelines about the interaction of the users and the ticketing system, so designers can start their work in the right direction for providing assistance to the handicapped especially visually impaired people. We want to provide a prototype of the working machines that the prototype will include some screen shots of any working machine.

1.4 Research questions

Main question:
What design principles may be considered in order to make a ticketing machine system more available to the people with visual impairment disability?

Sub-questions:
1. How much intelligence may be required so that the system may recognize the user and perform tasks according to the user needs?
2. How can the machine and the user interact with each other?
3. What kind of difficulties the handicap with visual impairments could face while using these machine and to which extent the solution of that difficulties exists?

1.5 Target Group

The research in our thesis will involve essential design principles for the development of interface of ticketing machine for visually impaired persons. The main target group in our thesis is students, teachers and researchers in the field of computer science or related fields. Others are the designers and developers working on the interaction design principles of the ticket vending machines or other interactive kiosks, specifically for the handicapped people. The companies that develop interactive kiosk systems are another target group of our research studies. The interface which is designed efficiently and adequately will be beneficent for both the user and business. For the future we also hope that the knowledge we will gain can lead to further research in the related fields and could be a source of inspiration of new ideas for students and researchers. The outcomes of our research can be used as a basis for further research in the field of interaction design principles.

1.6 Delimitations

Focusing on software rather than hardware level our research work would be bound to the interface of the ticketing machines only. We have restricted ourselves to the interaction between the users and the machine, not on how machine will work. Our focus will be on the usability
rather than the actability. This is because we are confident about the system which should be able to achieve its objectives without any hurdles.

1.7 Expected outcome

The expected result of our research would open the new avenue of thinking about the reserving tickets for the people with eyesight problems and would open new ways for the handicap people with other disabilities. It will facilitate the interaction between users and the systems; this kind of research has not been done yet. The implementation of such systems would facilitate trouble free ticket booking for the visually impaired people of the society. Summary of the new principles that could be part of the user friendly interface for visually impaired people will be the expected outcome of the research along with the synopsis of what features make the interface usable from the users’ point of view. Short summary of those features will also be provided to make the ticketing machine interface easier to use intelligently.

We would like to introduce new ideas with some basic principles that how to develop a system which can provide user-friendly interface to the users, that can decrease the threat of misunderstanding attempt, cognitive load and wastage of time. We expect the system, that would be easy for everyone to use smoothly without any assistance and interruption, which has speaking and hearing facility for more productiveness for the handicapped users. The people who can’t operate the ordinary systems will be benefited from speaking with the system. This will reduce most of problems at the users’ end.

1.8 The authors’ own experience and background

Our own experience and background about the research area is that we are active travellers by buses and trains from Boras to Gothenburg and Stockholm, and have used the ticketing machine. We got an idea to undertake the research work in this specific area, when we saw a disabled person booking ticket from the ticketing machine in Gothenburg. Disabled person was not able to do so because the interface of the ticketing machine was not designed to cater all types of handicaps like him. None of us has some kind of disability or is handicapped. We both have done our major work in the field of informatics in computer network designing and troubleshooting. None of us has any experience in interface designing but currently both of us are studying the course of Interaction Design which would definitely help us in this specific field during our studies.

1.9 Structure of thesis

The following flow chart has been designed for our research studies. In which, we will choose the research method which depends on the theoretical and empirical study. We will analyze the results of theoretical and empirical study, and then develop the prototypes and will evaluate them. After evaluation and analysis, we will make the changes as per our requirement. At the end the results will be able to provide the answers to the research questions.
Figure 1: The relationship between different part of thesis


2 RESEARCH DESIGN

This chapter has been designed to describe the methods that how the research work will be carried out and what approach we have chosen. The aim of this research design is to answer the questions. We will also present the overview of the choice of methods used for data collection, analysis and results.

2.1 Research perspective

There are two main scientific perspectives, positivism and hermeneutics. (Ann Lind, 2005), since we want to create comprehension knowledge, a hermeneutic perspective is best for our research. The aim of the hermeneutics analysis is trying to make sense of the relationship between people, organization, and information technology (Michael D. Myers, 1997). Hermeneutics is defined as the theory of operation of understandings in relation to the interpretation of text. The text could be any sacred and legal document (David L. Rennie, 2006). “Hermeneutics dealt with two aspects of interpretation which will be encountered again: firstly, the problems of analyzing texts in a way that looked beyond the surface features (e.g. of a parable), and secondly, the problems of verifying the analysis so produced” (Wallace, Ross, Davies, 2003, p 589-590). We can say that the hermeneutics deals with the interpretation of any aspect of the technology. Hermeneutics opens the path of protecting the social sciences from violation of the methodology of natural sciences, but the main concerns are always similar as those acknowledged previously i.e. to what degree the readings are to be ordered and to what level they are accurate? (Wallace, Ross, Davies, 2003)

The hermeneutics also deals with the difficulties of text interpretation, analysis of text and verification of that analysis. The qualitative study produces some kind of results in the form of text from interviews or observations; the produced text needs to be interpretive because “texts are not just more or less meaningful, they are also more or less useful.” (Wallace, Ross, Davies, 2003, p 592) It will show the objectivity of the text, we think that the hermeneutic approach with qualitative research is better approach to choose (in our case). The qualitative research gives chances to interviewees or respondents to answer in their own opinion.

Every research design has some positive aspects in it beside with some negative sides. It is not possible to say that any research design a perfect design. There are mainly two research designs which are the source of the today’s research, one is qualitative research and other is quantitative research. “Qualitative researchers aim to gather an in-depth understanding of human behavior and the reasons that govern such behavior.” (Wikipedia, 2010) “The objective of quantitative research is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena.” (Wikipedia, 2010)

The Qualitative research helps to recognize any given research problem or subject. Qualitative research prevail distinguishing information about the principles, opinions, behaviors, and combined contexts of particular groups of population. The qualitative research provides textual analogy of, how any research problem is experienced by the researchers. There are three qualitative research methods which are: participant observations, in-depth interviews, and focus groups. The participant observation depends on the observation of the participant to be observed,
in-depth interviews depends on the collection of answers of the questions from the individuals personally, and focus groups depends on the collection of data from the group of particulars. (Namey, 2005)

The quantitative approach, on the other hand, has more benefits of generating data that is open to the statistical analysis, and something that is predominantly imperative in a security context. The quantitative research approach mostly being in understandable form, the representation of the data in quantitative structure is normally in form graphs or charts. (Wallace, Ross, Davie, 2003)

In this research we will use qualitative research methods with hermeneutic approach. Our research design will show how this work will be applied, and why we have chosen the approach. The research design will help to answer the research questions. We will use the procedure of the observations and the interviews in this regard. We will try to explore that what are the requirements of a user (visually impaired people) and how the ticketing machine could be provided by the user friendly interface. This approach will rely on the conclusions and results that we will gather from interviews and observations. We will try to broaden our perspective at the start of the work, because it would be very helpful at the point, when we will be collecting data. We will analyze that how the interface of ticket machine system affects the users.
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Table 1: Comparison of quantitative and qualitative research approaches (Mack, Cynthiaawoodsong, 2005)
2.2 Research Strategy

We need to look at the available methods and practices, possibly to develop them. Once a specific project is developed, we may need to collect information to examine the program and assess its effectiveness by answering the question. Is it meeting its targets? Is it satisfying its customers? (Paul Nichols, 2006). The research strategy we will follow during the research will consist of the collection of the information through interviews and observations, and then we will review the effectiveness of the data and try to answer the questions that Nichols asked.

There are two types of research strategy approaches.

1. Exploratory research
2. Descriptive research

1. Exploratory research

An exploratory study is conducted when the researcher would like to follow a new interest, or when the subject area in itself is relatively new and unexplored. The aim to such a study may be to create a superior understanding, to test the feasibility of further research or to establish a method for further research. (Ann Lind, 2005) Exploratory studies are important when we are creating new knowledge of the research area. (Babbie, 1995)

2. Descriptive Research

Descriptive research or Statistical Research is used to describe the data and characteristics of the study. The idea is to study the frequencies, averages, and other statistical calculations. Descriptive research is very accurate but it does not gather the cause of the situation behind. (Jenny Anto, 2007)

We have chosen the exploratory approach as our research strategy because we want to follow a new knowledge. Our research area has been unexplored and is a new one. This area needs to be of better understanding for the further exploration. The interviews and observations fit well with exploratory approach, which will create better understanding of the problems and towards the solution of those problems. The application of the exploratory method will help us to get a better understanding and make the interface of the ticketing machine system better and usable by the visually impaired people.

Once the phase of interviews and the observations will be finished, we will build a prototype of the interface that will help the visually impaired people to purchase tickets for the experimental purpose. Our effort would be to get a better understanding of how users perceive the interface of the ticket machine system and how we can make improvements in the interface to be useable for the visually impaired people. We will come up with better design of the machine interface to investigate further on to make it more reliable for the users. If we notice and observe that the interface of today’s self-service systems always needed to be improved and required some kind of updating and upgrading in it to be usable for all kind of users.
The role of theoretical study

The role of the theoretical study is to explore the literature related to the material which is relevant about the research topic. According to Oates (2006, page 72) the goal of the theoretical study is to collect and show proof to support that you have produced some new knowledge. The theoretical study is used to point out the key concepts and propose theories that might describe the data, which the researcher has gathered from the study. The base of any kind of research is a theoretical study. The theoretical study is dependent on the literature resources like books, journal articles, conference papers, catalogues etc.

In the theoretical part we will make a base for the empirical survey, which will later on be implemented. We have inquired the different ways of conducting interviews. We have to keep in mind that what is significant to think about and what we should do to attain validity and uniformity in the theoretical study. We have studied various theories about the usability, ticket machine system, and human-computer interaction and design principles.

The role of Empirical study

According to Oates, (2006, page 2-3) the researchers are carrying out empirical researches in information systems for a long time to sort out what happens when these information systems designed, developed and used by the people. The development and acceptance of information system is directly dependent on the outcome of the empirical study. The empirical study helps to foresee the results of the implementation of any information system. If we want to develop a system in a manner that it does not fail then there should be support for the research. The empirical study is used to verify the results of theoretical study. (Oates, 2006)

Our intention is to acquire an enhanced understanding of how the user recognizes the interface in the ticket machine system, and what measurements we can take to make the interface of a ticket machine system better for the handicapped people (visually impaired). This can be done with the help of theoretical study along with empirical study because the role of the empirical study is to verify the results of the theoretical study.

2.3 Data collection procedures

For the solution of the problem of design issues of interface of ticketing machine system for the visually impaired people, we will use the interviews and the observations. During the interviews, we will ask the questions from different visually impaired people about their thinking of such kind of ticketing systems. The interviews from the normal human beings, who travel regularly by buses or trains, will help us to sort out the availabilities and problems of the current ticketing machine. It will also help to get the idea about what they think of current system to improve and to make usable for the visually impaired people. During the observations, we will analyze and argue the different responses given by the interviewees and will try to reach any results.
Theoretical study

Our theoretical groundwork is based on articles, books and literature review as well as the material which is relevant to our study and our problem area. The literature review will be done by searching keywords like usability, interface, human computer interface, information service and user interfaces etc.

Theoretical sources

The theoretical source is a tool of qualitative research. We have selected to go through the comprehensive study of literature that is related to our research, which will compose of the journals, books and articles in the research area. We will make analysis of the problem by making predictions, understanding and explaining the matter.

Our theoretical groundwork will comprise of articles, books, internet and literature review as well as any material that is relevant to our study of problem area. We will definitely consider that the authors are more trustworthy than others. In our theoretical study will be composed with the websites, books, articles and journals because this will provide quality of our data.

Empirical Survey

The empirical study is related to balance with what the theory says. The theoretical study is starting point and the preparation of interview questions and observation procedure depends on it. In an empirical study the observations and interviews will be conducted at different places. We will also try to collect the data by the interviews from the blind or visually impaired people that would be the source of direct quotations from them, and also yields their previous experiences, previous knowledge, feelings and opinions about the ticketing machine or booking system (Michael Quinn, 2002). The observations will provide the handicapped people’s behaviour, activities, actions and their interpersonal interaction with other assistive technologies.

Empirical sources

The empirical source will be composed of a number of interviews and observations, which will be conducted randomly from normal users on the spot after or before buying ticket form ticket reservation machine.

According to Briony J Oates (2006, page 202-203) to observe mean ‘to watch’ and ‘to pay attention to’. Several humans perform observations most of the time by: seeing, hearing, noting, analyzing, formal theories, making inferences, imposing meaning. He further says that, the researchers use observations to learn what people do in reality, rather than what they say they do when questioned. Mostly the observations consist of looking and watching, but it can include hearing, smelling, touching and taste. Oates presents many different kinds of observations, out of which we can use three kinds of observations that includes, short duration observation, record keeping by using simple notes and maybe a camera as well (if required) and third one is that no feedback is given to the observed people. The people observed would be only the people with the visually impairment disabilities. (Oates, 2006)
Highly systematic observations of pre-defined types of events | Observations of anything and everything
---|---
Narrow concentration on particular type of event | Broad focus
Observation takes no part in the proceedings | Observer participates fully in the proceedings
Facts of Observations taking place is known to all | Fact of observation taking place is known to none except the researcher
No explanation, or false explanation, given for presence of observer-researcher | Full explanation given for the presence of the observer-researcher
Short duration—could be as little as 5 minutes | Long duration—possibly years
Record-Keeping uses only note taking | Record-keeping uses technology (e.g. audio tape, camera, stopwatch, two way mirror, computer program)
No feedback given afterwards to the observed | Full feedback given afterwards to the observed

**Figure 2: Different Kind of Observation (Briony j Oates, 2006)**

We will try to observe and describe the interaction between the visually impaired people and the ticketing machine or the booking system along with data and information which will be obtained by the means of observations and experiences. We will start with a theory as starting point then we will formulate interviews which will base on that theory.

Interviews are defined as a particular type of conversation between people. Usually the reason of the interviews is to gain information from other(s) by producing useful information for the researchers (Briony j Oates, 2006). In interviews we will try to do the things that Oates suggested (page-187) like gain comprehensive information; explore emotions, experiences or reactions that cannot easily be observed. We will use unstructured interviews; we will start by introducing the
topic to the interviewees and allow them to develop their own ideas about the topic let the interviewees to speak according to their mind.

