Evaluation of Accessibility Through Mobile Phones

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In the Name of ALLAH, the All-Merciful and Very-Beneficent

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ABSTRACT

This research thesis presents a study of mobile-enhanced accessibility evaluation. In the first phase we have identified the evaluation methods that enable evaluation of mobile-enhanced accessibility. In the second phase we have performed evaluation of a specific mobile-enhanced accessibility prototype named “Augment” based on some selected evaluation methods that enables evaluation of mobile-enhanced accessibility. Finding methodologies for accessibility evaluation is just as important as early assessment. Therefore, in the last step on the basis of the evaluation results and literature review findings, we have presented an efficient and usable evaluation method that would enable valid and reliable evaluation of mobile-enhanced accessibility. The name of the presented evaluation method is “AccessEva” that is a diary method supported by a software application, which will run on a smart phone with the mobile-based accessibility software. This enables the testers to survey user attitudes, and experiences about the mobile-enhanced accessibility. At the end of this diary method period we suggest that a group discussion will be introduced and conducted together with the participants under the supervision of evaluators.

Objective: The aim of this research is to evaluate mobile-enhanced accessibility and to identify the efficient evaluation method that ensures a reliable evaluation of mobile-enhanced accessibility. In the first phase we performed literature review and in the second phase we performed evaluation of mobile-enhanced accessibility prototype named “Augment”. The findings from the above mentioned phases supported us to identify the properties of an evaluation method for mobile-enhanced accessibility evaluation. The identification of properties helped us to present a new method “AccessEva” for mobile-enhanced accessibility evaluation.

Methods: Literature review was the starting phase to get the current state of research in mobile-enhanced accessibility through user participation. Furthermore, through literature review we identified some evaluation methods which were commonly used like scenario based testing and expert walk through to evaluate mobile-enhanced accessibility with user participation. We selected Use Case Testing as an evaluation method for the evaluation of mobile enhanced-accessibility prototype and performed 14 tests because use case testing can be helpful tool for early evaluation. It can be a useful method to get the most accurate results to its respective objectives. Moreover, we conducted five extensive interviews with the people who are directly/indirectly related to the Augment Project. The aim of interviews was to explore interviewees’ views about suitability of available evaluation methods for mobile-enhanced accessibility evaluation.

Conclusion: We have identified a number of evaluation methods, which could be helpful for the evaluation of mobile-enhanced accessibility such as scenarios of use, personas, field study/observations, focus groups, interviews, heuristic evaluation and expert walkthroughs. On the basis of the literature and evaluation findings we have presented a method named “AccessEva” that is a diary method supported by a software application, which will run on a smart phone and after the completion of diary method there will be a group discussion among the participants under the supervision of evaluators. The reason behind the presentation of a new method named “AccessEva” is to find an efficient evaluation method for the evaluation of mobile-enhanced accessibility. The presented method is based on the strengths of already developed evaluation methods and it is new in context of mobile-enhanced accessibility evaluation.

Key words: Accessibility, Inclusive design, Evaluation methods
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1 INTRODUCTION

The term accessibility has long been used by geographers, economists, and urban planners for the ease of access because it provides equality of services for individuals (Ertugay and Duzgun, 2011).

In the era of 1990 there was a considerable positive change in thinking towards design for disability and assistive technology. The positive changes happened because of widespread desire among the disabled community for inclusion within the mainstream of consumer society and growing awareness of demographic ageing as a global trend. Many terms were used such as accessibility, inclusive design, universal design, design for all, transgenerational design but the common shift and key in thinking was to replace the view that people are disabled by mental and physical impediments. The point was that people are disabled by environments and design that do not take account of the full range of human capabilities. (Clarkson & Coleman, 2010) As a result, links were formed among users, government organizations, and the design community leading to new and innovative products.

Even though the Design for All paradigm would be universally embraced and accessibility barriers were removed from all the designs, numerous people with disabilities still need special input/output devices to be able to use computers and its applications (Abascal and Civit, 2001).

Augment is an inclusive design prototype which is used to cover accessibility issues for all users whether they are disabled or healthy. Applications can be made more accessible by involving its users. To involve users we have different evaluation methods which make the product/application error free and more accessible (Sharp et al, 2007). These methods permit users to inject their direct feedback for all type of applications mobile and computers. Evaluation is a process that is used throughout the design process to minimize the faults in the design and to ensure that all design aspects are clearly assessed. There is a close relationship between design and evaluation methods and this relationship is beneficial for better product (Sharp et al, 2007).
These methods vary according to their limitations, advantages and disadvantages. Some methods are considered better for gathering qualitative data, some for quantitative data and some methods vary according to the audiences and the other important thing which is considered that is the cultural background of the communities (Muller, 2001). Evaluation methods have been used to understand users’ needs and requirements with respect to several other technologies, such as websites Ellis and Kurniawan (2000), usability guidelines Kurniawan and Zaphiris (2005), as well as game concepts Abeele and Rompae (2006).

While dealing with new method suggestion for the evaluation of mobile based accessibility, we can use prototype as a tool for user need identification and analysis. The main benefit of prototypes for user-needs identification and analysis is the fact that they represent concrete future ideas. When dealing with prototypes, evaluation could be a good process to evaluate prototype according to users’ needs and requirements to present a new method for the evaluation of mobile enhanced accessibility. (Landauer, 1995)

In this research thesis our main challenge is to present a new evaluation method which can be helpful to evaluate the mobile enhanced-accessibility. To present the new method we have evaluated the mobile-enhanced accessibility prototype Augment by using use case testing. We have indentified some problems/weaknesses which were faced by users while testing. To remove those problems/weaknesses we have introduced a new method ”AccessEva” on the basis of literature findings and evaluation results which will remove those problems and provide efficient evaluation of mobile enhanced accessibility.

1.1 Background

1.1.1 Inclusive Design, Universal Design and Design for all

Inclusive Design, or Universal Design, or Design for All, is an overall strategy and philosophy which is based on giving all people equal opportunities to contribute and participate in modern society (Silva and Almendra, 2007). According to above explanation it means that our physical surroundings, products and services are planned and designed in a way so that everyone can participate regardless of physical ability or age.

Inclusive Design shares a similar origin as well as identical objectives of other design approaches or denominations, such as: “universal design”, “lifespan design”, “design for all”, and “design for diversity”. The origin of the term Universal design is North American
and more advancement started when the issues of disabled people arise, having assumed later on more overall position and meaning.

According to Centre for Universal Design, USA formally the concept supports itself in the “Seven Principles of Universal Design”, formed by a group of researchers, architects, engineer, product designers, and environment designers. Inclusive Design is not an obstacle, in fact it’s a challenge and a philosophy based on individual differences. They further added that the basic concept is all human beings are entitled to human dignity on equal terms. This principle must dominate the development of a society open to everyone, and that leads to Inclusive Design concept. They said that when we are talking about participation then we must think about physical surroundings that also play a major role in the creation of physical barriers for example when wheel-chair users, people pushing prams, persons with walking difficulties, or senior citizens cannot climb the steps to a shop or an office or a mean of transportation like bus stops and where there is no elevator or any other alternative. While designing systems we must not forget that these people are active agents of their own will.

In many situations the physical environment can directly prevent people from participating in desired activities on equal term. Apart from physical environment there are many other areas such as buildings, product design, sign-posting, colour selection and combination, transport and IT where Inclusive Design could has a considerable growth (Silva and Almendra, 2007). They further said that an environment filled with obstacles or lacking of facilitators will eventually reduce the performance on the other hand the environments, filled with facilitators, will eventually improve the performance. Silva and Almendra (2007) further explained that Inclusive Design doesn’t start only with the ambition of designing for all, but with a critic overview of the world in which we live in. They said that in fact it is based in a holistic and sustainable understanding of the people who built environment.

According to Silva and Almendra (2007) the Inclusive Design is framed by the two central concerns of the 21st century Design:

- **Demographic Changes** – A reduced birth rate and longer life of the elderly are the main factors.
- **Sustainability in global terms** – The understanding of the point of view of degradation of the natural resources is not enough. The best way if to find a better management of time, creativity, consistency, and without loss of human life quality.
Apart from all above a cultural, social, and relational sustainability, stimulated by a material culture.

Silva and Almendra (2007) explained that Inclusive design is frequently associated with usability and utility. As a result, inclusively designed products are often looked at as tools with which users achieve tasks. They further said that the challenge for inclusive design is to move from looking merely at users, tasks, and products to take a more holistic view at people, products and their relationships.

A practical lead was given by Sweden, because of innovative thinking people like Maria Benktzon of Ergonomic Design Group who develop high quality assistive products in collaboration with the Swedish Health Service (Clarkson & Coleman, 2010). The products are based on contemporary design values and extensive user research. They further said that this development was basically triggered by a 1968 seminar at the Design School in Stockholm in which Papanek and Andrzej Pawlowski were involved. Papanek also contributed at a similar design seminar at the Royal College of Art, London, in 1976, which explored the subject of Design for Need between 1979 and 1982. In addition, American designer Patricia Moore of Raymond Leowy’s New York office conducted an influential experiment, where she transformed herself into an elderly woman to reveal the inadequacy of much design.