The criteria for the selection of the sources of the interviews or the person to be observed will be the amount and type of the information required for the empirical study. For example if we want to assess the users’ requirement we will interview visually impaired people, and if we need to know that how the ticket machine works for the normal people we will interview general public for that.

For the study of a group of individuals, (visually impaired people) we will be visiting various people with visual impairment disabilities at the care centers for interviews and observations. The selection criteria for the interviews and the observations will depend on the information and data required for the empirical study.

Most part of our observation will be undergo when we will be conducting interviews, because the visually impaired people might not be able to give us a long time for observation separately. There are very less chances that we found these people personally interacting with ticketing machine as we can find normal people interacting.

### 2.4 Data analysis procedures

The data analysis procedure that we will follow is the Qualitative Comparative Analysis (QCA). This technique is logical deterministic technique. “This technique is developed by Charles Ragin in 1987, for solving the problems that are caused by making causal inferences on the basis of only a small number of cases” (Wikipedia, 2010). At this stage of inspection, we will analyze the data that we will receive from our observations and interviews. Then we will revise and compare that between real findings and experiences. This will provide some results in form of data with written descriptions. The evaluation method means to produce a high-quality with the help of evaluation, so we can authenticate all the gathered data in order to get new information. It should be done right after the empirical study. For the interpretation of the data analysis we will use text interpretation.

The analysis of theoretical study depends on the data that we will collect from important key concepts and subject areas. We will analyze important subject areas and try to give the answers of research questions from that analysis. During empirical study different questions will be asked from the visually impaired people. This will help in giving the idea of the problem to the user’s mind. By this way we will reach to our goal of what we need and what are problems in the interface of the current ticketing machine for the visually impaired users. Then we will make a comparison between the interviews with various users’ viewpoints. The important aspects that we will find in the empirical study (interviews and observations) will be compared and analyzed with the aspects or findings of theoretical study. At the end we will review of all data that we have collected through the interviews and compare that with our theoretical study.

### 2.5 Strategies for validating findings
According to Collin Robson (2004) evaluation is assessment of the value (or worth or merit) of something. The ‘something’ focused on here is some kind of innovation, or intervention, project, or service. (Collin Robson, 2004).

The evaluation method is used to validate the findings of the research. The research would be rich and meaningful if we evaluate the quality of the research. There are many methods for the qualitative research as: (Kaplan, Maxwell, 2005)

- Validity
- Data quality
- Feedback

We will also use these evaluation methods in our research, according to Bonnie Kaplan and Joseph A. Maxwell (page-14) “Validity in qualitative research addresses the necessarily ‘subjective’ nature of data collection and analysis. Because the researcher is the instrument for collection and analyzing data, the study is subjective in the sense of being different for different researchers. Different researchers may approach the same research question by collecting different data or by interpreting the same data in different ways.” We will compare the results of interviews and observations taken from different people. (Kaplan, Maxwell, 2005)

Data quality will reveal us that the data we collected is in detail and varied enough that it will provide a comprehensive and complete picture of, what is going on and what actions are included. Data quality will help us to see the whole process and developing some results deeply. (Kaplan, Maxwell, 2005)

The feedback is the most important way of eliminating the risk of misinterpreting the meaning of what participants say and do, or what the researcher has observed (Kaplan, Maxwell, 2005). The feedback will imply the gathering of responses about the conclusions from the participants. We will try to check that our interpretations make sense to the visually impaired people; which will help us in collecting additional important data.

We want to keep the structure of the research flexible and feasible, which would provide easiness and comfort of the reader. We will have empirical aid because of interviews and observations that we will conduct from visually impaired people and the machine ticket purchasers. The aim is to create consistency in the research so that it becomes easier to see that how the different parts to the research fit together. After finishing observations and interviews, we will try to join the results from both scenarios and evaluate the results.

### 2.6 Result presentation method

After analyzing all the observations, interviews and the literature, the research results of our thesis would be presented in form of mainly prototype, models or diagrams to a certain extent, along with the small amount of data as well. We will illustrate our results in the form of prototype for the visually impaired people.
3. THEORETICAL STUDY

In this chapter we have described key concepts, subject areas relevant to the research, relevant literature sources, Interactive Kiosks, System Development, Artificial Intelligence, User-Centered Design, Usability Engineering, Computer Interaction, Usability, Actability, Design Principles, Guidelines for Public Information Kiosk, Shneiderman's Eight Golden Rules of Interface Design, Interaction Design Principles and summary of theoretical findings.

3.1 Key Concepts

We would like to explore the interaction design principles of the ticket machine system for the visually impaired people and their interaction with the machine. We will stare at different theories that are linked to our main research theme in the thesis. The key concepts in the theoretical study with regards to the research questions are identified as

- Design principle
- Booking systems or machine
- System availability
- Users with handicapped disabilities
- System intelligence
- Actability
- Users’ needs
- Usability
- User interaction
- Interactive kiosk

It is essential to follow design principles that can help us to reach customer needs. It is the main strategy to assume that the current ticketing machine system's center of attention is on users. The preservation of users’ needs involves sorting out the purpose of the machine that who will use the system? What are the goals of users? And what are the problems that could be faced by the users in future? The design principles are described in detail in the later part of this chapter.

Booking systems or machines are the systems which produces tickets or book tickets on the users’ request. These machines are placed at the places like railway stations, central stations, airports etc. The booking of the ticket consists of different steps from users, that uses the display interface of the machine, and selects the type and number of the required tickets along with source and destination, then inputs the users’ or traveler's name and required details. The users then choose a payment method for example paying by debit or credit card, by cash or by any other available method (mostly through bank cards). At the end the ticket(s) is printed and output to the users physically.

System availability means the ability of the community of the users to access systems if a user wants to do a new work, edit the previous work or update the work, or gather the results of the work that is previously done. If the users are not able to access the system, then the system is said to be unavailable. (Wikipedia, 2011)
**Users with handicapped disabilities** are the users who are suffering from inability to perform any task physically and are called as physically disabled persons. There are users with other kind of disabilities such as cognitive, sensory or mental disabilities or a combination of these disabilities. There are many assistive technologies and special facilities available for the handicap users around.

**Actability** is mainly an information system’s capability to carry out actions, and to allow, support and assists the performance of events by users, both with the help of the system and depends on the information from the system, in any business context. (Pär J. Ågerfalk, 2003)

**System intelligence** means the behavior of the system which is human (behavior) in nature. When a situation or human interact with such systems, the intelligent systems react in an intelligent way like the humans i.e. observe the environment, get the feedback and give the response with intelligence.

Understanding the **User needs** is a very important key concept in the theoretical study of our research, because the needs of the users with visual impairment problems are different from the normal users. This means that we need to sort out what are the things that, the users can do on their own and what are the steps that users can’t take because of their disability. This could be done by keeping the two senses of the disabled users in mind which are hearing and touching (in our case).

**Usability** is the ease of use and satisfaction that a user experiences, when he or she interacts with an artifact or invention. Usability is related to the experiences of a specific user performing a specific task in a specific situation. It is important to realize that usability is not a single, naive attribute of a user interface. Usability consists of many things like the easiness of learning, effectiveness of use, and personal satisfaction of users. (Wikipedia, 2010)

**User interaction** is an uninterrupted procedure of action and reaction between two parties whether human (user) or machine. The design is said to be making sense (of things), then the interaction is said to define the performance of artifacts and the worth of communication service to its users, and the value of the experiences they (users) have using it. (Larry E. Wood, 1997)

**Interactive Kiosk systems** are the information systems which serves people according to the type of system. The users gives input and the system provide some output, these kiosks are located in public places for the self service to provide information, buy tickets, pay utility bills, deposit or withdraw cash etc. In our research we assume that the visually impaired people will interact with the same kind of interactive system for purchasing tickets.

### 3.2 Subject Areas Relevant For the Research

From the key concepts above it is possible to identify many subject areas. For the illumination of the research questions, the subject areas relevant to the research questions are
System development is the underlying structure which is used to organize, design and determine the developing process of the information system. There are many types of system development methodologies such as waterfall method, prototyping, rapid application development, spiral etc. Each method has its own advantages and weaknesses. For the development of the system, the developers use the technique which best suits them. Regarding to our research the things that must be considered before choosing any system development method is that the system will be used by the handicapped people. The methodology, which we recommend for our research question is prototyping. (Wikipedia, 2010)

Usability is a qualitative characteristic and is the process of exploring that how much it is easy to use the user interface of a system. The usability defines how the system and the users will be able to work, and how much support the users will need to complete the task. The usability of the system not only deals with the user interface it is also related to the concepts on which the system is based. For the ease of use of the visually impaired people, the goal of the usability design is to meet the user needs and expectations. The usability can be used to answer the concepts like system availability, users with handicaps and user needs. (Wikipedia, 2010)

Artificial Intelligence is an area of science, which deals to find the solutions to complex problems in a more human-like style. According to our research the ticketing system should be much intelligent that it can interact with visually impaired users. Here the use of interactive artificial agent is one option, the agent can interact with the users through voice recognition. The subject area of artificial intelligence may help us to find the answer to our research question of how much intelligent system could be, so that it recognizes users and perform accordingly. (Alex J. Champandard, 2002)
Figure 3: Relation between subject areas and research questions

User-centered design is the identification of the special needs and requirements of the visually impaired people i.e. to identify the specific requirements and constraints of the people with poor eyesight. Then the design is based on the goals by keeping in mind the purpose of the project and the users' requirements. In our research we will try to simplify the structure of the tasks by making the things more visible and usable for the users. The user-centered design is very important subject area regarding to our research, as the user will be the person with visual impairment problems, so it is necessary to design the system around the users. The user-centered design can be used to answer all the research questions because the users will be the visually impaired persons.
**Human-Computer interaction** is the study of the communication between the human beings and the computers, the interaction depends on the interface. The subject area of human-computer interaction is very important to answer the research question like how the users (visually impaired) will interact with the system. Human-Computer Interaction is explained later in this chapter.

**Interaction design** specifies the structure and organization of the interactive systems. The process of design is used to make predictions of the results or outcomes. In our research we will specify the interaction design principles of purchasing tickets for the visually impaired people i.e. what design principles might be considered while designing such a system? Human computer interaction is defined as the understanding of the interaction between the computers and the users. According to our research questions this interaction will be between the visually impaired people and the ticket machine. The user’s limitations and requirements are very important aspect of the research because our research is dependent on the visually impaired people and the people with this kind of disabilities. The interaction design is indicated by the key concept of design principles. It will help us to answer the research questions by exploring the designing principles for the booking system or ticket machine. (Wikipedia, 2010)

<table>
<thead>
<tr>
<th>Subject areas</th>
<th>Key concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔ Interaction Design</td>
<td>✔ Design Principles</td>
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<tr>
<td>✔ System Development</td>
<td>✔ Booking System</td>
</tr>
<tr>
<td>✔ Usability Design</td>
<td>✔ System Availability</td>
</tr>
<tr>
<td>✔ Artificial Intelligence</td>
<td>✔ User with Handicap</td>
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<tr>
<td>✔ User-Centered System</td>
<td>✔ System Intelligence</td>
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<td>✔ Human-Computer Interaction</td>
<td>✔ Actability</td>
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<td>✔ User Needs</td>
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<td></td>
<td>✔ User Interaction</td>
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<tr>
<td></td>
<td>✔ Interactive Kiosk System</td>
</tr>
</tbody>
</table>
3.3 Relevant Literature Sources

For the purpose of getting useful and relevant literature, we will use different kind of sources. The most powerful sources are books but the production time for books can be too long. Therefore, we can find the most important and up to date information in research articles. We can learn and get a lot of information from books and research articles in comparison to other sources. It can be helpful with introductions and details of subject areas. Books and articles can help us in getting survey related previous work, ideas and discussions in depth and detail. Manuals can also give us as a useful source of data, mostly for designing and creations of projects. In journals there are academic articles where we can find information related to our research. We will also prefer journals because we can easily find articles relevant to our research area, which are published regularly. Some of the popular sources where we can find journals is ACM computing survey, IEEE transactions and information system research etc (OATES, 2006). The other relevant literature resources will be catalogues and online databases, which are relevant to information system and computing (e.g. ACM digital library, INSPEC and Design and Applied Arts Index). The media literatures like videos, newspapers, etc. will also provide additional help.

In interaction design there are many writers, the most important book is *About Face 3: The Essential* which is written by Alan Cooper, Robert Reimann and David Cronin. Others are Jonas Löwgren and Erik Stolterman the name of the book is *Thoughtful Interaction Design*, they have described the interaction design in detail. In system development the book written by Jeremy Lewis with title of *Software Development Life Cycle* in which, he discussed the system development life cycle. In usability a good work is done by the Jakob Nielsen who has written many books and articles about the usability design for example the *Designing Web Usability and Web Usability*. In Artificial Intelligence the book written by Stuart Russell and Peter Norvig is a handy book for the subject area. There are many other articles which are very important to be considered as the research area is continually evolving with the passage of time e.g. Experiences on a Multimodal Information Kiosk with an Interactive Agent by Erno Mäkinen, Saija Patomäki, and Roope Raisamo. In User-Centered Design, Human Computer Interaction and Usability Engineering Xristine Faulkner and Donald A. Norman are important writers who have described the subject areas in great detail.

3.4 Previous Research

According to previous research a lot of work has been done by different authors and researchers for visually impaired users in different fields. There is an article written about how to make the interaction smooth and what measurements should we take to make communication easy between users and machines by Caldwell (2008). Another article written by Erno Mäkinen, Saija Patomäki, and Roope Raisamo (2008) in which they use interactive intelligent artificial agent, which can interact with the users like human beings. Another article which describes the interface design principles of ticketing machine that how it can be made better to operate and use, written by Sandnes, Jian, Huang and Yueh (2010). According to an article by Slack and Rowley (2002),...
that illustrates the importance of kiosks, which are mainly focused on the users’ interest. In this article different type of kiosks are described along with their working.

We didn’t find any articles or related literature which is specifically focused on kiosk machine or ticketing machine for visually impaired or blind people. We can’t say anything about how much work is done previously in our subject area. Therefore we decided that it will be better to study and examine related articles and find out the new idea for the interaction of the visually impaired users.

3.5 System Development

System development is the process that applies to information system development projects confirming that all functional, users’ requirements, agency strategic goals and objectives are met. The system development process is used to lead the analysis, design, development, and maintenance of information systems. (Kal Toth, 1998) There are many types of System Development Methodologies. A system development methodology is used to structure, plan, and control the method of development of an information system. There are different types of methodologies that have evolved with the passage of time, every methodology has its own pros and cons. It is not necessary that any single system development methodology suits all types of the projects. There are many types of the methodology available, which suit the different types of projects, depending on the required technical, organizational, project and team considerations (CMS, 2008).

3.5.1 System Development Methodologies

There are many acceptable system development methodologies defined by CMS for the system development such as

- Waterfall Method
- Prototyping Method
- Incremental Method
- Spiral Method
- Rapid Application Development (RAD)

In the Waterfall Method the project is separated into different ordered phases, with few overlaps and splash backs between phases. In Prototyping Method the project is done by breaking into small parts and provides ease-of-change in the process of development. Incremental Method is done by the increments and all the requirements are defined before moving forward to evolutionary development of individual increment of the system. Spiral Method consists of cycles, every cycle is progressed through the sequence of the steps which are same, the product is evaluated and elaborated through the series of these same steps. In Rapid Application Development (RAD) the idea is the development of the quality system at a fast speed with low overall cost in compare to other methods. (CMS, 2008)
Regarding to our research, the system development methodology which best suits us can be the prototype method. The prototyping would be appropriate because it is not an individual development method and the risk of failure or not working is reduced by breaking the project into small segments and the users (which are very important in this case) are involved in the whole project in the requirement or testing of the prototype. The greatest strength of the prototyping is that it deals with the deficiency of different users to specify their requirements. It also provides the system at the earliest possible time to the users for experimental evaluation. (Janson and Smith, 1985) We assume that the handicaps users have the inability to specify their information needs and might not have the complete idea of the environment around. A schematic representation of prototyping is given below

![Prototype Model](image)

**Figure 4: Prototype Model (Janson and Smith, 1985)**

### 3.5.2 Interactive Kiosk System

Interactive kiosks are also called as “self service kiosks”. Information technology plays a vital role for the general public, the consumers can handle their own affairs without interaction or help from another person. If a person can solve different matters by himself/herself then no one requires help from another person. A self service system is such an interface that allows the users to solve problems and routine works on their own. It can save time, money or both and provide 24 hours services. Self-service machines are basically computer systems, which can provide or performed specific tasks and provide particular information.
A kiosk system is defined as a “…computer-based information system in a publicly accessible place, offering access to information or transactions for an anonymous and constantly varying group of users, with typically short dialogue times and a simple user interface” (Borchers, Deussen, Knorzer, 1995, page 1). They further added that the outcome of such systems relies mostly on the attractiveness of their user interface, how simply they allow access to information and how visibly they show the information. Most of the time the kiosk systems are used by the inexpert users that is why it is not possible to define design principles which always works (Borchers, Deussen, Knorzer, 1995). The purpose of such systems is to provide services or information to the type of users for which they are designed. The type, signage, location, and outer appearance of a kiosk system need to be considered carefully so that the customer accepts it as a permanent apparatus for information, communication and transactions (Kollmann, Häsel, 2006).

We can see these kind of systems around at the places with large amount of people for example cinemas, central station, markets, shopping areas etc., depends on their purpose for which they are served for example cash deposit or withdrawal, buy a ticket for travel, scanning etc. In our research of the booking system for the visually impaired people, who might not be experienced computer or system users because of their disability. It is crucial that the interface of the system must be transparent and actionable for the users. (Kollmann, Häsel, 2006)

### 3.6 Artificial Intelligence

“Artificial intelligence, also known as man-made intelligence, it is a branch of science and engineering which is used to study and design intelligent machines, and in particular the intelligent computer programs”. (Jane Marshall, 2010)

According to Liu Xian, (2010) AI (Artificial Intelligence, called AI) is the study of understanding and simulation of human intelligence. The main work is to present a theory, and then design computer systems which act as humans. Artificial intelligence is the potential of machines to behave in human intelligence-related manner in performing things like judgments, reasoning, proofs, identification, perception, understanding, communication, design, thinking, learning, problem solving and other thoughtful activities. Artificial intelligence is a very important aspect according to our research because its use in ticketing machine can simplify the process of ticketing for the handicapped users especially visually impaired users. The attribute of AI which can be used for interaction is the voice recognition where the system understands the voice of users and reply accordingly. (Liu Xian, 2010)

**Applications of AI**

There are many applications of the Artificial Intelligence in many fields like logistics, robotics, speech recognition, control systems, facial recognition, scheduling and data mining etc., amongst which the field of speech recognition is very important and can answer one of our research question. The involvement of AI as speech recognition can help the visually impaired persons to interact with the system to book the tickets. (Jane Marshall, 2010)
AI derived from numerous fields like operations research, control theory, philosophy, neuroscience, computer science, cognitive science, psychology, linguistics, logic, optimization, economics and probability. (Jane Marshall, 2010)

AI is used in many areas:

- **Playing Games** – Computers can play games very well against the (human) users because of artificial intelligence, it can even defeat world champions. For example, the chess machine can assess 200 million positions per second and can beat its opponent because of AI. (Jane Marshall, 2010)

- **Speech Recognition** – Speech recognition is also very important aspect of AI, it has limited use in normal life, but it is very useful you can find it in many machines like computers and laptops. It can replace your keyboard and mouse with voice recognition. Most of people give preference to use keyboard and mouse instead of speech recognition but if the user is disable or handicap then this thing is of great usage and importance. (Jane Marshall, 2010)

- **Understanding Natural Language** – Another thing which is possible in the AI field is the understanding of natural language. You can talk and give commands to machines or robots. In the past this thing was only possible in a limited area but the situation is changing now and lots of things can be done. In future it will be possible that machines can understand different commands and more languages. (Jane Marshall, 2010)

- **Computer Vision** - It is also an effort of AI like human beings to copy 3 dimension (3D) images and information from the world and process it. At present this ability is also limited. (Jane Marshall, 2010)

- **Expert systems** –It is the knowledge of Artificial Intelligence that is used to develop expert systems in specific fields, which is then installed in machines and computers to carry out the specific tasks like airplane auto pilot. (Jane Marshall, 2010)

### 3.7 User-Centered Design

The term User-Centered Design and Usability Engineering are very close to each other. User-Centered Design (UCD) is a design approach depends on the active participation of users for a clear understanding of the requirements of tasks and users along with the iteration of design and evaluation. (Mao, Vredenburg, Smith, Carey, 2005). User-centered design are also called as Pervasive Usability this term is used by Suneet Kheterpal (2003, page 1), she defines “Pervasive
usability advocates the application of methods to evaluate a design’s usability at every stage of the design process, keeping in mind the goals of the project and the users' needs.” User-centered design basically focuses on the users throughout the entire process from planning for the manufacturing of the product. It is on the user's mind what he or she desired to design. The user requirements help to design of the interface, on the other hand the requirements of the user interface override the design of the system. We can say that the user-centered design is the design process which includes requirements, needs and the limitations of the users about a specified technology. The designers analyze that how the users will use the system to track the strength and confirmation of the things that the designer assumes as the user’s mode of action with that system (Suneet Kheterpal, 2003, page 1). The difference between the user-centered design and other type of design is defined in Wikipedia (2010) as the user-centered design tries to achieve the efficiency of the product around the users rather than pushing the users to change their own behavior to adapt the product.

In our research the design principles for booking or purchasing a ticket for the visually impaired people will be based on the User-Centered Design. We know that the ticketing machine is a type of information system that provides booking and purchasing of travel tickets. The design of the machine should be user-centered.

It is very important that an information system should be developed around the requirements of users. If the users are not included in the design process of any information system, then the information system is likely to be unsuccessful. Such a system will leave the users frustrated and possibly unable to achieve their goals. (Jonathan Lazar, 2001)

It is important that the information system such as self service kiosk like ticketing machine systems for the visually impaired needs to be designed around the requirements of the users. For designing of other type of information system for normal people this thing is equally important but when any person with the handicapped disability involved, it needs more users’ involvement. It is most likely that the system design would be failed without users’ involvement as it would be unable for the users to achieve what they desire.

When a user-centered design is developed, so often it goes through four different activities, these tasks are shown on the model below.

A user-centered design often goes through five different phases, these phases are (Emi Yano, 2007)

1. User survey
2. Analysis of user requirement
3. Prototype
4. Assessment of usability
5. Design revision on the feedback received

These design phases are shown in the figure below
Below is the list of activities shown in the above model:

1) **User surveys**

User surveys contain the gathering of the type of users who will use the system. User surveys are a source to sort out, how the machine or system is used by a specific set of users. The information or data which user surveys provide must be appropriate to the problems that are worthy to the designers. The internet helps a lot now days for gathering information for user surveys. Before the user surveys, we should keep in mind two questions which are stated below, and they are the backbones for the surveys. (Emi Yano, 2007)

   - What sort of people are the users of the system?
   - How the users will use the system?

2) **Analysis of user requirements**
Analysis of the requirements of the users is the method of understanding the user’s requirements and deeply studying them. The requirements tell us how the system acts or how the system’s description or attributes should be.

Analysis of the user requirements includes the questions that are

- What kind of information and functions do the users of system require?
- Identify the requirements and the goals that are required to be met for the successfulness of the system. (Emi Yano, 2007)

3) Prototype

If new designs are implemented without prototyping, it could cause unexpected problems. In this activity the prototype of the design after the user surveys and the analysis of user requirements is created. The type of the prototyping called as “Proof-of-Principle Prototype” can be used for prototyping, to validate or test some aspect of the intended design. The prototypes are used to show the theory at the back of the concept is capable of achieving the particular (assumed) results. There is a possibility that the prototype might even not work at all or work to a very low extent, but that is useful just to show that whether it has potential to create or not. (Wikipedia, 2010)

Types of prototyping:

The prototyping has many versions. There are four basic prototypes, but all of them in some aspect based on two main prototyping types: Throwaway prototyping and Evolutionary prototyping. Each is explained below:

a) Throwaway prototyping:

This type of prototyping is used at early stage to build models for different parts of the system, after short early research. This prototype can be developed easily and quickly. This type of prototype is built with the approach that consists of the initial requirements, needs of users, and how to design the prototypes. On the basis of previous experiences of users the developers sort-out new requirements. If they are according to user needs, then they are finalized to build the real products that customer needs in the market. (Wikipedia, 2009)

b) Evolutionary prototyping

The main theme of using evolutionary prototype is to create an efficient prototype in its structural manner and then constantly refining it with time. In this prototype type, we have the opportunity to continuously polish and reconstruct what we are doing. (Wikipedia, 2009)

c) Incremental prototyping
In this stage of prototyping, the end product is generated as split prototypes. In the end all the prototypes are integrated into an overall design. It is like building a block or brick for a house. In every increment new component is added, depending on overall design solution. The advantage is that the customer can test the functionality of product and provides feedback. (Wikipedia, 2009)

d) Extreme prototyping

This kind of prototype is used to improve the overall techniques or methods and build web applications (system development) on advance level. At this level we breakdown the web development activities into three different stages, where every stage depends on its previous stage. The initial stage is called static prototyping which contains mainly HTML pages, the second phase consists of programming of screens simulations, in the third phase these simulations are implemented. (Wikipedia, 2009)

4) Assessment of usability

In assessment of the usability the users are provided by the prototype(s) for assessment. The usability of the prototype can be assessed with the help of the following two features

- Heuristic evaluation
- User tests

A heuristic evaluation is used to recognize the usability problems in the prototyping. It is evaluated that the prototype has met the usability principles or not; which were set by the designer in earlier stages. The results of the heuristic evaluation help in the improvement of the design. (Emi Yano, 2007)

In user tests, the usability of the prototype is assessed by testing it on users and to test the prototypes meeting the required purpose. In user tests, the things like effectiveness, efficiency and satisfaction are evaluated from the user tests, which may contain the questions like can the user achieved the goal? How much the prototype is efficient? And how was the experience of user with prototype? (Emi Yano, 2007)

5) Getting feedback from users

Assessment of usability is used to get feedback from users about the system. This includes the users to perform a task with prototype and get the feedback from users. This can be done with several different tasks and getting the feedback for each task, then the design is revised according to the user feedback. In simple words it is the response of what the designer has created. After testing and analysis of prototypes the users comment on it about, where there are shortfalls in it, and how it can be improved. The feedback is of great importance to make any project successful. (Emi Yano, 2007)

3.7.1 Usability Engineering
The usability engineering is defined as “…. A process whereby the usability of a product is specified quantitatively and in advance. Then as the product itself, or by early ‘base levels’ or prototype of the product are built, it is demonstrated that they do indeed reach the planned levels of usability” (Xristine Faulkner, 2000, Page 10).

According to Jakob Nielsen (1998, page 1) simple user-centered behavior forms the origin of the usability engineering. The user activity contains the questions like, who will use the current project? Have you talked with such a user? Have you visited the users’ work environment and observed their tasks? How they approach these tasks? And what practical situations they have to cope with? He further provides (page 10) the basic reason for the existence of usability engineering is that it is not possible to design best interface design with the help of best interface designers. Users have unlimited potential for making unexpected misunderstanding of the interface in many ways than the designers imagine. The design will be much improved if the designers work on the concerns of the users and their tasks. (Jakob Nielsen, 1998)

Xristine Faulkner (2000, page 2) says that the usability engineering can be viewed as a straight reply to the failure of developers to produce truly effective and usable systems. Usability engineering is used to sort out the problems and making sure that the intentions of the design of system is to work for desired goals. This is done by the process of exploring stuff like, what will make an adequate system for the users, and finally comparing the final artifact against those previously determined criteria for approval of the system. Usability engineering tries to address practical rather than theoretical things. (Xristine Faulkner, 2000)

The main aim of the usability engineering is that the design of any system is centered on the users. If the users and their requirements are not considered or consulted, it is quite obvious that the system would fail. In our research, the principles of the usability engineering could be considered to make the system much intelligent so that the system may recognize the users and perform tasks according to the users’ needs. The design should be user-centered i.e. by keeping the visually impaired people in front, according to their requirements and by keeping in mind the constraints of their movability and workability. If the end users are not consulted, the system at the end might not be able to deliver what it was designed for.