Over the previous more than 50 years, the trend has moved to participation as well as empowerment. The participation has emerged to meet the needs of the disabled people (Eriksen and Ekelin, 2008). A number of techniques were developed but the more emphasis was on “engaging users activity in design on prototyping” (Eriksen and Ekelin, 2008 & Dearden and Rizvi, 2008) which could support the disabled people to access the inaccessible places/things. According to Pretty et al (1995), Dearden and Rizvi (2008) the user participation approaches are being utilized for the projects which are working on livestock, health, rural development, community appraisal, water and agriculture and many more. Pretty et al (1995), Hanks et al (2008), and Ekelin et al (2008) explained that participation is a source to make product design better in terms of accessibility.

Furthermore (Holmquist, 2005) explained that it is a good idea to evaluate the accessibility as soon as possible. In the same context (Billi et al, 2010) said that the basic purpose of accessibility evaluation is to assess the accessibility of application. The accessibility evaluation could be user specific such as for target groups like hepatic, motor, blinds and visually impaired people.
There are many evaluation methods available for accessibility evaluation like scenario base testing, expert walkthrough and focus group and their selection has based on their context of use. The pros and cons of accessibility evaluation methods are also based on their context of use.

This thesis research is a contribution in the on-going research to find out an efficient and reliable evaluation method to evaluate the mobile enhanced accessibility. We have evaluated the Augment prototype (Designed by BTH innovation and released on February 2011) to find out the efficient and reliable evaluation method for mobile-enhanced accessibility. The purpose of the Augment prototype was to deal the accessibility issues faced by all users.
2 Research Methodology

2.1 Problem definition

Newell et al (2010) has suggested that the methodologies should be extended to form a paradigm; this should include methods for communicating research results effectively along with techniques. There are many applications for disabled people with the combination of new technology like ComMotion (Zhao, 1997) for location sensing with time constraints, Sonera Pointer (Kaasinen, 2003) in Finland for location aware, GIS (Beale et al, 2000) modelling access for wheel chair, MoTag (Goh et al, 2007) for disabled people to share up to date accessibility information about buildings, OurWay (Holone and Misund, 2008) for route planning functionality and accessibility ratings and Ekelin et al (2010) has also suggested the Augment prototype for disabled people to share information among people. To evaluate the mobile-enhanced accessibility there are number of evaluation methods available such as scenarios of use (Nielsen, 1991), personas (Cooper, 1999), field study/observations (Preece et al, 1994), focus groups (Caplan, 1990), interviews (Macaulay, 1996), heuristic evaluation (Nielsen, 1992), expert walkthroughs (Fitter et al, 1991). As explained above there are different evaluation methods available in the literature to evaluate the mobile enhanced accessibility but the question is still unsolved, what are the efficient and usable evaluation methods that enable valid and reliable evaluation of the mobile-enhanced accessibility. According to Billi et al (2010) finding methodologies for accessibility evaluation is just as important as early assessment and these must be as appropriate as possible to specify the project. According to Duh (2006), mobile devices typically are used in different situations, but current evaluation method cannot cover problems in all type of situations.

Thesis Task

This thesis study evaluates the effectiveness of conventional real life situation in context of mobile enhanced accessibility and eventually presents an efficient and usable evaluation method named “AccessEva” for the reliable evaluation of the mobile-enhanced accessibility.

2.2 Aims of Thesis

The aim of thesis is to find out a method for the evaluation of mobile enhanced-enhanced accessibility which can provide an efficient and reliable evaluation of mobile enhanced accessibility applications.
1. To identify the efficient and usable evaluation method that enables valid and reliable evaluation of mobile-enhanced accessibility in real life situation.

2. To provide optimal solutions for mobile-enhanced accessibility evaluation with user participation.

2.3 Research Questions

To fulfil the aims, two research questions were designed which are as follows.

1. How to evaluate mobile-enhanced accessibility with user participation?
2. What kind of efficient and usable evaluation methods enable valid and reliable evaluation of mobile-enhanced accessibility in real life situation?

2.4 Research Methodology

We have conducted our study using qualitative research methodology. In first phase, we have conducted literature review to understand Accessibility and evaluation by using IEEE, ACM, Compendex, Inspec and Google Scholar and to know how it could be helpful to improve the mobile enhanced accessibility. In the first phase literature review supported us to identify the evaluation methods that enable evaluation of mobile-enhanced accessibility. In the second phase based on some selected evaluation methods that enables evaluation of mobile-enhanced accessibility, we performed evaluation of the Augment prototype in real life situation as mobile-enhanced accessibility.

There are different methods to evaluate accessibility through mobile phones but we have chosen the use case testing because it is useful and important tool for early exploratory design situations and evaluations (Carroll, 2000). It is the first release of The Augment prototype so we have utilized use case testing scenarios for its evaluation. After the demonstration of Augment prototype and before users, we observed the participants while they were testing scenarios. We repeated the consecutive number of test sessions with different participants. We conducted tests indoor and outdoor to notice the behaviour of the users and to know whether environment and weather had some effect on the users. The observation is used in two distinct ways, one is structured and another is unstructured Pretzlik (1994). The motivation behind using structured observation in the Augment prototype evaluation is, to record physical and verbal behaviour of users as a discrete activity. We observed users while locating and searching desired location in indoor and outdoor environment. Instead of laboratory setting user can feel comfortable to perform
tasks in actual contexts as well as observation is quite closer to the expected response from users while using augment prototype. In the field of psychology structured observation is used extensively, and many researchers have make use of this method for their own research studies.

The main purpose of the interview is to get information regarding some specific product Kvale (1996). In addition it is identified that interviews could be structured, semi structured and unstructured. We used unstructured interviews for evaluation of the Augment prototype. As this is the first version of the Augment prototype so there were some risks in using structured interviews, as structured interviews restrict users around particular asked questions by interviewer. The main idea behind using unstructured interview was to provide space for interviewees to let them discuss their own ideas. We conducted interviews with the users, researchers and the prototype developers. We used video recorder to record conversation through interviews. After then we transcribed all the videos and got valuable data because they were very useful for us to evaluate the Augment prototype.

Furthermore on the basis of the evaluation results, suggesting the efficient and “usable” evaluation method that enables valid and reliable evaluation of mobile-enhanced accessibility.
2.5 Motivation

Evaluation is an important aspect of HCI process (Greeberg & Buxton, 2008) and it is done to remove the faults in application/prototype. We are rich in technology and it is becoming a global asset reaching out to different kinds of people with varying competences with computers and software products in general. This trend in technology has led software designers to gain insight into the way the target users understand and utilize given interface
designs of their products. There are many people who are physically impaired and they are unable to move in the society as the healthy people can as well as the technology may become easier to use with less complications. The above explanation put more focus on the mobile-enhanced accessibility applications and their evaluations. In the literature we identified that finding methodologies for accessibility evaluation is just as important as early assessment. On the basis of the findings from literature review and evaluation of Augment prototype, we have presented the mobile enhanced accessibility evaluation method named “AccessEva” that enables the reliable evaluation of mobile enhanced accessibility in real life situation.
Literature Review

3 LITERATURE REVIEW

3.1 Accessibility and Evaluation methods

3.1.1 Accessibility

The National Board of Housing, Building and Planning prescribes the following under Section 6 of the Planning and Building Ordinance (Swedish Code of Statutes (SFS) 1987:383) that contains regulations and general recommendation relating to the requirements of the Planning and Building Act “the PBA” that public spaces and areas for constructions other than buildings shall be usable by people with limited mobility or orientation capacity. (Swedish legislation, 2004)

Accessibility essentially describes an individual's ability to engaging users activity in design by iterative prototyping – collectively, 'opportunities' (Litman, 2003). Accessibility is closely related, but not similar to mobility. Accessibility is the ultimate aim of mobility. (Matthew et al, 2006)

Dan et al (2007) described that Individuals with mobility problems such as wheelchair users face difficulty while traveling even for short trips sometimes. Independent mobility is important for the people who have mobility problems for quality of life. People with wheelchair face many barriers like bad weather, street ramps, and door pressure and travel surfaces during their activities of daily living. Many wheel chair users hesitate to travel a new location because they have no information about the accessibility conditions of that place. (Dan et al, 2007)

According to Staphinids, (2000) accessibility lies with the possibility to “direct” the user into an artificially “smaller” information space than the real one, where all the required information is present. At early stages, accessibility problems were primarily considered to concern only the field of Assistive Technology (AT), and consequently, accessibility involve meeting prescribed requirements for the use of a product by people with disabilities (Staphinids and Anthony, 2001). A product for accessibility which is designed for disabled people some time becomes more difficult for the people without disabilities and almost impossible for the people with all type of other disabilities in terms of accessibility. Accessibility features are considered as a part of normal designs and products. Accessibility is closely related to the purpose of facilitating the user to develop and maintain his views of the information space. The accessibility challenge is to enable users to understand the overall
structure of the system like similarities and differences between its components/portions. (Staphinids et al, 2001 & Newell & Gregor, 2002)

Moreover Newell and Gregor (1999) explained that in all stages of specifying, designing and implementing technology for work, it is vital to consider people with disabilities while considering the potential user group. They further explained that it is because nowadays disabled people forming a significant and growing proportion of the workforce. They further explained that many people have some disabilities, sometimes temporarily due to accident, or permanently due to ageing and other processes. According to the authors of this thesis, Newell and Gregor (1999) also contributed in the research of optimal software systems and they considered disabled people as an important part of our society.