In order to understand the usability engineering more visibly, the usability engineering life cycle is helpful. The Usability Engineering Lifecycle is shown in a figure below (Faulkner, 2000)
<table>
<thead>
<tr>
<th>Task</th>
<th>Information Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Know the user</td>
<td>□ User characteristics</td>
</tr>
<tr>
<td></td>
<td>□ User background</td>
</tr>
<tr>
<td>Know the task</td>
<td>□ User’s current task</td>
</tr>
<tr>
<td></td>
<td>□ Task analysis</td>
</tr>
<tr>
<td>User requirement capture</td>
<td>□ User requirements</td>
</tr>
<tr>
<td>Setting usable goals</td>
<td>□ Usability specification</td>
</tr>
<tr>
<td>Design process</td>
<td>□ Design</td>
</tr>
<tr>
<td>Apply guidelines, heuristics</td>
<td>□ Feedback for design</td>
</tr>
<tr>
<td>Prototyping</td>
<td>□ Prototype for user testing</td>
</tr>
<tr>
<td>Evaluation with users</td>
<td>□ Feedback for redesign</td>
</tr>
<tr>
<td>Redesign and evaluate with users</td>
<td>□ Finished product</td>
</tr>
<tr>
<td>Evaluate with users and report</td>
<td>□ Feedback on product for future system</td>
</tr>
</tbody>
</table>

Table 3: The Usability Engineering Lifecycle Model (Xristine Faulkner, 2000, Page 15)

### 3.8 Human Computer Interaction

The human computer interaction (HCI) is defined as, the knowledge of the interaction between the humans and the computers (Paul A. Booth, 1989). He further adds (page 4) the term “Human Computer Interaction” is generally used interchangeably with names like “Man Machine Interaction” (MMI), “Computer and Human Interaction” (CHI) and “Human Machine Interaction” (HMI). If you have user friendly interface you can easily interact with computers or machines. In HCI, it is the user who follows the computer or machine. The human sets the parameters for the interaction between the users and computers. The Interaction between users and machine is through user interface that can be at software level as well as at hardware level, so we should be very careful while designing the interface (Paul A. Booth, 1989). In our research the interaction will be the human machine interaction, where the visually impaired users will interact with the machine. The machine is a type of computer that is why we can say that the interactions will the human computer interaction.

Here we approach the failure modes that people with disabilities sometime encounters in attempts to use inaccessible human-computer interfaces. (Gilman, Vanderheiden, Zimmermann, 2003)
The figure above describes the interaction between the human and the computer, which starts from the input which is provided by the user through some interface. The computer performs some computation processing on that input and provides some output though the display and present to the users. The user then perceives that output and cognitively recognize it, and at the end the user actually recall what actually happened.

Information technology is basically used by people for usability viewpoint. If the interface of system is not user friendly and flexible then it means it can’t achieve its goal therefore it is useless. The IT systems are used to serve humanity by helping in completing their different type of daily simple and complex works. It is essential that human computer interaction should be useful, flexible, actionable, efficient and user friendly

According to Hayes-Roth and Amor (2003, page 75) in past the interface design was used to be a machine centered, so if user failed to complete a task, it was users’ fault not the machines’ fault. Now the attitude has changed and we have established a user-directed attitude i.e. designing for the user not for the machine. During the process of developing the prototype, we will keep this thing in mind that the process of designing is centered on the users. The thing which is very important to consider in human computer interaction is that the interface which is poorly designed might output some unwanted and unexpected results and may cause the customers or users (visually impaired persons) financial or time losses. For example, if a visually impaired
user want to book or purchase a ticket from Boras to Gothenburg, and if the interface of the machine is not designed according to the needs and requirements for the users. There is a possibility that he/she might get the ticket to the wrong destination or of wrong origin of traveling. These kinds of mistakes might be caused by poorly designed human machine interface. A small mistake from the visually impaired user could lead to big issues.

### 3.8.1 Usability

The International Organization of Standardization (ISO) defines usability as “.... The effectiveness, efficiency and satisfaction with which specified users can achieve goals in particular environment” (Xristine Faulkner, 2000). He further says (page 8) that in some ways, the usability builds on the older idea of user friendliness. According to Dumas and Redish, (1999, page 5) usability means that the people can complete their tasks quickly and easily while using a product.

Pär J. Agerfalk (page 116) describes the citations (above) as the first citation, effectiveness suggest that specific goals are to be achieved with accuracy and completeness. Effectiveness can be understood as the level to which a system does what it is assumed to do. The second citation efficiency, suggest that the expenditure of resources when achieving the objective should be reduced. The satisfaction citation tells that, the users should have idealistic approach to the use of the system, and feel safe and relax while using it. in this way the satisfaction is the concept of ease of use, user satisfaction, and usefulness. Finally the specific context of use includes users, tasks, equipment, and the physical environment. (Pär J. Agerfalk)

In addition to narrow obedience and common human decency, there are hard-nosed business grounds to make web design (information system design) available for the users with disabilities. Mostly, the disabled users can become mature to be regular users once they find their special requirements. Designing accessible information systems for these types of people can make a good business sense of the companies. (Jakob Nielsen, 2000)

Nielsen further says (page 298) that the concept of usability needs to be defined in a broad way. There is a difference in the types of information which is online or in printed form. Online information gives many advantages in comparison with the printed information. It is easy for the people with poor eyesight to amplify in the size of the font, and text-to-speech communication for the visually impaired and blind users works well for the text that is available on the internet (online) than the printed stuff. (Jakob Nielsen, 2000)

Nielsen (page 302) talked about the accessibility problems of the blind or visually impaired people, because most web pages (information system interfaces) are very visual i.e. they have many types of foreground and background colors. These colors sometimes make the display unreadable for the color blind users. It is important to ensure that the high contrast is used between the foreground and background colors. (Jakob Nielsen, 2000)

The idea behind a ticket vending machine is to develop a design for the system that is usable for the visually impaired users. The focus of the system must be on the people with visual impairment disabilities and the system should help these people to complete the task according to their requirements.
The system should be designed to assist the users to reach their goals and possible problems related to the specific needs of the users should be minimized. “We should regard usability as one more quality attribute for consideration during software construction. Of course, we shouldn’t concentrate on just a single quality attribute when designing systems: combining software characteristics poses the real challenge.” (Juristo, Windl, Constantine, 2003, page 1-2).

According to Faulkner (2000, page 1) the major difficulty that the designers of the information systems face during the development of a system is ensuring that the final artifact is what the user really required. In our research we also need to ensure that the system we would design could be usable for the users. We must need to understand the requirements of the users. The quality of the design depends on the designer’s understanding of the user requirements. The usability is required to find the answer to the question like, is the product or system is usable when produced? If the system does not work according to user requirements then it can be said that the usability of the product was poor. (Faulkner, 2000)

In usability there is a very important factor called “User”. The usability depends on the users and the users in our case would be the visually impaired persons. For this we need to design such a friendly interface which is easy for the users to understand and achieve the required goals. The interface will be more friendly and effective if unnecessary cognitive load is removed.

As said earlier that the usability build on the older idea of user friendliness. The factor of user friendliness is compulsory to consider while designing interface of a system for the visually impaired people. The user friendliness or usability are basically consist of the two things which are

- **Input**
- **Output**

The *input* allow users to enter some input to the system, the people with visual impairment can input some information from keyboard (special keyboard for visually impaired persons) or through voice to interact with the system in order to input data into the system.

The *Output* allows the user to get output after the input and some processing by ticketing machine. This output can be some information on the screen or the information in the form of voice or a printed ticket.

### 3.8.2 Actability

Actability is defined as: “an information system’s ability to perform actions, to permit, promote and facilitate the performance of actions by users, both through the system and based on information from the system, in some business context” (Agerfalk, 2003, page 1).

#### 1. Actability Features of Information System

In order for an information system to be regarded as actable during an interactive usage situation it should be able to help (permit, promote and facilitate) an interacting performer to:
a) Choose what communicative action to perform.
b) Formulate the propositional content of the action and attach it to an understandable and appropriate action mode.
c) Execute the communicative action.
d) Interpret and evaluate the action and its business effect(s).

(Goldkhul, Agerfalk, 2002, page 17)

The ability of the information system should be helping by permitting and facilitating the interpreter to accept sufficient bases to go through the planned actions. The purpose of the information systems should be to help the users to be convinced to carry out what the user desires and the final information reaches the intended interpreter(s). (Goldkhul, Agerfalk, 2002, page 17)

According to our research the actability features of information system may be followed to answer the research question like how the booking system could be more available for the handicap people. This could be achieved by choosing what communicative action to perform, formulate the propositional content of the action and attach it to an understandable and appropriate action mode and execute the communicative action. (Goldkhul, Agerfalk, 2002)

2. Usability vs. Actability

The purpose of an information system from a usability perspective is to achieve particular goals, whereas actability focuses on accomplishments of actions. The usability is primarily centered on humans who actually interact with a computer system, while in actability, a user is anyone affected by the events performed by the system. The usability idea of ‘product’ is equal to the ‘IS’ idea of the actability. The actability puts more focus on the software components and lesser on ergonomic issues. (Agerfalk, Cronholm, 2001)

3.9 Interaction Design Principles

According to Strijbos, Kirschner and Martens (2004, page 235) to understand the definition of the interaction design more precisely we needs to separate these two terms ‘interaction’ and ‘design’. The interaction is a constant process of action and reaction between two parties whether humans or machines. The design is making sense (of things), then the interaction design is defined as the discipline devoted to define the actions of artifacts and the worth of communication services to its users, and the quality of the experiences they (users) have while using it. (Strijbos, Kirschner, 2004)
The Human Computer Interaction and User Interface Design are used to increase the efficiency, effectiveness and adaptation of the interaction between the users and the computer by representing, understanding and implementing models. (Yusof, Amin, Zainudin, Baker, 2004, page 1). The purpose behind the human computer interaction is creating a relation between the human and the artifact.

For the improvement of usability of a system, it is important to have a rightly designed interface and these "Eight Golden Rules of Interface Design" are said to be a good guide of interaction design. (Shneiderman, Plaisant, 2005). The golden rules of interface design are as follows from table:

<table>
<thead>
<tr>
<th>Ben Shneiderman's Eight Golden Rules of Interface Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strive for consistency</td>
</tr>
<tr>
<td>2. Enable frequent users to use shortcuts</td>
</tr>
<tr>
<td>3. Offer informative feedback</td>
</tr>
<tr>
<td>4. Design dialog to yield closure</td>
</tr>
<tr>
<td>5. Offer simple error handling</td>
</tr>
<tr>
<td>6. Permit easy reversal of actions</td>
</tr>
<tr>
<td>7. Support internal focus of control</td>
</tr>
<tr>
<td>8. Reduce short-term memory load</td>
</tr>
</tbody>
</table>

*Table 4: Eight Golden Rules of Interface Design (Schneiderman)*
During the interface design phase we will try to consider these golden rules, when we will be designing the prototype. We might face some difficulties while designing, when we will follow these rules, because all these rules are for the normal users. In our research the users would be the visually impaired people but we will try our best to follow these rules because in our opinion these rules are evaluated after a long time.

For the achievement of all the points that are discussed above (theoretical points) there are some interaction design principles which could be followed, if these design principles are properly followed they will help to reach the requirements of users. For designers, these kinds of systems are a challenge to design for effective usage.

There are guidelines presented by M. C. Maguire (1999) in an article “A Review of User-Interface Design Guidelines for Public Information Kiosk Systems”. These guidelines are very nicely described, but the problem in these guidelines is that they may not work properly for the handicapped interacting with interactive kiosk systems. More things needs to be considered while designing such interactive systems for handicapped and specifically for the visually impaired users. To overcome this issue we will use Web Content Accessibility Guidelines (WCAG) 2.0 presented by Caldwell and Cooper (W3C, 2008), these guidelines provides a broad scope of recommendations for development of more accessible web content (visual). If these guidelines are followed properly they can help for the better accessibility for a broad range of people with handicap disabilities, including blindness and low vision, deafness and hearing loss, learning disabilities, cognitive limitations, limited movement, speech disabilities, photosensitivity and combinations of these. (Caldwell, Cooper Reid, Vanderheiden, 2008) We will try to combine these two guidelines because our research demands this from us and to come up with a prototype that works for visually impaired persons.

3.10 Design Principles

The design principles that was proposed by Julie A Jacko (2007) for the ATM design for the elderly people (page 7), these design principles may be considered to work for the visually impairment people. The design is based on the simplicity and helpfulness, which are as follow

A. **Just one operation requires at one screen**
   The user can perform the actions in a step by step manner by only one option at one screen, and for the visually impaired people this is very important that this manner is followed to make things easy. (Julie A Jacko, 2007)

B. **The screen switch must be noticed**
   The switching from one screen (step) to the next screen (step) must be notified to the user so that the user can know that they are moving to next step and prepares for the next step. (Julie A Jacko, 2007)

C. **The operation flow must be comprehensible**
   The flow of operations must be comprehensible for input and the output, so that the user can use the system with confidence and confirmation. (Julie A Jacko, 2007)
D. The screen information must be easy to read (sufficient font size and contrast)
   The information on the screen must be easy to read for the user with the help of sufficient
   font size and color contrast. Other methods could be used to convey this information to
   the user by voice or announcement. (Julie A Jacko, 2007)

E. Screen information must be simple as possible
   Screen information must be kept as simple as possible for the users by simple text. (Julie
   A Jacko, 2007)

F. The same content as announced must be displayed on the screen
   The information which is displayed on screen must be announced by voice. (Julie A
   Jacko, 2007)

G. The announcement must be done at the time just before changing to the next screen,
   and it must not repeat
   The timing of the announcement is very important it must be done just before changing to
   the next screen, and it must not repeat. (Julie A Jacko, 2007)

3.11 Guidelines for Public Information Kiosk

The guidelines for the design principles are as follows

Design Principles

It is essential to follow those principles which can help us to reach the needs of customers for the
ticketing machines. It is important to sort out the purpose of the machine. Who will use the
system? What are the user's goals? And what problems could occur in the future. It is important
to have a symbol which indicates that the ticketing machine exists here. (Maguire, 1999) Maguire
also says that there should a manifestation on the screen for what the machine will be used for
and how it will be used, and there must be an option to stop the demonstration at any time. It is
essential for users, to place the machine at the correct height for easy access of users. Especially
for those sitting on wheelchair and cannot stand, be able to come and get in touch with the
machine. The wheelchair can be easily rolled close to the screen and keyboard, so that users can
comfortably use the machine. According to the suggestion (Maguire, 1999, page 3) the maximum
height of the machine should be between 70 and 120 cm from the ground. To make it comfort for
a person with low vision, the area around the machine should be free from other equipment
within a radius of 1.5 meters. It is important to clearly show the users how to enter or take
payment card. Maguire suggests that a poster or a printed brochure is a great approach to show
users what system contains and to show some simple steps on how to use the system. If the ticket
machine will be used by foreign tourists or international users, it is important to have multiple
language options in the system. We will also consider these principles while designing prototypes
for the visually impaired users (Maguire, 1999)

a) Privacy
It is very important that when user input some data there should be security and privacy on the system. If there is lack of privacy in the system then the user will not feel friendly and confident in performing actions. If the user is sure about the data privacy then he/she will interact with the machine smoothly and in a friendly environment. The machine should be placed where the users should feel protected (Maguire, 1999).

tt) Help

It is important that there must be help option at each step for users, if a user feels hesitation at any step he/she can easily get it. By this way it will be called self service system without dependency or help of other persons. If users have a problem at any step then, the help option and further details should be transparent and simple in a way which is understandable. (Maguire, 1999)

c) Input

Different types of input devices are used for ticket machine system. The most general is keyboard, touch screen, oral speech recognition and trackball. (Maguire, 1999)

d) Output

According to Maguire (1999), text, images, language, icons, colors, graphics, voice and music should be according to some standards. The text should not be smaller than 16 points so that people with impaired vision have no problems to read. The text should be modest and the contrast between text and background should be high which can be easily differentiated. The text should not be colored, language should not be hard, technical terms should not be used. The colors should not be embellished, almost four to five colors should be used and they should preferably use in a convenient way, for example to distinguish between elements. The red and green colors should be avoided for the reason of color blindness. The graphics should be high quality but it should not contain a lot of colors.

According to Maguire (1999) if the machine is in an open atmosphere, where it is crowded the people will feel it difficult to communicate with the machine, it is feasible to use with a handset. It will be beneficial for people with impaired vision that can easily communicate with the receiver. There should be options for volume control. The structure, navigation and menus should be very clear so that the user knows where in the system he / she is, and where to go next. The user should always have an opportunity to go back to the home page.

e) Menu Selections

The menu selection is a very important aspect of machine, if someone does not understand it then, it is impossible to go further. The menu choices must be prominent and transparent, so that the user knows roughly what information or features are presented in it. If the system is inactive for a couple of minutes then it should be automatically positioned on the home page again, but it should happen in a proper way and after a specific time so that the user cannot be frustrated. (Maguire, 1999)

f) Customization

The interface should be able to be smoothly modified to users’ needs and skills. The machines should also be provided with the things that they can customize the interface on their own. (Maguire, 1999)
3.12 Shneiderman's Eight Golden Rules of Interface Design

"Eight Golden Rules of Interface Design" are claimed to lead to good interaction design. (Shneiderman, 2008)

I. Strive for consistency

A stable chain of events should be necessary in parallel situations; the similar terms should be used in menus, prompts and facilitate screens, and fixed commands should be engaged throughout. (Shneiderman, 2008)

II. Enable frequent users to use shortcuts

There should be some shortcuts for daily users so they can easily perform their specific task instead of using long regular procedures. Microsoft Word is one of the example in which you can use Ctrl +c and Ctrl +z to copy or undo any event. There should be a facility for users to save time. (Shneiderman, 2008)

III. Offer informative feedback

For every action to perform there should be some backup or indication from the machine, which indicates and give you options that you can go further to the next step. While for the final and sensitive actions related to bank transitions, there must be a text message on your screen or mail option that this action is performed successfully. There should be some record options for users to keep transactions save with them. (Shneiderman, 2008)

IV. Design dialog to yield closure

The easy information should be at the start, and informative information should be at the end. The system should be designed in such a way that the user should be mentally prepared for what information it will ask me in the next step, so the user is sure and satisfied with achievements. (Shneiderman, 2008)

V. Offer simple error handling

While designing a system, there should not be options of small errors, which are difficult for user to detect and handle. If there are some minor and serious errors then the system should be able to identify the bugs and provide simple and intelligent mechanisms for removing bugs. (Shneiderman, 2008)

VI. Permit easy reversal of actions
There must be easy and reliable option in the system design to remove and undo action without any hesitation. There must be saving option when user wants to go back and also the option to detect and sort out the steps that user performed wrongly. (Shneiderman, 2008)

VII. Support internal focus of control

Experienced users always wish that they should be in-charge of the system while using each action of it, instead of the system is in-charge of user and perform every action. The designing of the system should be in a sense to make the users starter of action instead of the responder of actions. (Shneiderman, 2008)

VIII. Reduce short-term memory load

The short term memory load of the users should also be reduced. The display of the system should be kept simple, window-motion frequency should be reduced, and enough time should be given to codes, mnemonics and sequences of actions. (Shneiderman, 2008)

3.13 Summary of Theoretical Findings

The essential figures which can take us to our goal to generate prototype of ticketing system for visually impaired people and to answer the research questions, consists of key concepts like design principle, booking systems or machine, system availability, users with handicaps, system intelligence, actability, user needs, usability and user interaction. The subject areas relevant to our research question contain areas like interaction design, system development, usability design, artificial intelligence, user-centered design, human computer interaction and interactive kiosk system. These key concepts and subject areas can help us to get our goal easily and answer our questions on the theoretical base. We should aware of; for what kind of users we are designing, or who will be beneficial of the system. We should keep the users in front. The system must be user-centered and the principles of human computer interaction must be considered. If we want to be victorious in our goal then we must be on proper track to make an excellent and friendly human computer interaction between the specific system and the users. The machine’s user interface should be more users friendly and intelligent, that have voice recognition facility in it, and there should be specific keyboard in the system for visually impaired users. The users with visual impairment disabilities may face many difficulties while using the public information kiosks like ticketing machine. These difficulties can be input, output, understanding the operation flow and switching from one step to next step etc., these difficulties can be minimized or removed by following the proper designing principles for the visually impaired people.

1. How much intelligence may be required so that the system may recognize the user and perform tasks according to the user needs?

This sub question can be answered by the key concepts like system intelligence, actability, user’s needs and usability. We have evaluated these concepts in detail and understand that if the visually impaired users need to interact with the system, the system
needs to be intelligent, otherwise it might not be possible because the only available communicative sense the users can have is voice. With the help of usability and actability the system can be made more usable and available to the users. For example an interactive artificial intelligent agent can be used in the system to interact with the visually impaired users through voice that can understand the users’ speech/voice, and could reply accordingly and intelligently to complete the goal.

2. **What kind of difficulties the handicap with visual impairment could face while using these machine and to an extent the solution of that difficulties?**

From research it is clear that there are many problems which blind or visually impaired people faces during performing their daily life events, because they can’t see perfectly as a normal human. There are many problems like using laptops, driving cars, handling kiosk machines, and many more. For all of this they need special care from normal people. It is only possible if scientists and researchers are going to invent any new machine, they should take care of people in the sense of how people with disabilities will handle the machine. There should be some special type of keyboard and voice recognition facility in it which can work for all types of users. The whole process for booking tickets should be efficient and flexible, so it will be easy for users to purchase tickets or complete a task. There should be options of making size of font large, zoom, help about every page and control the volume of the sound, so the user can easily adjust according to their requirements.

3. **How can the machine and user interact with each other?**

The question of how the machine and the user interact with each other is possible to answer by understanding the subject area of the human computer interaction and the concept of user interaction with the machine or the system. For the users who are not able to visualize the surroundings the study of the principles of interaction between the user and the machine becomes more important. The interaction should be made flexible and smooth, by the help of exploration of the user requirement and their constraints in using different kind of systems. The human computer interaction may consist of three main steps i.e. input, processing and output. The input from the user can be given to the machine by voice and keyboard, the processing can be done step by step through voice (or without voice) between the user and the machine, and the output will be the ticket, schedule or whatever the user required.

3.14 **Arguments for an Empirical Study**

Since very little has been published on information kiosks in any forum, it has been necessary to develop a common framework to analyze (Slack, Rowley, 2002, page 70). Till now the situation almost the same, as it is said earlier that this kind of work is not done specifically for the visually impaired people before, hence it is not necessary that the theoretical study answers our research questions completely. There are many questions that have not yet been answered in the theory for example does a visually impaired person used ticketing machine or such kind of system? If yes how? How they perceive the ticketing system? There are many questions that need to be
answered which cannot be answered by the theoretical study. We can only get the answers by interviews and observations from the actual users i.e. visually impaired people.
4  EMPIRICAL SURVEY

In this chapter the empirical survey is described, the empirical data is gathered through interviews and observations. We have chosen to perform the interviews from the visually impaired people, and normal people who are the users of the existing ticket machine system. The purpose of the empirical study is to examine, what an individual thinks about today's self-service systems and the ticket vending system. The aim is to find the problems from the individuals and then we can try to solve that. The purpose of the empirical study is to verify the aspects found in theoretical study.

4.1  Purpose

We illustrated the empirical study through interviews and observations. We collected all our related data through interviews from two different groups of people. As stated earlier, the empirical study that we have carried out in order to achieve our goals consists of interview questions and observations. The basic aim of the empirical study is to sort out what users think about today's self-service systems like ticketing machines. The purpose is to find out the problems which visually impaired user could face during the usage of ticketing machine, and to sort out the solution on the basis of interviews and observations. After completion of interviews and observations, we will be able to get a complete idea of the problem.

4.2  Sampling

The methods used in empirical study of our research are interviews and observations. The selection of the empirical objects is based on the type of information required by us from the type of informants. According to our research questions, we conclude that empirical objects can be the visually impaired people and normal people who regularly use ticket machines. The interviews were taken from visually impaired and normal people. The people observed were the visually impaired people because they are the core part of the research.

For empirical survey we have selected two types of informants, first the visually impaired people, and secondly we decided to conduct the interviews from normal people. The reason for selecting normal people is that most of the time we didn’t get cooperation of visually impaired people. Most of time, the disabled people might feel embarrassment to ask them questions related to their deficiency. There were fewer chances to conduct interviews from a big number of visually impaired people, and then we decided to take interviews from normal people also who use these types of machines regularly. We thought that the regular machine users could indicate the deficiencies in existing machine which could occur for visually impaired users.

In chapter2 we described the criteria for the selection of sources of the interviews and the person to be observed will be the amount and type of information required for the empirical study. According to our research questions the handicaps with visual impairment are the most important actors. We have chosen visually impaired persons for interviews and observations, to get the knowledge, idea or feeling about the system like ticketing machines, and how the machine could
be molded so that they can use it without any external help. They can provide the ideas that we cannot find in books or articles. They could describe the difficulties, problems and the tools which could work for them or not. At the end when we will develop prototypes we can test that prototype and evaluates the results, and make the required changes, hence reaching a final product.

The reason for the selecting of the normal humans for the interviews is to get the feeling and idea of, what they think about any proposal that could work for the visually impaired persons, and how they think that the current machine could be made usable for the visually impaired persons. The regular users of the machine could give us better ideas, because they use the machine more often and can point out any specific point about the interface of machine, which is still hidden from us.

The first and very important empirical object is informants of interviews, who are the people with visual impairment problems because these people are the core part of our research question. It is very important that these people actually come into our research. The information which these people could provide would not be available in theoretical study.

The second empirical object for the interviews is the normal people who uses ticket vending machines regularly, because they could have observed the machine more often than those who use ticket machine less regularly. The purpose of the interviews with the normal people is to elaborate their opinion of; what they think of such machine and how the machine could be made more available to the visually impaired people.

As we discussed in chapter 2 that we will, conduct the observations and the interviews. The observations will be performed at the same time when we will be conducting interviews with the visually impairment people about the usage and requirements of the ticketing system. We believe that we would not be able to conduct the observations separately from interviews, because it is difficult to find visually impaired people quite often. We will concentrate on both observations as well as interviews at the time of interviews.

4.3 The Interviews

The purpose of the interviews from the normal people is to explore the research questions more, and to find out what a normal user think of the ticketing machine. How they think that the interface of ticketing machine could be made usable for the people with visual impairment problems? The preparation of the interviews started with the readiness of the interview questions. The questions include their previous experiences and the knowledge of the ticketing machine usage and their suggestion for the improvement of the interface of machine for the visually impaired people. For conduction of the interviews, we decided to go central station of Boras and at the University of Boras. In Boras Central Station we have tried to interview any person who just purchased a ticket from the ticket machine. The other place we have chosen is the University of Boras, because the students belongs to different cities and countries, this could help us in getting greater views of the people from the countries other than Sweden. The questions were tested by making sure that these questions provide the answers of our research questions. We also made changes in the interview questions with the help of our supervisor before giving them a
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final form. The introduction about the interview was given to the respondents by a brief explanation of the research topic, research questions, and our intention about the research. We started by asking people if they could help us by giving some time and answering some questions if they replied with yes, we started the interview, and if they replied negatively we moved to search some other person for the interview. The first part of interview questions consists of general question like name, age and questions about the general public information kiosks. The other part of the interview as described earlier based on the knowledge and experience of the machine usage and to get suggestions from the interviewee about the machine to be usable for the visually impaired persons. The documentation of the interview answers was done on the blank paper. The numbers of the questions were only written on the blank paper, so that we wrote the answer against each question number during the interviews. If one of us asked the questions, while the other recorded the answers on paper. If any interviewee didn’t want to answer any question we left the space of that question. We used our own self-made short language to write answers of the questions to save time. When we were finished with all the interviews that we required, it was not so difficult to put material together after the interviews, because the answers of the interview questions were taken in the orderly manner i.e. the answer to each question is written against its number.

For interviews with visually impaired people, first of all we discussed our thesis with different friends and request them for help to conduct interviews with few visually impaired people. One of our friend requested the in-charge of an old house in Vaglangdsgatan 53, Boras and tried to conduct some interviews from the visually impaired persons. She agreed, we met her and discussed our problem, then she contacted with two visually impaired persons for the interviews, but both of them refused. Then she gave us address of Eye Center Boras, Elenasgatan, where only visually impaired and blind people spends their most of time. Then we went there and discussed our problem with a responsible person, she gave us one week for feedback after that she called us for interviews. Then we filled our tested interview questions from our supervisor to make sure that these questions can answer all the research questions. We interviewed three persons in Eye Center Boras, who were not totally blind and were able to see at certain extent. An employee of Eye Center acted as translator.