Afterwards Banes & Seale (2002), explained that "the assistive technology community focuses on the design, production and evaluation of equipment (including software) that can be used to maintain or improve the functional capabilities of people with disabilities". The organization of physical places limits and affects disabled people’s possibilities of participation in routine activities. In addition to this Ekelin et al (2010) further said that the physical environment in Sweden at some level lacks the relevant customization as well as there are also gaps in accessibility for groups of people with different disability problems. She further explained about the other side of coin that in the field of rebuilding of physical environment, some accessibility problems are solved over time as well. But the point is how these reinforcements and changes are communicated to the affected groups of individuals with disabilities who are dependent on such information.

If we consider the wish list of people with disabilities then a repeatedly formulated wish is the possibility to describe environments with the help of images where the user of software her/himself can decide about and evaluate the offered accessibility. Ekelin et al (2010) further explained that "in a recent charting of different EU-initiatives, HANDISAM, the Swedish Agency for Disability Policy Coordination, point out that the aim of steering development and research towards more inclusive projects and solutions has been based on the i2010 strategy, the guiding framework for accessibility issues".

Von (2008) explained that there are discussions going on about legislation of eAccessibility within EU. He said that the European Commission highlights the importance of prioritizing a mutual, coherent, and effective strategy for eAccessibility, or web accessibility, in order to rise up the development of the eSociety in line with a new social agenda.
3.1.2 Accessibility Related Projects/Applications

We have found some applications through literature for individuals with disabilities e.g. Beale et al (2000) developed and test GIS for modelling access for wheelchair users in urban areas Kurihara et al (2004) presented a general architecture for barrier free street maps and Sobek and Miller (2006) developed a web-based system for pedestrians of differing abilities. Ekelin et al (2010) presented the idea of the Augment prototype which is a mobile phone application and provides support for the disabled people to move around. The Augment prototype works with smart phones especially with android. Mobile phone popularity is growing rapidly and it is estimated that currently over one half of the world’s population, or 3.25 billion people, owns a cell phone (Micheal, 2008). MoTag is a mobile tagging application which is used for the help of disabled people to share up-to-date accessibility information about buildings and other physical structure to navigate (Goh et al, 2007). Another mobile phone application is the OurWay prototype whose server stores the necessary data and user annotations, and provides route-planning functionality and accessibility ratings (Holone and Misund, 2008).

Due to the mobile phone usage the communication has become very easy and it has changed the life style of the common users of mobile phones (Virrantaus et al, 2002). GPS technology permits the localization of the receiver with increasing accuracy, that using complex methods can reach to the meters (Abascal and Civit , 2000). As applications for mobile phone terminals with localization capabilities in many areas are potentially very high and the high success rate of these systems is easy to predict. The real benefits from mobile phones with Localization for disabled and older users will depend to a great extent on their requirements being considered during the evaluation phase.

3.2 Evaluation methods for mobile-enhanced accessibility

Our main challenge was to find out efficient methods for evaluation of mobile-enhanced accessibility applications. Duh et al, (2006) has described that there are two main areas for evaluation of mobile phone application, Laboratory and real life-settings. We selected evaluation methods for real life-settings in order to come as close to the users’ experiences and circumstances as possible.

Users are the main stakeholders who directly interact with the system. Developers who are working on their own do not have sufficient domain knowledge of user domain (Landauer, 2005). In order to capture user interaction and experience as well as perform evaluation there
are number of related methods such as observation, use case testing, usability testing, interviews, think aloud protocol, contextual inquiry, heuristic evaluation and expert walkthroughs. The basic philosophy behind these all is that the best and affective way to understand and capture users’ experiences how they use application and the observations while users’ operate and concurrently talk about their experience.

The accessibility is evaluated through unrefined prototype as soon as possible because prototypes provoke further innovation through evaluation (Holmquist, 2005). The aim of the accessibility evaluation is to assess the accessibility features of a mobile application for a specific user group like motor, hepatic, blinds and visually impaired people (Billi et al, 2010).

We performed accessibility evaluation of the Augment prototype to find out an efficient and reliable method for the evaluation of the mobile-enhanced accessibility. There are number of methods for the evaluation of accessibility which vary according to their context of use. In the next section we have identified the methods that can be used for the evaluation of mobile-enhanced accessibility but our purpose is to find out the most efficient evaluation method. The found methods are as follows

**Field study** is used for the evaluation of accessibility. Nielsen (2002) said that Field study is easy and fast to conduct and it does not require all members of design team to visit the customers/users. Bevan & Sharon (2009) explained that a field study is a method used to collect data about users, users’ needs and product requirements by having observation and interviews. They further said that in field study data gathered about users’ physical and organizational environments. In this method investigators observe users at their work and note down users’ activities and questions asked by users. This method is also helpful in gathering requirements at early stages of product development from the users. It is also helpful to study the executed processes and tasks at the same time.

In context of the Augment prototype field study could be feasible because as explained by Nielsen (2002) Field study is helpful in gathering requirements at early stages of product development from the users. He further explained that in field study we gather data about users’ physical and organizational environments. In case of prototype argument it is in early stages of development and we can also gather data about the Augment prototype users when they are performing tasks. Field studies could be a suitable method for our case as it gives an opportunity to gather data about real environment. In real environment we can gather data about the actual context of use instead of gathering data in lab studies.
Rabiee (2004) and Krueger & Casey (2000) described that **Focus group** is a method which is used for detailed group interviews in which participants are chosen because they have the same purpose and keep focus on the given topic. Focus group members selection criteria is to choose those members who can speak on the topic, have same age group and comfortable while talking to the interviewer. The selection based on the knowledge on area of the participants. One aspect of focus group is to get deeper and richer data as compared to one to one interview. Focus group is a method to get information regarding every individual on some specific topic and remove the differences among group members. Focus group can attain a lot of data as compared to any other method in a very short time. Through focus group we can gather very rich data in a very short time. During the focus group we can gather data about the specific group of people. It will identify between person level differences about the Augment prototype. It will further identify different thinking and opinions during the focus group discussion.

Bevan & Sheron (2009) stated that the main aim of the **observation** is to note the behaviour of the user through watching and listening. Observation is a very good method to see what people are doing, when they are doing, where they are doing and how they are doing. Information gathering may vary with environment, with people in surrounding with weather conditions and time also does matter. Observation includes Actions, place, time, behaviour /situation. Observations are of two types, one is direct observation in which the observer is actually present during the task and the other is indirect observation in which the task is viewed by using some other source like video recorder to follow the activities of the users. (Bevan & Sheron, 2009)

After the analysis we observed that the observation is a considerable method for mobile-enhanced accessibility because it gives the data about an overall behaviour of the users who are performing tests. For example if the user is not feeling comfortable while performing the tasks but he/she hesitates to explain about it to evaluators then the evaluators can observe this situation after seeing the video. Evaluators can identify their emotions, feelings, and experience about the prototype they are testing.

The main purpose of the **interview** is to get information regarding some specific product. The key Informant is the one who can provide the information regarding the product in a better ways because he/she has better knowledge of the product. The key informant provides information according to his/her own assessment and the other thing is that to access that information which would be difficult to access without his/her participation. Questionnaires
are also suitable to get the views of the people against the product and to get some suggestions for its betterment.

We identified that interviews are useful for all systems but the main concern is the structure of the interview and the structure depends with whom we are going to conduct interviews. The interview strategy could be very effective in semi-structured interviews. In semi-structured interviews the interviewers can formulate the questions according to the interview flow and discussion. The findings about the semi-structured interview were identified during the interview phase of this thesis. The main focus was to identify the efficient and usable evaluation method enables valid and reliable evaluation of mobile-enhanced accessibility. Authors identified that semi-structured interviews are very effective in order to evaluate the mobile-enhanced accessibility.

According to Bevan & Sheron (2009) the expert walkthrough is a scenario based method, aiming to identify usability problems and possible improvement. This method does not require evaluators training. The expert walkthrough is particularly suited for early evaluation of applications. In walkthrough the evaluators are the expert of domain so they can provide valuable feedback beyond usability issues based on their own experience. We can also use some additional material to motivate the participants to find more problems and their possible solutions. Expert walk through is one the evaluation method which is a proper source to evaluate mobile enhanced accessibility prototype because it provides the motivation for the participants to find more error in the prototype, and the evaluators add their knowledge and experience during evaluation as well.