4.4 The First Interview

We did our first interview from approximately 47 year old male. He was affected by shortsightedness. He was little familiar with computers and according to him he could use the interactive kiosk systems up to some extent. He knew about the SJ ticket reservation machine but because of the shortsightedness, he never used that machine. According to him, if the visibility issues are solved then he would be able purchase the ticket without any problem. In current situation of the usage of interactive kiosks like an ATM machine, he said that it was too difficult and annoying for him to use current kiosk machines. He always required help from others and it was not secure because sometimes he needed to expose his pin code. According to his suggestion when we asked him about the keyboard, colors and touch buttons, he said that the keys of the keyboard should be in Braille style, so it would be easy for him to feel through sense of touch and recognize the alphabets. When we asked him about the information on display screen, then he told us that text should be prominent and less combination of colors should be used, so it should
be easy to differentiate different things on the screen. He also added that there should options for the voice, it will be very good and helpful if there will be voice communication between users and machine.

4.5 The Second Interview

Our second interview was very good. We got and learned a lot of information required to validate our work. This interviewee was a young one and he was also a male. He was familiar with computers as well as through different general public information kiosk machines. He explained that he knew the ATM machines well. About the ticketing machine he said, these machines help people to reserve seats or buy tickets of bus or train for travel. He told us that kiosk machine are designed for normal people, it’s difficult for people like him to handle. The touch buttons and interface should be in such a way that there is the sense of touch and completeness in doing every task like generation of sound when there is click on the screen. He told us that he also travelled by bus and trains, but most of time another person bought ticket for him. He told us that first of all there should be voice option on the machine, to which they can talk and give or receive commands, and there should be options for zooming the contents of screen. He criticized the available display, text and colors of information display screen of current kiosk machines, because it needed lot of unnecessary concentration. He further said that text and color of the screen of interface should be black and white, the text should be larger than normal. There should help option if someone's find any problem then he/she could get help easily.

4.6 The Third Interview

The third interviewee was a female with the age of over 30 and her eyesight was better than previous interviewees others. When we asked her about kiosk machine experiences, she told us that she knew it and also used it, but it was bit difficult for her to perform or complete the required task. She added that she didn’t require the help of another person, but she said that it will create many problems if other visually impaired user will use it. She further said that I personally sometime cannot see the text very well and also the combination of colors confused me, it also creates stress on my eyes. We asked her how it could be made better for visually impaired people, then she suggested that there should be zooming options in menu from where average text size could be increased according to our requirements. There should be color option for color blind people like simple black and white along with special keyboard in which alphabetic structure should be in Braille structure. Most of all there should be voice recognition option and options to control the volume according to requirements. Moreover, there should be help at each stage. She also suggested that it will be the ideal system if the machine at the start asks the level of expertise of using a machine from users. Then machine adjusts itself according to the user's expertise, needs, level and requirement of visually impaired users.

4.7 The Fourth Interview

The fourth interview was taken at the Boras Central station from a normal person. Who had just finished the process of purchasing a ticket for the travel from the ticket vending machine. The interviewee was male and has the age of around 30. He was a regular traveler from Boras to Gothenburg for his job and often bought tickets from the machine. He knew the general public
information system very well and did not find any problem in using the ticket machine or other information kiosks. He expressed that the language of the ticket machine consists of the easy words and there is no need of the help to continue the steps because the steps are simple. He said that the machine should have the zoom option so that the visually impaired could use the machine. The color choice should be very simple so that it should not create problems for the low vision people. He did not agree that the current machine can meet the requirements of the low vision persons. Because there was not any special facility in the machine for visually impaired users to complete the process of purchasing tickets except few red and green keys on the keyboard. He said that there should be a separate machine for the handicap users where they can use the machines separately, because they may require more time and space to do the job in rush situations. He said the things he pointed out should be in the machine to improve the interface for visually impaired people.

4.8 The Fifth Interview

The fifth interview was taken from a female also in the Boras Central Station, her age was also above 30. When she finished purchasing a ticket from the machine, we went to her and asked that we want to conduct a little interview, she agreed and we started the interview. She was a frequent traveler to other cities and she was also familiar with the ticket machine because of regular use. She said when she was using the machine for the first time, it was a bit difficult experience because she did not know how many steps to go. She said there was no such introduction about the machine how to use it either in the form of text, voice or in any other way, but the language and the wording used was simple to understand. She expressed that there was not any information present about the current page or step to have a better understanding for the new users. She said that the use of the colors, text and screen buttons should be more visible and bold, and additional information should be provided for every step. There should be zooming option at each step to make the machine usable for the visually impaired persons. She did not express anything about the color choice for the low vision people. She said that there is no need of a separate machine for the users with visual impairment because it would be very costly to make a separate platform for each type of user.

4.9 The Sixth Interview

The sixth interview was taken at the University of Boras from a male student whose age was 24. The student belongs to Ethiopia and he travels between Boras and Skoved for the study purposes. He said that he used public information kiosks but found difficulty of finding the English language especially in ATM machines. He used the ticket vending machine many times for purchasing tickets. He said that there must be an introduction of the machine usage at the start of the process. It will help the people from the other countries to understand the mechanism of steps involved. The language should be as simple as possible so a less literate person can also understand. He did not think that the people with visual impairment problems can buy tickets from the machines in the current situation because there are too many steps involved specially the schedule of the buses and trains might be difficult to see for them. He said that the steps of the ticket booking should be simple and less in number and only necessary steps should be included to facilitate the visually impaired persons. The color should be simple like black and white so that
the color blind users can use the interface without any color problem. He said that there is no need of any separate machine or separate platform for the visually impaired people because it will be too costly. The changes should be made in the current machine to make it usable for all types of users. The interface can be improved by voice recognition with the help of Artificial Intelligence and by use of some kind of tangible interfaces, so that the low vision users can use the interface with the help of voice as well. He added as there should be some involvement of the voice interaction that the visually impaired can interact with the machine. The keyboard should be different from the normal keyboard in a sense when the user pushes any key there should be some echo or sound (that key is pressed).

4.10 Observation procedure

According to our observation the most important factor is that, we thought that we will get enough time to observe the visually impaired or blind people. It was not in the real because most of the visually impaired or blind people were under observation all of the time in care centers. Due to which we required permission or an appointment to meet them and time for interviews as mentioned earlier. That is why, we prepared ourselves before the interview that we will have only this time to observe them and may not be given extra time for the observation. We decided to write some important points related to our research and we will observe them during interview. The things which we tried to observe are how they interact with a normal person, are they friendly, can they easily mix-up with normal people, can they easily understand us, what is the easiest way for them to communicate with us as well as with any electronic machine, which kind of knowledge or latest device most of the visually impaired people can understand and how they react to these questions.

At the time of interview as we said earlier that it was difficult for us to take interviews directly without the permission of the management of the Care Center. We were not aware of the time and occasion of the interviews that, when we will be called for the interviews. The responsible person gave us permission for the conduction of interviews. We always kept our mind active in parallel both for interviews and observations because the shortage of time. Mostly the things we observed in them were that they were not so social in the society and environment, and they were bit isolated from the normal routine works. We already mentioned that the visually impaired people were not much cooperative and was hesitating to face us. The reason for hesitation could be language problem or any other problem. But when they talk with us for few minutes they were becoming friendly with the passage of time. They were expressing things about themselves. The visually impaired people were very reluctant in disclosing their identity like name and occupation. One thing that we observed that they were hesitating and were not friendly, but with the passage of the time during the interviews, they were becoming more open in talking and sharing things. Their body language changed by the time as the interviews progressed.

We were not able to get the answers of all our observation question, but one thing that we observed in them and which was very pleasant and worthy for us that, when we told them that we are trying to create or develop something like ticketing machine for them specifically. They started feeling positive and their body language towards interviews also became positive. We felt very confident when we observed this thing.
4.11 Empirical Research Results

The result of the empirical research also consists of the facts that were indicated in the theoretical study. We have reached to the conclusion of empirical research that the majority of visually impaired people required something more visual in term of seeing and hearing way so that they can interact with in the system to buy the ticket. The result is structured according to each sub-question as follow:

Sub-questions:

1. How much intelligence may be required so that the system may recognize the user and perform tasks according to the user needs?

The system should be much intelligent to interact with the user through voice recognition in the system, and help users about each step and how to complete the task. The keyboard as well as other function buttons should be in Braille structure or in form, that users can easily start initial interaction with the system. About the choice of text, it should appropriate for visually impaired people as well as overall design of information details should be in the appropriate color. The text should be highlighted and as well as spoken by the system so the visually impaired people know where they are in the system and how to go to the next step to complete the task.

2. How can the machine and user interact with each other?

The empirical study shows that the user can interact with the machine with the help of the interaction through voice, which can guide the user through the whole process. The content of the screen should be more visible and zoomable in a sense that the user can zoom in and zoom out any time when required. There should be facilitated with help or information about every step in which the user is currently in and the user should be acknowledged when he/she finishes any step. The user can input with the help of the special keyboard for the visually impaired users like Braille. The most important problem is that the interviewees indicated that if such kind of system needs to be worked for the visually impaired or blind people, the interaction between the system and the user should be very simple and user friendly. The input, output and the processing should be very simple, so the user should not feel any hesitation in using the machine again. The interviewees suggested that if the users are severely impaired there should be some kind of interaction through the voice as well. If the users are not severely impaired the color and size of the text should be changeable for users and the colors should be friendly.

3. What kind of difficulties the handicap with visual impairment could face while using these machine and to an extent the solution of that difficulties?

About the difficulties the handicap with visual impairment could face while using these machine, the empirical study shows that the difficulties that these people could face are visualizing the screen. The choice of colors should be made with precision so instead of the colors putting good effect on the users should not create problems for the color blind users. There can be problems with the input to the system through the normal keyboard. Normal screen contents like text, shape, buttons and images can be difficult for the low vision users to see and use. If the steps are
too many, it will also create problems for users and it may take a long time to complete the process.
5 ANALYSIS AND RESULT

In this chapter the analysis and the results of the theoretical and empirical study are described. We have developed some prototypes and a kit which can be used in any device belongs to visually impaired people.

5.1 Analysis

The analysis of the theoretical and the empirical parts of the research is as follow

Sub-questions

1. How much intelligence may be required so that the system may recognize the user and perform tasks according to the user needs?

In the theoretical part we have discussed (chapter 3) the use of the Artificial Intelligence in any system that makes it usable and help users to perform the tasks according to their needs. The Artificial Intelligence is a very important and continually evolving subject area and it is helping almost all kind of handicapped users to make the use of technology according to the requirements e.g. in many countries there are robots which serves handicapped people according to their needs.

In order to make a booking system more available to the people with visual impairment disabilities, the theoretical study shows that this could be done by using the Artificial Intelligence in the system. The Artificial Intelligence can be used in the ticketing machine in the form of voice recognition or speech recognition so that the system can understand speech from the users and reply accordingly to the users. For this purpose of intelligent interaction between the visually impaired people and the machine, an interactive artificial intelligent agent can be used. The agent can interact with the users as a normal human being in a way that the visually impaired person can get a feeling of the purchasing ticket from the ticket counter.

We think that the machine can have two main categories, one for the normal user and second for the user with visual impairment. If the user with visual impairment reaches the machine, the machine interacts with the users with a welcome message and asks them whether they are a normal user or visually impaired user. At the same time, same thing is presented on the screen of the machine with two buttons; one for normal users and one for visually impaired users. Once the user is recognized then the machine works according to the needs of users separately for visually impaired and for normal users.

The things that are identified in the theoretical study are also identified in the empirical part. In theoretical and empirical study, we pointed out that the use of the intelligence in the system can help users with visual impairment to purchase or book the ticket. In empirical study the interviewees indicated against the question of whether to provide separate platform for the visually impaired people or make the changes in the current system. Most of the interviewees replied to make changes in the current system and also making it available for the visually impaired people by changing in interface of current machine. The interviewees suggested that the
users with visual impairment can book a ticket with the help of the voice because this human sense can be more communicative to interact with the machines.

2. How can the machine and user interact with each other?

In the theoretical part we discussed about the interaction of the user (visually impaired) will consist of the three parts input, transition or passage from one step to another and output. All these steps should be performed easily by the users without any prior knowledge or training. The machine should be accessible and self-explanatory. The machine should contain the equipments like the touch screens, physical keyboard and some kind of speech recognition like speaker-independent speech recognition and microphones.

For the input from the users, the system should have keyboard (Braille), to input the name and other personal detail of the traveler. The transition from one steps to another like selection of source and destination of the travel, date and timing of the travel, number of travelers and the choice of type of the traveler (adult, student, youth, etc.) can be done by the interaction between the user and the machine through the help of artificial intelligence (voice recognition). The interaction should be as smooth as the user gets the sense of interaction with a human being not with a machine. The output will be the schedule of the travel which includes date and time of the travel. At the end finally ticket is printed and output to the user.

The answer given by the most of the interviewees about the interaction between the user and the machine indicated that, the interaction should be very simple because the user will be visually impaired. The respondents pointed out many things which we discussed in the theoretical part that the usage of voice or speech can be an option for the visual impairment users, so that the users can interact according to their needs. The keyboard should be the combination of the Braille and normal keys which can be used by each type of users. If the user pushes any key from the keyboard, it should produce some echo sound which indicates that the key has been properly pushed/pressed. The color of the keys is also important so that the users can see them easily. There should be a description of each step, process and text which is spoken by the machine should also be on the screen and the spoken text should be highlighted at the same time when it is spoken. The text should be prominent and the space between the text and lines should be adequate for readability. The color choice should be made carefully by keeping the users in mind. The red and green colors should not be used because these colors cannot be seen by the users with color blindness. The text in black color with the white background works well with the user of minor visionary problems.

3. What kind of difficulties the handicap with visual impairment could face while using these machine and to an extent the solution of that difficulties?