Use Case Testing

Testing focuses on user needs and iterative design and they are conducted to get information about the specific tasks. Dumas and Reddish (1999) has stressed that designers are aware that the product should be tested before it is released for the public. There are different methods to evaluate mobile enhanced accessibility but use case testing is a useful and considerable tool for early exploratory design situations and evaluations. (Carroll, 2000) It is useful to get information and it is also the most suitable method to get the expected results for specific objectives. Test cases are used to tell the users what to expect, the developer what to code, the technical writer what to document and the tester what to test. (IEEE, 1990 & Ron, 2001 & Heumann, 2001)

Each use case also requires a significant amount of text to describe but if it has some mistakes like incompleteness, less description, low functionality, inaccuracy, ambiguity and
update then these problems will affect the whole testing phase of the prototype. (Heumann, 2011)

Historically testing is done in the laboratory with the experts in user-interface design and testing. Many large organizations like Microsoft and IBM follow the same. In addition Dumas and Reddish (1999) and Ben Shneiderman (1992), identified that the test are conducted in the area where designers observe the testers unnoticed.

The other main aspect is that the evaluation should be continued as the product has been released. According to Dumas and Reddish (1999), Use Case Testing aims to achieve the following goals

- Improve the product’s accessibility
- Involve real users in the testing
- Give the users real tasks to accomplish
- Enable testers to observe and record the actions of the participants
- Enable testers analyse the data obtained and make changes accordingly

**Scenarios**

Each use case documented as use case scenario and user or system navigates through the application by using these scenarios (Quell, 2006). Scenarios are stories and they have goals and objectives (Carroll, 2000). Scenarios provide help for designers to focus on assumptions about people and tasks. Scenarios are concrete yet flexible. Scenarios can encourage reflection during design. Scenarios promote work orientation. Scenarios are generated through field studies by designers and they are used to introduce concrete ideas about how users’ requirements can be met. Scenarios are created for the representations of a task’s objects. Interaction design scenarios elaborate how users would interact with the system to perform the new activities. (Rosson and Carroll, 2001) Scenarios in accessibility have proved to be a useful and important tool for early exploratory design situations and evaluations (Carroll, 2000). Scenarios can also be used for good and bad use situations. We have designed some tasks to perform the testing on the selected Augment prototype. These tasks were given to the participants to perform their tasks and the evaluators recorded their actions and problems, how they performed the test so that the evaluators could present an efficient method after removing those problems which were faced by users during testing.

### 3.3 Dix Model

In order to get an efficient and reliable method through the evaluation of the Augment prototype, we can have a number of models and standards like International Standards
Organization (ISO 9126-1 & ISO 9241-11) and Nielsen model but we have selected Dix et al (1993) model to use the evaluation results which is based on effectiveness, efficiency, satisfaction and learnability and covers the Nielsen (1994) usability model and ISO standards 9241-11. According to ISO 9241-11 we have the following attributes to measure the prototype in terms of use.

**Effectiveness**: According to ISO 9241-11, effectiveness is the accuracy and completeness with which users achieve specified goals.

**Efficiency**: Efficiency is how a user can perform tasks on the system accurately and correctly. It is related to the system performance. (Minati, 2006)

**Satisfaction**: Satisfaction deals with the users requirements to be fulfilled when users use the system. (Folmer and Bosch, 2004)

**Learnability**: Learnability is defined as: “The system should be easy to learn by the class of users for whom it is intended” in 1980 (Michelsen et al, 1980).

According to Giorgio et al (2009) there are many recommendations on how technologies should be used without posing barriers to people with disabilities like Web Content Accessibility Guidelines (WCAG). These guidelines are followed by developers and designers to ensure good level of accessibility for all users including users with disabilities. They further explained that WCAG can also be used as a base for evaluation through different metrics. These metrics depend on single result obtaining from the verification manually performed by experts or automatically evaluated through software. Expert evaluation provides in-depth answer of the accessibility quality of a web page and poses problem on the scalability. On the other hand software evaluation has the benefit of scalability and objectivity.

Our concern in this research is to find out a method for the evaluation of mobile-enhanced accessibility. Hornbæk (2006), Jiyoung & Han (2002) and Carroll (1997) have referenced about Dix et al (1993) model and explained that it could be a better tool for the evaluation of the prototype. So we have chosen Dix et al (1993) to use the Use Case Testing results because it elaborates all the factors which could be helpful for evaluation. The main aspects of Dix et al (1993) model regarding efficiency are as follows

1. **Number of good characteristics recalled by users**
   There are some characteristics of the system or prototype like icons, visibility, performance, and error free, response time that users while performing the test recall them as good.

2. **Number of bad characteristics recalled by users**
Sometime while performing the tasks user feels that the system response time is slow and application take a long time to complete.

3. **Time to active one task**
   How much time is required to active one task, like if someone clicks an icon then how much time it required to active and performs something?

4. **Time spent on errors**
   How much time is used on the errors in the application? If you use much time on the application then no one will use it.

5. **Error’s percentage**
   This deals with the percentage of the errors, it means while performing the task how frequently errors occur.

6. **Documentation or help user frequency**
   Documentation or help can improve the functionality of the system. Users pay more attention towards application and this increases learnability of the system. Help also provide guidance for users to perform tasks on the system.

7. **Repetition’s number of failed commands**
   How many commands are there which do not perform operation and they are repeated.

8. **Number of available commands not called upon**
   There are some commands which are present on the main interface but they are not recalled.
Fig. 2 Usability model (Dix et al 1993)
4  USE CASE TESTING

Use case testing is useful and considerable tool for early exploratory design situations and evaluations. We have evaluated and analysed the mobile-enhanced accessibility prototype named “Augment” in order to find an efficient method for mobile enhanced accessibility.

![Augment Prototype Front Page](image)

Fig. 3 Augment Prototype Front Page

4.1  Designing of Use Cases

We have designed use case tests for the participants who took part in testing. We designed use cases on the basis of Unified Modelling Language (UML) by using Microsoft Visio tool. Each use case represents a functionality that will be implemented using mobile phones and every actor (test participant) represents someone outside the system who interacts with the mobile phones. Each use case also requires a significant amount of text to describe but if it has some mistakes like incompleteness, less description, low functionality, inaccuracy, ambiguity and update then these problems will affect the whole testing phase of the prototype.
Table 1. Use case description

<table>
<thead>
<tr>
<th>Use Case section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name</strong></td>
<td>An appropriate name should be used for the use case i.e. view Tag, add tag</td>
</tr>
<tr>
<td><strong>Brief Description</strong></td>
<td>Use case’s role and purpose should be described briefly i.e. use case is designed to perform function to view(toilets, cinema, restaurant) and to add picture</td>
</tr>
<tr>
<td><strong>Flow of Events</strong></td>
<td>There should be clear description for the participant/user to understand the system with regard to the use case. I.e. how to reach the view tag or add tag.</td>
</tr>
<tr>
<td><strong>Special Requirements</strong></td>
<td>Non-functional requirements on the use case, that is not considered in the use-case model, but need to be taken care of during design or implementation in text description.</td>
</tr>
<tr>
<td><strong>Preconditions</strong></td>
<td>Any constraints on the system before the start of the use case in text description</td>
</tr>
</tbody>
</table>

4.2 Tests cases conduction

We used use case tests to find out an efficient method to evaluate the mobile enhanced accessibility prototype. Test cases are conducted to get information about the specific tasks like view tag or add tag... We have designed two tasks for every user to perform i.e. task 1 is view tag and task 2 is add tag.

Table 2. Test protocol for use case testing (Jacobson et al, 1992)

<table>
<thead>
<tr>
<th>Task 1. View Tag test protocol</th>
<th>Task 2. Add Tag test protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. User will click on, one of the “icons” on the main interface.</td>
<td>1. User will click on report icon on main interface.</td>
</tr>
<tr>
<td>2. User will click on the “menu” button.</td>
<td>2. User will click on camera button to take picture.</td>
</tr>
<tr>
<td>3. User will click on “include me/ follow me” button.</td>
<td>3. User will click on done button after taking picture.</td>
</tr>
<tr>
<td>4. User will click for zoom in and zoom out.</td>
<td>4. User will click Android Gallery button.</td>
</tr>
<tr>
<td>5. User will click on the icon on the map.</td>
<td>5. User will select camera shoots</td>
</tr>
<tr>
<td>6. User will select one item from the listed tag.</td>
<td>6. User will click on menu</td>
</tr>
<tr>
<td>7. User will click on the “map view” option.</td>
<td>7. User will click on share</td>
</tr>
<tr>
<td></td>
<td>8. User will click on Augment</td>
</tr>
<tr>
<td></td>
<td>9. User will click on title.</td>
</tr>
<tr>
<td></td>
<td>10. User will click on “Unknown”</td>
</tr>
</tbody>
</table>
8. User will click on back button.
9. User will click on “Street view” option.
10. User will click on back button.
11. User will click on “Detail” option.
11. User will click on “Adjust Position” button
12. User will click on comments
13. User will click on “send” button.

4.3 Scenarios

We designed use cases for the participants to perform some specific tasks on the Augment prototype like “view tag” and “add tag” and observed how they behave/react while performing these tasks. Each use case documented as use case scenario and user or system navigates through this prototype by using these scenarios. Scenarios for mobile enhanced accessibility prototype are given below.

Table 3: use case testing scenarios (Jacobson et al, 1992)

<table>
<thead>
<tr>
<th>Task 1. View Tag scenario</th>
<th>Task 2. Add Tag Scenario:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. User will click on, one of the “icons” on the main interface.</td>
<td>1. User will click on “report” icon on main interface.</td>
</tr>
<tr>
<td>2. System will show icon on the map.</td>
<td>2. System will show camera for picture.</td>
</tr>
<tr>
<td>3. User will click on the “menu” button</td>
<td>3. User will click on camera button to take picture.</td>
</tr>
<tr>
<td>4. System will show four options, include me, follow me, toggle map and back to main</td>
<td>4. System will show two options done, camera icon.</td>
</tr>
<tr>
<td>5. User will click on “include me/follow me” button.</td>
<td>5. User will click on done button after taking picture.</td>
</tr>
<tr>
<td>6. System will show a small circle on the map.</td>
<td>6. System will show main interface.</td>
</tr>
<tr>
<td>7. User will click for zoom in and zoom out.</td>
<td>7. User will click Android Gallery button.</td>
</tr>
<tr>
<td>8. System will show small and large map</td>
<td>8. System will show camera shoots.</td>
</tr>
<tr>
<td>9. User will click on the icon on the map.</td>
<td>9. User will select camera shoots.</td>
</tr>
<tr>
<td>10. System will show items related to tag</td>
<td>10. System will show picture taken through camera.</td>
</tr>
<tr>
<td>11. User will select one item from the listed tag.</td>
<td>11. User will click on menu.</td>
</tr>
<tr>
<td>12. System will show three options map view, street view and detail</td>
<td>12. System will show multiple options.</td>
</tr>
<tr>
<td>13. User will click on the “map view” option.</td>
<td>13. User will click on share.</td>
</tr>
<tr>
<td>14. System will show map again</td>
<td>14. System will show different icons.</td>
</tr>
<tr>
<td></td>
<td>15. User will click on Augment.</td>
</tr>
<tr>
<td></td>
<td>16. System will show screen with keyboard.</td>
</tr>
<tr>
<td></td>
<td>17. User will click on title.</td>
</tr>
<tr>
<td></td>
<td>18. System will show entered title.</td>
</tr>
</tbody>
</table>
Use Case Testing

15. User will click on back button.
16. System will show again three button
17. User will click on “Street view” option.
18. System will show street view
19. User will click on back button.
20. System will show three options
21. User will click on “Detail” option.

19. User will click on “Unknown”.
20. System will show selected tag.
21. User will click on “Adjust Position” button and then pick position.
22. System will show picked position.
23. User will click on comments.
24. System will show entered comments
25. User will click on “send” button.
26. System will show progress like one sent.

4.4 Context and Observations of Mobile Phone Users

4.4.1 Context of Use

The Augment prototype is designed to deal the accessibility issues for different people. We performed these tests in different context in order to know how users behave using the same application in different context.

We conducted 14 tests in different context. We selected fourteen members from different backgrounds. Six of them were students, three of them were professional smart phone users, and five of them were common people. Most of them were young, two of them on wheel chairs. The users ages vary from 20-30, 30-40 and the remaining were above 40. Every user was given two tasks to perform on the Augment prototype. The tasks were “view location” and “add location”.

We performed tests indoor and outdoor with users so that we came to know that how users behave during tests with different environments. Does this affect the users or not. Indoor tests were taken in calm environment while during the outdoor tests there was hustle and bustle in surroundings.

Some of the users performed both indoor and outdoor tests. The indoor tests were conducted at different places. Some tests were conducted in Blekinge institute of technology, Gräsvik campus. Some tests were conducted at school in Ronneby and some tests were conducted in Karlskrona Municipality Library.

In Gräsvik Campus, authors conducted tests at different locations like outside library, corridor, cafeteria and silent rooms. We selected different test locations for different users so that they can perform tests in multi environments (indoor, outdoor). We performed some tests when nobody was in surroundings and some tests when many people were in surroundings. In Ronneby school, we tested in study room where a very few people were in
In Municipality Library, we performed tests in the main hall where people were moving around. We did some tests outdoor as well and selected different outdoor locations like Karlskrona Centrum, Ronneby Centrum and its surroundings. We conducted tests in a pleasant environment. In Karlskrona Centrum, we performed tests in a sunny day and many people were moving around while in Ronneby Centrum, it was cold outside and during one test it was raining as well. Some people were walking around.

We designed scenarios for users to facilitate them, so that they can perform tests easily. We also gave 10 minutes briefings to every user before conducting the test how to perform prototype tasks. We gave use case scenarios and smart phone with the Augment prototype to every user. Every user performed his/her first task (View Tag) following the use case scenarios. We recorded through video camera when he/she was performing his/her task on the Augment prototype. Then every user performed his/her second task (Add Tag) following the use case scenario and we also recorded through video camera as well.

![Use Case Testing participants using the Augment prototype](image)

(Fallman and Waterworth, 2005)

4.4.2 Observations

As the users were performing their tasks one of us was recording the video and the other was observing the behaviour of the users. We recorded video for all users. It longed more than two and half hours. Some users took more time while performing the tasks and some of them performed their tasks in few minutes. The video recording was very helpful and useful for us to observe the behaviour of the users while performing the tests. We observed that face expressions of some users were changing continuously. In the beginning some users were
nervous, some were happy and some were stern. We observed that users were feeling difficulty while remembering the steps of first and second task.

As the users were unable to remember the steps so they were looking for help again and again while performing the tasks. We also observed that while performing tasks sometimes some users lost themselves in the prototype and they became nervous and they could not perform well according to the test case scenarios. We noticed that sometimes during the test when some users forgot something to perform, they got puzzled and they behaved as, we were testing their ability. We took some test retakes for such users. We observed that only a few users were able to perform tests without asking for help. Most of the users happily performed their tasks.

We also noticed that good and bad weather effects on the behaviour of the users. During the sunny day all users were performing happily. The users seemed interested to spend their time in the use of prototype. While in the cold and rainy day, the users seemed that they were interested in using the prototype but due to the bad weather they only performed their tasks but could not spend more time with the prototype use. It was also observed that when the users were free they performed their tasks well and when they were in hurry or busy somewhere they did not perform accordingly.

![Fig. 5 Use case Testing Participant’s observations (Gabrielli et al, 2005)](image)

### 4.4.3 Emotions

During the Augment prototype evaluation we observed that most of the users were happy and in a good mood. Some of them were enjoying the sunny day and some were free from their jobs and studies and some of them were enjoying holidays. Some of them were walking on the road and some were going for shopping. Every user was happy and some of them
were enthusiastic to perform the tasks on the Augment prototype. In the beginning, every user started the test in a good mood but during the tests some users felt problem while using the Augment prototype. They changed their emotions at different stages while performing the tasks but at the end many users performed their tasks successfully. During the use case testing we noticed that the users needed a learning period before conducting the tests themselves.

4.5 Analysis of Use Case Testing

We have analysed the results through use case testing and observation of participant while performing tasks, which are as follows

- **Sense of Freedom**: During testing, we analysed that many users were feeling hesitation while performing tests.
- **Learnability**: During testing, we found user with short memory. He took a lot of time while performing the test. We had to revise our test many times and at the end he was so puzzled, he could not perform the test properly.
- **Motor Disability**: During testing, we found one user, whose fingers start to shiver in nervousness. While performing test, he tried to click at one place, but he clicked at other place. His reply was that it happens in nervousness. So it was hard for him to perform test because he was just thinking that we are testing his abilities.
- **Physical disability**: During testing, one of the users was facing a problem of mobility and load unbalancing. It was a big problem for him to perform test in the field.
- **Exploration**: During testing, many users could not perform tests properly, because they were unable to explore the prototype in a proper way. They were just performing tasks and when they could not, they became nervous and lost their attention towards prototype.
- **Time**: We performed tests in the field. We observed that people spent their much time in using the prototype.
- **Engaging**: Sometimes scenarios are difficult to recreate and hard to extend with assurance. Scenarios weakness is that they are not engaging. We found through testing that scenarios are not engaging the participant properly.
- **Efficiency**: During testing, we found that users are facing some errors in application which reduces the efficiency of accessibility prototype.
• **Reliability:** During testing, we found that tasks completion was not reliable. Some users performed tests differently as they were asked to perform.