From our theoretical study the difficulties that the handicap users with visual impairment could face, while using these kind of machines are the problems in usability and actability of these systems. The usability is effectiveness, efficiency and satisfaction with which specified users can achieve goals in particular environment (chapter 3). The problems that, the users might face during the usage of such kind of machines are to perform the task with accuracy and confidence of completeness. The ticketing system should do what the user wants to do and it should not
contain unnecessary steps. Unnecessary steps gives the feeling of less friendliness to the users and users might not want to use the same system again in the future. The users should be able to achieve their goals with efficiency i.e. the system should be efficient and it should help or allow users to perform the task with minimum effort from user and maximum effort from the system. This efficiency of the system should be based on the level of user i.e. normal or visually impaired user. The user satisfaction is the important aspect of the usability of the machine. If the users are not satisfied with the usage of the system they will feel hesitation, hence putting questions on the existence of such kind of system. The idea of the user satisfaction depends on the core process of user friendliness in the machine. The other things that are very important for the usability of such kind of machine are tasks, equipment and the physical environment in which the machine is being placed. The tasks are the steps or activities required to achieve the goal (purchase the ticket).

5.2 Result Summary

The results of our research questions are summarized in the form of screen prototypes (see appendix). The results are displayed in the form of screen shots which contain the answers of the research questions. We have chosen the interface of current SJ machines which is currently in use. We have tried to mold the current user interface to be usable for the visually impaired persons. We have tried to reduce the steps, but all the steps are necessary and contain the core information which is primary. If we reduce or lessen the steps then each step will be too condensed by a lot of things that might create problems for the users so we avoided that thing. We have also suggested a kit of tools for the visually impaired users from which all or some tools should be used in the machines’ hardware.

The interface of prototypes which we have developed for the visually impaired people is shown in the appendix in detail which is summary of our results.

5.3 Brief description

The prototypes which we have made are in the appendix after chapter 6, below is the brief description of the each prototype screen below:

SLIDE 1:
There are two types of each picture or prototype; one for the users with only visual impairment problems at the top-half of a page and one for the colorblind and visually impaired users at the bottom-half of a page. The users can switch between the “black and white” or “color” mode by clicking the button on the top right corner of each screen. All the contents of the entire screen are same but there is only a difference of the colors. We have tried to keep the button diagonally not in a straight line so the users can differentiate. All the screen contents which appeared on the screen could also be heard with the help of voice through the system. The system is able to understand the voice of the user, and can act and react accordingly (ideal situation). The idea is that if any visually impaired user touches any button or part of screen for a little longer duration. The information about that button or screen area will be given to the user vocally and visually (by text). If the user clicks the cancel button the system will go to home page or startup page. If user clicks the back button the system will go to previous page.
The first slide welcomes users to the ticket machine, and the welcome message is at the top of the screen with the current time and date. On top left of the screen the “info” button indicates the more information about the current page denoted by the “i”. On the upper right corner of the screen there is a button to switch between the “color or black and white mode” (for color blind persons), along with the “language” button to select the required language.

On the lower part of the page there are tools for the visually impaired persons. There is a “zoom in zoom out” button on the lower left corner with default screen size button for the normal screen. The zoom item button can be used to zoom a particular item or area. There is a “press the button” with the hand icon and “use the keyboard” icon to inform the user to click any button (on screen) and use the keyboard to enter text. On the lower right corner the “sound” button can be used to adjust the volume of microphone and speaker, the user can also switch on or off the volume. The upper and the lower horizontal parts of all the other screens consist of the same interface as it is on the first screen. The contents in the middle of these two interfaces can be zoomed in and out without any change in the upper and lower part but the upper and the lower part can be zoomed in with the help of zoom item button.

In the middle part of the screen there are two buttons one for the use of “normal user” and one for the use of “visually impaired users”. If the user clicks the normal use button, the interface for the normal user can be used in that case. The user can enter the visual impairment mode by pushing any key from the keyboard or by pushing “visually impaired user” button.

SLIDE 2:
When a user clicks the “sound and microphone” button, the volume control screen will appear. The user can adjust the volume of the headphone and microphone by moving the figure back and forth or by clicking on the icons of plus (+) or minus (-). The user can turn on or off the headphone and microphone, and can test the sound and microphone by clicking on the test button. All this can also be done by the interaction through voice with the system.

SLIDE 3
If a user clicks on the language button the “language screen” is opened to choose the required language. The users can scroll between the languages by using fingertip on the line, beneath the country flags or by clicking on the next or back button.

SLIDE 4:
The “human avatar” is used to give the impression of natural interaction to the users, so that the users get the feeling of interaction with the human beings instead of any machine. Users can see what the machine is saying and what the users are saying in text form, users can enter the instructions by text input. The users can turn the avatar on or off by clicking the button above the avatar.

SLIDE 5:
The fifth slide related to the main menu, if user already has customer card, then he/she can insert it to buy tickets, obviously this is for experienced users. There are three buttons on the screen for
collecting ordered ticket, buy a new ticket or buy a last minute ticket. The users can click the “card info” (information) button to get information about the acceptable debit or credit cards.

SLIDE 6:
This slide is related to the source to destination of the travel. Here you have the option to change the default source and select your destination by clicking the required button and continue. The user can cancel the whole process at any time by clicking “cancel” button. The default source will always be the station name where the machine is installed.

SLIDE 7, 8:
User can choose or change the departure or arrival stations, they can search the station by scrolling or by entering the text in search field.

SLIDE 9:
In this slide the user has the option to choose how many people are travelling along with age group, e.g. adult, student, youth etc. There are also options for discount as well as promotion code for the users who already have a promotional code. There is a button for more information about the number of passengers.

SLIDE 10:
Here the users can select the time and date of the travel and there is an option to buy “return ticket” as well.

SLIDE 11:
The user can delete the return ticket if he/she doesn’t want to buy a return ticket or if user bought a return ticket undesirably.

SLIDE 12:
This slide is related to show different schedules, prices and class of the buses and trains. The users can scroll between the next or earlier timings.

SLIDE 13
Here is the brief summary of the users’ booking of the travel, which contains things like; source and destination of the travel, date and time, class of travel, price etc.

SLIDE 14
The user is instructed to enter the debit or credit card from which he/she wants to purchase ticket and enter the password in the password field. The user can get the information about the card acceptance by “card info” button.

SLIDE 15
Here is the summary of the ticket confirmation, after the payment and the ticket is printed and delivered to the user through the slot given probably right beneath the keyboard.

SLIDE 16
5.4 Evaluation of Prototype

The target groups that we defined in the second chapter were the students, teachers and researchers in the field of interaction design. Who are interested in learning more about the design interfaces of the ticket machine system specifically for the handicapped people. We said earlier that we will evaluate these prototypes by some people of our target group. We tried to reach the person to whom we interviewed to evaluate the prototype but could not able to get time from the same persons. Then we decided that to evaluate these prototypes from other visually impaired persons and we reached a few people who have weak eyesight. These persons live near the place where we live.

When we reached them with the prototypes and explain the working and motive of the prototypes. At first glance they were little uncomfortable with the prototypes and feeling little difficulty in understanding each of the thing there. We described them there will be help of voice or speech about everything present on the screen, which will respond according to the query or question from the customer. Vocal interaction will help the user continuously during all the steps to complete the task. After that the responses were positive from them when they feel the involvement of voice will be very helpful for them.

We have also evaluated the prototypes from the students and researchers (who are working on final Master’s thesis) in our university. While evaluation we get satisfactory results from the evaluation of the prototypes. We got many technical ideas for many screens and then we made changes if we felt that idea will help in ease of the work.

Evaluation

We have evaluated the prototypes from a visually impaired person, he lost his eye sight slightly due to some disease in recent years. We are discussing his comments about many most important screens.

For slide 1, he said that it is very wise to use a black and white and color screen button because the color blind people can also use this. About the language button he said that people from different countries can use the machine (he belongs to Romania). The idea of page info button on each screen is good idea for user to get the information about the page if required but the button should be little wider than it is now. It is also sensible to have introduction of screen along current with date and time, the user can understand the purpose of each screen. The tools (available in all the screens) for the visually impaired users which are on the lower horizontal part of screen are the backbone to use the machine. The zoom options are very important for the visually impaired users. The volume control button is also necessary if the user wants to communicate with system vocally and seems meaningful. It is intelligent to use these buttons on all the screens. The sound and microphone screen (slide 2) is very visible and smart to use. The user can control the volume of the vocal interaction. About slide 4 he said that if I want to say something I can write, so any misunderstanding in communication can be removed. It fulfills the accuracy and use of avatar also looks lively. For slides 7, 8 “from station and to station”, he said that the number of stations should be lessen to two or three to increase the visibility. The slide 12
“choose time and price” is a bit messy, it should be more visible. Overall it is easier to understand and is in a step by step manner. All type of visually impaired users can use these screen along with normal users.

5.5 The Visually Impaired and Blind persons’ Computer Kit

A visually impaired and blind persons’ keyboard is a normal keyboard with special alphabet stickers on it. To avoid pushing a key on the keyboard by mistake the computer kit contains:

General
- USB Pedal
- Software
- Headphones
- Special Mouse for the visually impaired

OBS! This visually impaired and blind persons’ kit with “Special High Tech Lens”, “Special Goggles” and “Special Mouse” is only for those who are visually impaired or half blind not for the completely blind user.

The visually impaired and blind persons’ alphabet

The visually impaired and blind persons’ alphabets look like this:

![Braille Alphabet](image)

Picture 1: Braille Alphabets

Stickers
One can buy stickers with the visually impaired and blind persons’ alphabets and stick them on any keyboard, which can work with any type of keyboard for visually impaired persons.

**Picture 2: Alphabets Stickers**

**Keyboard**

Visually impaired and blind persons’ keyboard is a normal keyboard with the visually impaired and blind persons’ alphabet stickers. It is a normal keyboard that uses slicked on special alphabets on the keyboards.

**Picture 3: keyboard with stickers**

**Keyboard Pedal**
The USB Pedal work like an ON and OFF switch for the keyboard:

![Pedal Image]

**Picture 4: keyboard pedal**

**Software**

The software makes it possible to interact with the Pedal, the Headphones, the Goggles and with the Keyboard. It also provides with audio and alphabets for the visually impaired adding the possibility of talking to write in big word documents and reading with the help of the software.

![Software Image]

**Picture 5: Software**

**Headphones**

The headphones together with the software, lets the visually impaired and blind person hears what button or alphabet he/she has pushed on the keyboard. It will also help vocal interaction
between the systems and user. It has a microphone so the user can talk to the computer not only listen to it as well.

**Picture 6: Headphone**

**Special Mouse**

Mouse for the blind, it has inbuilt vibrators that gives signals to the user that he/she is over a mouse button. The left and right button has special patterns to differentiate it.

**Picture 7: Special mouse for Visually Impaired**

**Special High Tech Lens**

Special High Tech Lens of the everyday use for the visually impaired user and the user with total blindness cannot use this.
**Picture 8: Special High-Tech lens**

**Goggles**

Special universal goggles for the visually impaired people, these goggles can be used independently for computer usage and other stuff.

**Picture 9: Goggles for the visually impaired**

**3D Table Special Mouse**

Below is the 3D Table for the visually impaired people. The pins can make a 3D image that the blind can feel on with their hands or fingertips.
Special Keyboard

The special keyboard with the touch feeling, before each tap on the button the visually impaired user can touch the keyboard and the software by the headphones will tell the user what key it is.

Picture 10: 3D Table Special Mouse

Picture 11: Special Keyboard

Full packages:
Package for the visually impaired people:

Picture 12: Full Package 1

Package for the visually impaired people:
The Special Printer

This is a special printer for the visually impaired, it prints differently than any other conventional printer.

Picture 13: Full Package 2

Picture 14: The Special Printer
This is how (below) the printer prints compared to a normal printer.

Picture 15: Comparison of Prints
6 DISCUSSION

In this chapter we have discussed our thesis in regards to the conclusion, implication in informatics, method evaluation, result evaluation, possibilities to generalize and ideas for the continued research.

6.1 Conclusions

There are many problems for visually impaired and blind people in society. They face many types of hurdles in performing everyday routine work, the barrier of low vision doesn't let them to become part of this society. They also feel embarrassment many times while performing normal tasks especially when they are unsuccessful in performing or completing them due to their visual impairment deficiency. It is a great blessing of God, if anyone have perfect 6/6 eye sights and one should be thankful to God for this. The humans are a sharp minded creation in the world, which helps technology to contribute a lot to fill the gap between society and visually impaired people. Day by day advancements in the field of science introduces new technologies for the benefits of normal and handicap persons to make the life easy and comfortable. The inventors should also keep this thing in mind that the people with visual impairment and other type of disabilities should also be facilitated, as they are also part of society, we can’t ignore them as a human being.

There are many types of hurdles during the reservation in ticket system for visually impaired and blind people. At present the current ticketing systems are not mature enough to work for visually impaired users. Only the normal users can be benefited out of this, whereas the visually impaired user needs the help of other people. One can say that today’s ticket vending machines are not user friendly for all types of users. In ticket vending systems there are two important aspects for visually impaired users which are; how to feed data and how to get the results.

The usability, actability and user-centered aspects should be considered while the designing of ticketing machines for visually impaired users. The features of the ticket vending system which are important for the visually impaired users are used in prototypes which we have designed with screen shots (see appendix). We have used the human avatar (interactive artificial agent) for the vocal interaction with the users, which can interact in a friendly environment with visually impaired users to complete the task of purchasing tickets. The user can therefore feed data to the system and get the result from the machine. The input and output functions should work in a parallel way during the interaction of user and machine. For the input to the system there should be special keyboard (Braille) for visually impaired users from which the user can input into the system like the user's name and other details. There should be information button on each page, if the user is having any problem at any stage, the user can get the help any time during the interaction. The users who don’t want to operate the system with vocal interaction can use the zooming options to make the things more visible for their understanding. The zooming option should also be available on every screen interface.

6.2 Implications for Informatics
It is worth mentioning that the Implications for informatics are the basic purpose to know how ticket vending system is related to the field of informatics, and how it would be helpful to the society. Our research area contributes a very important role in the field of informatics, because informatics deals in the field of development and use of information systems. In our thesis ticket reservation system is a box of information system, artificial intelligence, and most important thing is that its foundation is based on informatics. You can say that the human beings are experts in informatics. They have all the information and functionality of ticket reservation machine like how the user can communicate with the machine, to find the price and buy a ticket of each travel from any source to destination, to find each bus or train number, which route and schedule it follows, as well as time for each and every bus or train. The main goal is to give services to the society which includes members of handicapped society and make it easy for them to buy tickets with the help of informatics.