• **Usefulness:** During testing, we found that the application tasks were performed but some users became nervous while performing tasks and they could not produce useful results.

• **Satisfaction:** During testing, we found that users were not satisfied with the performance of the accessibility prototype. Users explained that its performance is low.

• **Accuracy:** During testing, we found that tasks performance was not accurate. Users mostly performed the tasks twice or thrice. However, it was asked them before how to perform the task but the tasks performed were not accurate.

### 4.6 Summary of Use Case Testing

After the analysis of use case testing, we came to know there were some weaknesses in the Augment prototype, which made it difficult to operate for some users. We also came to know that accessibility issues vary according to users. We also found that use case testing have some weaknesses like engaging the users and providing the sense of freedom to users while performing the tests. To provide the solution of these weaknesses we have suggested a new method for accessibility evaluation named as AccessEva.
5 INTERVIEWS

Interview is the source of collecting qualitative data and the aim of our interviews with representatives of the Augment prototype is to let them express and share their experiences, and opinions about accessibility evaluation of the Augment prototype. We made selection based on their ambition to interview different Augment prototype representatives, for the need of mobile enhanced accessibility evaluation.

5.1 Purpose

We made five extensive interviews with the purpose to explore interviewees’ ideas about the most suitable evaluation methods. All the interviewees have explicitly given us permission to use their names and affiliation in our report.

5.2 Selection of Interviewees

Based on our research questions, we selected five people who either have a key position in the Augment prototype, or who are directly/indirectly related to prototype.

1. The first interview was conducted with Peter Anderberg, from School of Health sciences, Dept. of Applied Health, Blekinge Institute of Technology (BTH), Sweden. He is working at BTH as Professor Adjunct.

2. The second interview was conducted with Professor Sara Eriksson, from School of computer sciences, Dept. of Informatics, Blekinge Institute of Technology (BTH), Sweden. She is working at BTH as Professor.

3. The third interview was conducted with Dr. Annelie Ekelin, from School of engineering, Dept. of Informatics, Blekinge Institute of Technology (BTH), Sweden. She is working as Senior Lecturer at Linnaeus University and post doc at BTH.

4. The fourth interview was conducted with Eilif Lien, from BTH Innovation. He was at that time working at BTH Innovation as Project manager for the Augment prototype.

5. The fifth interview was conducted with Gert Månsson, from ProcesstödTillgänglighetVästraGötalandsRegionen, Sweden. He is working as Regional coach.
5.3 Interview Execution Planning

The five interviews were conducted and recorded at five different times at five different places. Time duration of all five interviews was between 25 to 35 minutes each. At the start of every interview as an introduction, the background of research, research questions and objective of interview were explained to the interviewee to create an environment according to research context.

5.4 Designing and Conducting the Interview

In interviews we combined formal and informal questions in order to identify an effective method for the evaluation of mobile enhanced accessibility applications. We designed some set of pre-planned questions to explore the effective method for the evaluation of the mobile based accessibility application. The interview session was a combination of open-ended questions that were framed during the discussion based on the reply of the interviewees. All interviews were video recorded, observed and noted on note book to achieve the requirement of interviews.

5.5 Data Collection

We made interviews to get data related to the method for the evaluation of mobile-enhanced accessibility application. We recorded all the interviews and then transcribed these interviews to get the valuable data related to the efficient method for mobile enhanced accessibility prototype evaluation through video recording. We kept our focus on the research questions and asked questions related to the efficient method concerning accessibility. At the start of all interviews with the permission of interviewees the video recording was performed carefully during the communication between us and interviewees. The translated documentation also helped us to further analyse the interview data.

5.6 Interview Results and Analysis

5.6.1 What is Augment?

The Augment project as a whole is a long term initiative concerning timely and flexible use of smart phones in order to enhance availability for disabled people. It started out with workshops with municipal representatives as well as representatives from the handicapped
Interviews

organizations and developed further as a proof-of-concept into a full-scale project. We have been performing evaluation of the prototype which is just one part of a much larger project which include research and development involving several partners. Our main focus was on the prototype evaluation and to identify an efficient and effective method for the evaluation of the mobile enhanced accessibility.

5.6.2 Efficient evaluation method for mobile enhance accessibility prototype

In the section we will present the findings that are derived from the interview session. The findings will explain about the suitability of different evaluation methods for evaluation of mobile-enhanced accessibility applications.

According to the interviewees 1, 2, 3 “Focus Group” could be a better method for the evaluation of the mobile enhanced accessibility prototype if you have more users because user can share their ideas with each other during the discussion session. In focus group the users can focus their discussion on strategies of continuous development of new methods and techniques.

The interviewee 1 explained that “Interview” could be a good idea for evaluation of the Augment prototype. He further explained that the user observation is an important thing. Interviewee 3 said that a Group-based study should be considered with people who have the same disability problems, because it is not easy to fulfil everyone’s desire. She told that use-case testing is good and it is a good way to get a grasp of user interaction. She explained that the other thing is scenario change, when you ask the person to perform a task or he himself is ready to do any task. Interviewee 1 suggested that if you are doing use case testing then you should be aware of the risk and how these can be minimized.

The interviewee 2 explained that “Help Desk” is also a good option for the mobile enhanced accessibility prototype evaluation. In help desk when any company commercialize a product then they need feedback from the customers for the continuity of the design like in a lifecycle perspective. There is no consultation with the user in the beginning of the product launch but you require continues feedback from the users.

The interviewee 4 mentioned that a “Focus Group” can be good method for the evaluation of mobile enhanced accessibility. He further said that focus group provides insight about the user’s interest in the application. Interviewee 5 explained that group based study could be a good method for accessibility evaluation.
5.7 Analysis of interviews

We have conducted five interviews with researchers, users and developers and asked them about the evaluation tool for the mobile enhanced accessibility prototype. We also recorded all interviews through video recorder. We have analysed these interview results and summarized them in table 4.

<table>
<thead>
<tr>
<th>Interviewees</th>
<th>Analysis of results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviewee 1,2,3,4</td>
<td>The method for evaluation of the mobile enhanced accessibility prototype could be “Focus Group” because it is very helpful to get valuable data in short time.</td>
</tr>
<tr>
<td>Interviewee 1,3,5</td>
<td>&quot;Group based study” should be considered with the similar group of people, like a group based study of people who have mobility problems.</td>
</tr>
<tr>
<td>Interviewee 1</td>
<td>&quot;use case testing” is good evaluation tool and it is a good way to get user interaction for evaluation.” Interview” can also be a good method to get users view about the accessibility application.</td>
</tr>
<tr>
<td>Interviewee 2</td>
<td>The “Help desk” and “interviews” is also a good for the mobile enhanced accessibility evaluation.</td>
</tr>
</tbody>
</table>

5.8 Suggested Method: AccessEva

The AccessEva method presented in this thesis was inspired by the Diary method from the user experience field and focus group from usability evaluation field. The basic reason for the introduction of this AccessEva method is to perform valid and reliable evaluation of mobile-enhanced accessibility. Another reason is to provide the users a sense of freedom while performing tests. During the literature review and evaluation conduction, it is identified that some of the participants were not feeling comfortable while performing the tests with already available evaluation methods. There were many barriers in the evaluation conduction that we already identified and explained in the analysis of use case testing section. Apart from above during the interviews we also identified that there is a need of efficient and usable evaluation method that enable valid and reliable evaluation of mobile-enhanced accessibility.
Ideally a good method is a dependable tool that moves towards accurate predictions for all the accessibility problems that may occur in software. This is why methods are compared in terms of such criteria as accuracy, sensitivity, efficiency, usefulness, reliability and usability. (Rui et al, 2010)

Accuracy: AccessEva will provide accurate results, because it will get some results through mobile phone application and after that these results will be mapped through group discussion which will make the results more accurate.

Efficiency: AccessEva will be more efficient, because it will provide solution of problems in both ways

Usefulness: this presented method would be very useful for disabled people because they can provide their feedback from their homes when they are free, or when they encountered a problem while using an application of accessibility.

Reliability: the presented method would be more reliable, because its results would be matched and discussed through direct participation of users as well.

Usability: the AccessEva method will be a more useable because it allows the users to give feedback at least twice a week, when they find something interesting or problematic.

5.8.1 AccessEva Method

Maguire (2001) defined that diaries require user record activities and their behaviour over a period of time. The information may lead to the identification of a new system or a product. Diaries may contain multiple choice questions or open ended question for users to record their events in their own words. Diaries may be recorded on line via input forms administered by computer.

On the basis of findings from literature and testing, we have presented a method named “AccessEva”, which is a diary method supported by a software application, which will run on a smart phone with the mobile-based accessibility software, enabling testers to survey user attitudes, and experiences about the mobile-enhanced accessibility. Duration of this diary method will depend on the development phase of the mobile-based accessibility application. During the usage period of the mobile-based accessibility application the user can enter his/her comments in the mobile-based survey application. Atleast twice a week for two or more week’s duration the participant has to enter the two most influential reasons for negative experience with the mobile-based accessibility application and two most influential reasons for positive experience with the mobile-based accessibility application. In addition to this, every week the users can also explain about the other things that caught their attention.
The application is not limited to just two experiences and there is a possibility for users to enter more than two experiences. After the end of diary duration a group discussion will be conducted among the participants under the supervision of testers. The reason for having a group discussion is to give participants an environment to discuss their ideas about the mobile-based accessibility application that was used during the evaluation. The group discussion will not only give an insight of individuals but it will also give a group insight to testers. The group discussion could be among the participants who are most active in sending comments. The two week time will give an idea about the changes in preferences over time. During the group discussion the tester will point out the topic of discussion based on the comments by different participants.

The advantage of having a mobile-based software application instead of having a web based software or pen and paper is that the users can fill out the survey anytime whenever they want. The participants will have a freedom to write their comments according to what they feel while playing with application. They do not need to be in hurry to write the comments as they have the freedom to write their comments. Some participants might fill in this mobile-based survey right after playing with mobile-based accessibility application. Some might fill in survey forms while sitting in a car, bus etc. The important point is that the participants have a freedom to write what they feel and when they feel. The two week time will identify the consistencies and inconsistencies about their usage experiences.

In addition to this, the mobile-based software application will be directly connected to the server. The software application will also have a reminder option for the participants who are not sending comments during the test period. This method will give a sense of control to testers as well as tester can check the comments by participants during the test. On the other hand this method will give a sense of control to participants by giving them an opportunity to fill out survey according to their will. Moreover, we can use such kind of method remotely because the mobile-based survey software will be directly connected to the server that enable tester to keeps track of all the comments entered by the participants. We can use this method during any development phase but the testers need to think about the duration of this method according to the development phase requirement. This method will be cost effective because no expenses will be involved in paper and pen. Low human resources will be involved because one tester can take care of the survey software. The most important thing is the sense of control for the tester as well as for the participants. Because of server the analysis of data will be easier as compared to the pen and paper methods.
Fig. 6 AccessEva method process
6  **Validity Threats**

Validity assessment is a significant part of any research work (Guba and Lincoln, 2006). By specifying validity threats and addressing them can minimized the risks. According to Guba and Lincoln, there are four criteria’s for judging the validity of the qualitative research: credibility, dependability, transferability, and conformability. (Guba and Lincoln, 2006)

6.1  Credibility

According to Guba and Lincoln, the criteria for evaluating results tell authors about the findings that are found in this report are showing truthfulness of this system. We selected five interviewees who are related to the mobile enhanced accessibility prototype and they had a quite good idea about the evaluation perspectives. They expressed their experiences, opinions and domain knowledge about the Augment prototype and its evaluation. In addition to this, the evaluation was conducted with fourteen different participants in order to identify the evaluation perspectives. All evaluation participants were first time users of mobile enhanced accessibility prototype.

6.2  Dependability

According to Lincoln & Guba, it means occurring of changing in the context of research over time affects the results. It is responsibility of the researcher to identify the contexts and their effects on research.

We achieved dependability by selecting the interviewees who are related to the mobile-enhanced accessibility prototype “Augment” and selected interviewees are well aware about the Augment prototype and its evaluation. On the other end all evaluation participants were first time users of the Augment prototype. The evaluation results may affect the result of this research if the evaluation will be conducted with the different group of disabled people.

6.3  Transferability

According to Lincoln & Guba, transferability can be achieved by describing and identifying the context of the research being performed as well as the assumptions that were considered for the study. It refers that results obtained from that research are applicable in other
contexts. In case of this thesis, we can use these thesis results for some other mobile-enhanced accessibility application. As the thesis results is mainly based on an efficient and usable evaluation method that enables valid and reliable evaluation of mobile-enhanced accessibility application.

6.4 Conformability

According to Lincoln & Guba, Conformability is the degree at which results could be confirmed by other researchers. It refers that the outcomes from the research are the result of the participant’s bias, inspiration or motivation rather than that of researchers. To attain thesis research conformability, each interview is completely converted into text format and then separated into different contexts according to thesis research areas for comparisons and analysis purpose.
7 DISCUSSION

Through literature review we identified the evaluation methods that enable evaluation of mobile-enhanced accessibility. Through literature review we identified that field study/observation usually applies in the cases where situation is difficult for users to describe about their experiences during interview/discussion. In addition to this, field study/observation is suitable for the research cases when environmental has significant effect on usability. Through observation evaluators can identify the participants’ emotions, feelings, and experience about the application they are testing.

Furthermore, during the literature review we identified that focus group is generally useful for all the systems. During interview conduction phase we also identified that most of the interviewees also expressed their views about considering focus group for evaluation of mobile-enhanced accessibility.

Moreover through literature review and evaluation we identified that interviews are useful for all systems but the main concern is the structure of the interview and the structure depends on with whom we are going to conduct the interviews. During the evaluation we noticed that the semi-structured interview strategy could be very effective in situations where the mobile-enhanced application is in its early stages of development. In semi-structured interviews the interviewers can formulate the questions according to the interview flow and discussion. The findings about the semi-structured interview were identified during the interview phase of this thesis. The main focus was to identify the efficient and usable evaluation method enables proper evaluation of mobile-enhanced accessibility. We identified that semi-structured interviews are very effective in order to evaluate the mobile-enhanced accessibility. Moreover, we identified that scenario is generally useful for all systems and it help users to understand the way the future system might work as well as to specify their requirements in concrete terms. According to others the scenario could be a good method to evaluate the mobile-enhanced accessibility. In addition to this, we identified that Expert walkthrough is very useful when detailed feedback is required at detail level. We think that this detail level could be an overall evaluation of a complete prototype at all levels. In the second minor part of this thesis we performed evaluation of Augment prototype based on some selected evaluation methods that enables evaluation of mobile-enhanced accessibility. On the basis of the evaluation results, we identified the efficient and usable evaluation method that enables valid and reliable evaluation of mobile enhanced accessibility prototype.
There are different methods to evaluate accessibility through mobile phones but we have chosen the use case testing because it is useful and important tool for early exploratory design situations and evaluations (Carroll, 2000). We have used the structured observation and the motivation behind using structured observation in the Augment prototype evaluation is, to record physical and verbal behaviour of users as a discrete activity. In the field of psychology structured observation this is used extensively, and many researchers have made use of this method for their own research studies. The main idea behind using unstructured interview was to provide space for interviewees to let them discuss their own ideas. In use case testing tasks and scenarios were designed and recorded through video camera as the participants were performing the tests. The tests were performed indoor and outdoor and the behaviour of the users was noted in different environments. To get the broader perspective, informal interviews were arranged with the people directly or indirectly connected with the mobile enhanced accessibility prototype and also recorded their conversation through video recorder.

Table 5 Techniques used for testing mobile enhanced accessibility

<table>
<thead>
<tr>
<th>Methods</th>
<th>Tasks</th>
<th>Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use case testing</td>
<td>Task design, scenario design,</td>
<td>Video recording, diary keeping</td>
</tr>
<tr>
<td>Observation</td>
<td>Indoor, out door</td>
<td>Video recording, diary keeping</td>
</tr>
<tr>
<td>Interviews</td>
<td>Informal question</td>
<td>Video recording</td>
</tr>
</tbody>
</table>

After then we transcribed all the videos and got valuable data because they were very useful for us to evaluate the Augment prototype. On the basis of feedback from the test case participants and results we analysed that Use case testing, unstructured observation, and unstructured interviews are the evaluation methods that enable evaluation of mobile-enhanced accessibility. On the basis of above findings we have suggested a method named “AccessEva” that is a diary method supported by a software application which will run on a smart phone with the mobile-based accessibility software. The presented evaluation method is effective in a sense that it can give the anticipated results during the evaluation of mobile-enhanced application. It is implementable and beneficial for evaluators and users. On one side this method will give a sense of control to evaluators as they can check the comments by participants during the evaluation. On the other side this method will give a sense of control
to participants by giving them an opportunity and freedom to fill out survey according to their will. It is usable in a sense that the implementation of this whole method is not hard to accomplish. All you need is to have a software application, which will run on a smart phone with the mobile-based accessibility software and a group discussion session that will be conducted among the participants under the supervision of evaluator/testers. The presented method is influenced by a method named “Reconexp” (khan et al, 2008) from User experience domain that explains the feasibility of such type methods for the evaluation of mobile-enhanced accessibility applications. We modified the structure of Reconexp” (khan et al, 2008) method according to our requirement to evaluate the mobile-enhanced accessibility. The “Reconexp” is a diary method supported by a distributed application, which partly runs on a website and partly on a mobile device, enabling testers to survey users in field studies. We modified the idea of “Reconexp” by excluding the website from this presented method in order to decrease the burden on the evaluators. We also introduced the terms of positive and negative experiences entries. By using the application users’ can report their experiences that created a positive experience towards the application. Furthermore, by using the same application users’ can report their experiences that created a negative experience towards the application. In addition to this, we introduced the term of “other things” that caught user’s attention. The reason for introducing the term of “other things” caught your attention gives a sense of freedom for the users in the cases where user wants to report something unusual. Moreover, the user can fill diary entries as much as he/she can and this also gives a sense of freedom to the users. Moreover, the software application is not only limited to the explained entries available for the users. Evaluators can add or remove entries into the software interface according to their requirements of evaluation.
8 Conclusion

Through literature review we identified that when the situation is difficult for users to describe in interview or discussion then field study/observation usually applies. The observation could be helpful for the evaluators to identify their emotions, feelings, and experience. During the literature review and evaluation we found that there are many things which are lacking in existing methods like exploration, shortage of time, disability of any kind/type, learnability etc. in mobile phone applications.