The ticket reservation machine has also the same goal or task as humans who are serving for 24 hours. To provide its service to the society and give people all the information as well as the option to buy tickets from themselves without the help of another person. As mention above, the ticketing machine gives you all the information and tickets about travelling from one city to another. It can tell you travel’s starting and ending times as well as total travelling time, route, price of ticket and as well as allow the payments. All this is related to processing which depends on computers and this thing can also put effects on the businesses, so we can say that the field is related to informatics and artificial intelligence. Main purpose of the informatics is to serve humanity and society.

Our thesis is basically for the effected people of society, and who can’t be ignored at all. We can’t say that the people who have physical deficiency in their body are not part of the society. We believe that these people are more important than the normal human beings because they deserve more care due to their disability. We should try to do something different for them to make their life easier because these people have lots of problems in their daily life. They should not be allowed to feel that they are burden on the society. The informatics did a lot of the visually impaired people by filling the gap which existed between normal and visually impaired people, by providing many assistive technologies for the disables. We also believe that, if we can’t serve the humanity with the help of informatics then it is useless for us.

### 6.3 Method Evaluation

The main purpose of method evolution is to sort out appropriate properties of different subject areas and relate them to our own research area. The methods in our research work and interview questions make it is possible for us to relate it to current and previous research works. For understanding the problems and difficulties related to our subject area, we used many concepts and theories from a different subject area and relate them with our work. We also coped with the problem in merging those methods into our subject area as a whole. Sometime it shows common characters with each other, but the best approach of satisfaction for us was to make it relate to the interviews and observations from visually impaired users, which were of great importance to us, otherwise our thesis would be useless for us.
To verify and make authentic theoretical research work, we conducted interviews and observations. This makes it possible for us to relate and gather with the help of visually impaired and experienced users of ticket vending machines. We got answers to all our questions which were necessary for us to fill the gap of interaction between the systems and the user through interviews, observations and research.

In theoretical study, we have indicated many subject areas to get the answers of our research questions. The theoretical study only answers the question logically, but helps to get the answers practically. It is required to conduct the empirical study.

In theoretical study the subject areas that we studied were mostly according to our research questions. It was difficult to find any specific or same subject area related to our research. This might be due to the fact that nothing is written about the ticketing machine for visually impaired people. We feel this thing really missing in the theoretical study.

For the verification of the aspects that were indicated in the theoretical study. We performed an empirical study in the form of interviews and observations. The empirical study was necessary, because we could not find any specific subject area of theoretical study. The interviews and observations were very good, and we are satisfied with them, but we feel that the number of interviews and observations from the visually impaired people was quite small. We believe that we got the information that we required, it would be more appropriate that we could get more interviews and observations.

6.4 Result Evaluation

The evaluation method that described in chapter 2 was based on the

Validity
Data quality
Feedback

The validity describes the subjective nature of the data collection and analysis. We produced some results from the theoretical study, validate them by the help of the empirical study. The reason is that we might have misinterpreted some aspects or misunderstood something during theoretical study that might not be the actual fact in reality, so it is very important to validate the results.

The data quality reveals us that data collected is in detailed and varied enough to provide us with a complete picture of what is going on and what processes are involved. We have tried to ensure the quality of the data with the help of the theoretical study. In which we have tried to study as much as we can, about the related subject areas. We have then conducted the empirical study and at the end we evaluated our results to check the quality of the results.

Feedback is the most important part of the result evaluation and validating the results of the findings. There is always a possibility of misinterpreting the meaning of what participants say in the empirical part either by misunderstanding the answer of any question, during the interviews.
or by wrongly perceiving the observation. The Feedback will imply the gathering and the feedback about the conclusions from the participants. We have tried to check that our interpretation makes sense to the visually impaired people, by making them to go through by the prototypes and provide the feedback about how they perceive such prototype.

Evaluation of any system consists of two of types:

1. **Green box evaluation**
2. **Black box evaluation**

Green box evaluation is the evaluation of each individual component of a system. The evaluation of a system as a whole is called as Black box evaluation (Michael F. Mctear, 2002).

We cannot use black box evaluation or evaluation of the system as a whole because our results are not working prototypes, the results are just screen shots of a prototype. Instead, the evaluation of the individual components or individual screen shots is based on the answers of the evaluators, which is specified by the evaluator and comparing that by our own assumptions. We cannot evaluate the results from any mathematical formula as we haven’t used a quantitative approach. We have evaluated the results from our target groups and get the feedback from the users, and then we made a few minor changes according to their feedback.

“It is important that the study is guided by good ethics and that a survey has a high ethical value.” (Ann Lind, 2005) i.e. It is very important for the researcher should not add or remove some parts for the researchers’ own purpose, because that might result in the aspects which are not real or other than the facts. (Ann Lind, 2005). It is our duty to follow good ethical values during the study especially when we conduct interviews and observations because some of the respondents were not normal humans (handicapped). We have made this thing sure to the users that the respondent will be kept anonymous and we don’t think that our study is affected by this fact.

### 6.5 Possibilities to Generalize

The purpose of our research work is to create awareness in researchers that they can concentrate on visually impaired or blind people as well as for the people with other disabilities. There are many interactive ticket machines for the normal people but there is no option for specific people with disabilities. It is good for society as well as for the organizations to boost up their businesses. It can help different business organizations also, but the bad luck is that they have no expenses or good ideas or you can say no concentration on handicapped people. The results can be used at cash machines, ticket vending machines, information kiosks, charity kiosk machines, rental kiosks, internet kiosks and printing kiosk machines etc. The companies can merge these ideas into different kiosk machines to make their business at peak as well as serve humanity and society. Our thesis has both tangible and intangible assets according to business aspects as well as for the society. We believe that our little but sincere efforts can force researches to do something better than our work practically.

### 6.6 Ideas for continued research
For continued research according to our idea, there are many things which still having a big gap between visually impaired people, machines as well as society. Further research is required to make idea more appropriate and bring under the usage of visually impaired people. It is not easy to concentrate on all issues related to the visually impaired people. On the idea about the specific type of ticket kiosk machines for a specific type of people, we suggest that the machines should be at the care centers where the visually impaired people spent their most of the time of a day. They can get familiar with machine and can easily tackle that how it works. If there is a machine for such kind of people to serve them and if they are not familiar with it. Then it will create problems for users while communicating for first time and for every time they will use it. To invent something is not a big effort but the question that how the users would facilitate with that invention is more important.

The idea, which we have left out because that might not fit in our current investigation is that to put these prototypes in real working machines, so it can work and serve the humans and society practically. We also want to do the same kind of work for all or most types of handicapped people, which was not possible for us this time.
Appendix

The prototypes of screen shots for the visually impaired people & interview structure
Choose in what way you want to buy the ticket.

PUSH ANY KEY TO START VISUAL

CLICK HERE FOR NORMAL USE

CLICK HERE FOR VISUAL IMPAIRMENT

Choose in what way you want to buy the ticket.

PUSH ANY KEY TO START VISUAL

CLICK HERE FOR NORMAL USE

CLICK HERE FOR VISUAL IMPAIRMENT

Figure 8: Slide 1
Figure 9: Slide 2
Choose in what Language you what the page to be.

Choose in what Language you what the page to be.

Figure 10: Slide 3
Welcome...
Here you can read what I am saying.

Here you can read what YOU are saying or writing. In case I misunderstand you. You can write to me what you want to say.

Type in here what you want to say if you cannot pronounce it...

---

Figure 11: Slide 4
Customer Cards
If you have SJ Prio card, SJ Corporate card or SJ Annual Pass, Please insert this card first

BUY LAST MINUTE TICKET
Pensioners, youths and students can buy Last Minute tickets 24 hours before departure

COLLECT ORDERED TICKET

BUY TICKET

See accepted debit and credit cards. We accept all Credit and Debi cards.

Use the Keyboard to enter text!

Press the button on the screen

Figure 12: Slide 5
Figure 13: Slide 6
Figure 14: Slide 7
Figure 16: Slide 9
Wen do you want to travel to Göteborg?

Day: Today (Thursday 23 - Dec. 2010)

CHANGE DAY
December 23 - Thursday

Approximate Departure time
14:38

Do you want to return to Borås C?

BUY RETURN TICKET

Use the Keyboard to enter text!

Figure 17: Slide 10
Outward journey: Borås C - Göteborg C
Thursday 23 - December 2010

<table>
<thead>
<tr>
<th>Departure</th>
<th>Arrival</th>
<th>Travel time</th>
<th>Information</th>
<th>1st Class</th>
<th>2nd Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:33</td>
<td>15:37</td>
<td>1:04</td>
<td>Västrafik, Local Traffic</td>
<td>Departed</td>
<td>Departed</td>
</tr>
<tr>
<td>14:40</td>
<td>15:40</td>
<td>1:00</td>
<td>Västrafik, Local Traffic</td>
<td>83 - SEK</td>
<td>Not available</td>
</tr>
<tr>
<td>14:49</td>
<td>15:52</td>
<td>1:03</td>
<td>SJ, Regional</td>
<td>76 - SEK</td>
<td>114 - SEK</td>
</tr>
</tbody>
</table>

**Price Calculated for:** 1 Adult

---

Figure 19: Slide 12
Overview before you buy your ticket
14:55 Borås C – 15:55 Göteborg C
Thursday 23 - December 2010
Class 2 No rebooking or refund: 1 Adult
Flexibility: Can not be rebooked
Train: X 2000
Train nr: X243523

To pay: 83 SEK
Figure 21: Slide 14
Confirmation: Here is what you bought

14:55 Borås C – 15:55 Göteborg C
Thursday 23 - December 2010

Class 2 No rebooking or refund: 1 Adult
Flexibility: Can not be rebooked
Train: X 2000
Train nr: X243523

Your payment is: 83 SEK

COLECT your TICKET from the slot:
<table>
<thead>
<tr>
<th>Traveler</th>
<th>First Name</th>
<th>Last Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 23: Slide 16
Interview Structure:

Interview Questions from visually impaired people:

1. What is your name?

2. What is your age?

3. What is your gender?

4. What is your occupation / education?

5. How familiar are you with computers?

6. Have you used general public information kiosk like ATM machine?
   If yes, how difficult was it for you to go through the procedure?
   6. A. What do you think that how these difficulties could be solved or propose solution of the problems.

   If no, we will briefly explain them

7. Have you travelled by bus or train to other cities?

8. Who helped you in buying the ticket for travel or did you buy yourself and in that case how?

9. Do you know what ticket reservation system or ticket vending machine is?

   If no, we will explain them about such machine briefly.
   If yes
   9. a. please briefly explain
   9. b. how was the text visibility of the screen contents? You think changes required in text visibility

   How the text can be make more presentable and visible to you and please suggest a color for the text that you prefer.

   9. c. how was the experience with color combination and contrasts of the screen and the text.

   9. d. how was your experience with the screen buttons? Do you think there should be changes in dimension of buttons?

   9. e. how was your experience with the selection of source and destination of travel? You found any difficulty in the process?

   9. f. how selection of source and destination could be more easier for you?

10. If you are going to use such a machine how do you think that an introduction of such machine could be given to you so that you can understand?

11. How do you think a ticket vending system can be made more available to people like you?
12. If you interact with such an intelligent system through voice or speech will you get help to guide you through the completion of the whole process? Will that work for you or people like you?

If no, how do you think that the system should work to give you such help?

13. How do you think that you can interact with such system?

14. Are you able to input through a keyboard for visual impairment people like Braille?

15. Do you think help should be provided from the system if necessary?

16. You want to add anything more

**Interview Questions for normal people**

1. What is your name?

2. What is your age?

3. What is your gender?

4. What is your occupation / education?

5. Have you used any type public information kiosk?  
   If yes how difficult it was for you to go through

6. Have you travelled by bus or train to other cities?

7. Do you know what ticket reservation system or ticket vending machine is?  
   If yes 
   7. a. please briefly explain  
   If no, we will explain to them about such machine briefly.

8. If you are going to use such a machine how do you think that an introduction of such machine could be given to you so that you can understand?

9. What do you think about the choice of language? Easy word/difficult words?

10. Do you think you get enough help from the system if necessary?

11. What do you think should be included or excluded in vending machines for normal use to make them available for blind or visually impaired people?

12. How do you think that color should be chosen for users with visual impairment?

13. Do you think the current system can meet the goals of visually impaired user?
If yes how?

14. Do you think that there should be separate machines or systems for handicapped people or that change could be made in the system that is available now?

15. What could be improved in the interface for visual impairment users?

16. Do you want to add anything more (to help us to make systems available to people with visual impairment?)
References


16. Hjalpmedelsinstitutet, ?. [Online]. Available at:


   <http://www.aboutintelligence.co.uk/what-artificial-intelligence.html >[Accessed on Nov 29\textsuperscript{th} 2010].


University of Borås is a modern university in the city center. We give courses in business administration and informatics, library and information science, fashion and textiles, behavioral sciences and teacher education, engineering and health sciences.

In the School of Business and Informatics (IDA), we have focused on the students’ future needs. Therefore we have created programs in which employability is a key word. Subject integration and contextualization are other important concepts. The department has a closeness, both between students and teachers as well as between industry and education.

Our courses in business administration give students the opportunity to learn more about different businesses and governments and how governance and organization of these activities take place. They may also learn about society development and organizations’ adaptation to the outside world. They have the opportunity to improve their ability to analyze, develop and control activities, whether they want to engage in auditing, management or marketing.

Among our IT courses, there’s always something for those who want to design the future of IT-based communications, analyze the needs and demands on organizations’ information to design their content structures, integrating IT and business development, developing their ability to analyze and design business processes or focus on programming and development of good use of IT in enterprises and organizations.

The research in the school is well recognized and oriented towards professionalism as well as design and development. The overall research profile is Business-IT-Services which combine knowledge and skills in informatics as well as in business administration. The research is profession-oriented, which is reflected in the research, in many cases conducted on action research-based grounds, with businesses and government organizations at local, national and international arenas. The research design and professional orientation is manifested also in InnovationLab, which is the department’s and university’s unit for research-supporting system development.