On the basis of above findings from literature review and evaluation results we have suggested a evaluation method named “AccessEva” that is a diary method supported by a software application, which will run on a smart phone with the mobile-based accessibility software. After the end of this diary method there will be a group discussion among the participants under the supervision of testers. On the basis of our research findings we believe that “AccessEva” could perform a reliable evaluation of mobile-enhanced accessibility.

Research Question 1: How to evaluate mobile-enhanced accessibility with user participation?

There are number of methods like scenarios, task analysis, expert walkthrough, interviews, observations which are used for the evaluation of mobile enhanced accessibility but the use case testing can be a reliable method to evaluate mobile-enhanced accessibility and for communicating messages between designers and users of technology.

Research Question 2: What kind of efficient and usable evaluation method enables valid and reliable evaluation of mobile-enhanced accessibility?

We have used use case testing as an evaluation method for the mobile enhanced accessibility prototype as a mobile-enhanced accessibility because use case testing is useful for early evaluations. After the literature review findings and evaluation criteria we have used the structured observation and the motivation behind using structured observation is that in the field of psychology structured observation is used extensively, and many researchers have made use of this method for their own research studies. Through literature review and evaluation we identified that interviews are useful in many situation but knowing the requirement of conducting the interview and its context is worthy.

On the basis of above findings we have presented a method named “AccessEva” that is a diary method supported by a software application, which will run on a smart phone. After the completion of diary study period a group discussion will be carried out with the participants under the supervision of testers. We think that “AccessEva” could be an efficient and usable
evaluation method that would enables valid and reliable evaluation of mobile-enhanced accessibility.

8.1 Future work

After the literature review and evaluation of the Augment prototype we identified efficient and usable evaluation method that performs reliable evaluation of mobile-enhanced accessibility. After analysing the final findings of this thesis we have some suggestions regarding the possibilities of future work in mobile-enhanced accessibility domain.

1. In order to analyse the feasibility of this method there would be development of the suggested software.
2. A requirement engineering task could be a future work for suggested evaluation method in order to check the feasibility of a method which is embedded in a software application running on smart phones.
3. Video-based interactive theatre can be successful both in requirements gathering and in raising the awareness of challenges for the older and disabled people to use the new technologies. The strength of video is its engagement and its beauty is that it is not only portable but also versatile (Valoti, 2012).
4. The identification and categorization of evaluation methods for mobile-enhanced accessibility evaluation on the basis of different development phases.
5. There is a need of heuristics to evaluate mobile-enhanced accessibility. The heuristics could provide simple and efficient rules which could proposed to explain that how evaluators could perform evaluation, make decisions, come to judgments, and solve problems, typically when facing complex problems or incomplete information.
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10 APPENDIX - A:

10.1 Use case Testing

We conducted 14 tests for the purpose to identify the efficient method for the evaluation of accessibility through mobile phone. All the participants were given two tasks to perform on the Augment application. The transcribed results are as follows.

<table>
<thead>
<tr>
<th>User</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>User1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1- On main screen Icons are clearly visible and titled.</td>
</tr>
<tr>
<td></td>
<td>2- User feels difficulties in performing task related steps.</td>
</tr>
<tr>
<td></td>
<td>3- User feels difficulty in memorizing steps.</td>
</tr>
<tr>
<td></td>
<td>4- There are no options to go back on previous step.</td>
</tr>
<tr>
<td></td>
<td>5- Map response time is very slow due to which user concentration sometimes get divert.</td>
</tr>
<tr>
<td></td>
<td>6- Lack of learnability.</td>
</tr>
<tr>
<td></td>
<td>7- It is not user friendly especially in locating Icons on the map.</td>
</tr>
<tr>
<td></td>
<td>8- Icons are not large enough on the “Map”.</td>
</tr>
<tr>
<td></td>
<td>9- Street view is not understandable because there is no any guidance that how to use this particular option.</td>
</tr>
<tr>
<td></td>
<td>10- User feels problems in discovering new items.</td>
</tr>
<tr>
<td></td>
<td>11- There are many options that are available but not in function and it creates bad impact on user.</td>
</tr>
<tr>
<td></td>
<td>12- The system works only in android environment.</td>
</tr>
<tr>
<td>User2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1- Touch screen users can use the application in a better way as compared to others.</td>
</tr>
<tr>
<td></td>
<td>2- It is difficult procedure to share the picture with augment.</td>
</tr>
<tr>
<td></td>
<td>3- Sometimes it seems that the report function is not interoperable with the phone gallery.</td>
</tr>
<tr>
<td></td>
<td>4- User having problems in identification of icon on map.</td>
</tr>
<tr>
<td></td>
<td>5- Enlarge function is not on user imagined location.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>User3</td>
<td>1-</td>
</tr>
<tr>
<td>User4</td>
<td>2-</td>
</tr>
<tr>
<td>User5</td>
<td>1-</td>
</tr>
<tr>
<td>User6</td>
<td>2-</td>
</tr>
<tr>
<td>User7</td>
<td>1-</td>
</tr>
<tr>
<td>User8</td>
<td>1-</td>
</tr>
</tbody>
</table>

6- User feels memorizing problem while performing all tasks.
7- There are no indicators for users like (path for walk, path for road transportations, and path for trains)
8- Icons locations are very near to one another.

User3 - It works on android based system.
User4 - According to user this application is somehow reliable.
User5 - The report function is not interoperable with the phone gallery.
User6 - There is no any hierarchy in steps and user always tries to find and remember what could be next step.
User7 - User feels problem when system suddenly stops working.
User8 - User feels comfortable with the functionality.
<table>
<thead>
<tr>
<th>User</th>
<th>1-</th>
<th>2-</th>
</tr>
</thead>
<tbody>
<tr>
<td>User9</td>
<td>The slow function of map makes user irritated by the software.</td>
<td>When user mistakenly clicked on wrong button then suddenly system stopped and terminated.</td>
</tr>
<tr>
<td>User10</td>
<td>The user easily performed all the functions.</td>
<td>The software takes a lot of times for learning the process and after short time user forgets all the steps requires performing function.</td>
</tr>
<tr>
<td>User11</td>
<td>The system crashed when user clicked on wrong button.</td>
<td></td>
</tr>
<tr>
<td>User12</td>
<td>There is no coherence among steps.</td>
<td></td>
</tr>
<tr>
<td>User13</td>
<td>Touch screen users can use the application in a better way as compared to others.</td>
<td>User feels difficulty in memorizing steps.</td>
</tr>
<tr>
<td>User1</td>
<td>At initial activation of tasks the response time is good but when user clicks on Map the Map response time is very slow due to which user concentration sometimes get divert.</td>
<td></td>
</tr>
<tr>
<td>User2</td>
<td>Map response time is very low.</td>
<td></td>
</tr>
</tbody>
</table>

2-Time to active one task

**RESPONSE**

<table>
<thead>
<tr>
<th>User</th>
<th>1-</th>
<th>2-</th>
</tr>
</thead>
<tbody>
<tr>
<td>User1</td>
<td>At initial activation of tasks the response time is good but when user clicks on Map the Map response time is very slow due to which user concentration sometimes get divert.</td>
<td>Map response time is very slow due to which user concentration sometimes get divert.</td>
</tr>
<tr>
<td>User2</td>
<td>Map response time is very low.</td>
<td>Enlarge function is not on user imagined location.</td>
</tr>
<tr>
<td>User( ^3 )</td>
<td>1- The system is not efficient because the map response time is very slow.</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
</tbody>
</table>
| User\( ^4 \) | 1- User feels misguidance because of irrelevant location of icons.  
   3- When user enlarges the map then he/she finds him/herself lost in the map.  
   4- According to user it is not efficient because it is too much time consuming.  
   5- In Street view user feels confusion and user lost among different provided indicators i.e. arrows.  
   6- The slow working of zoom in and zoom out function on the map creates confusion for the user.  
   7- User needs to memorize the steps of report function and especially it would be very difficult for untrained user. |
| User\( ^5 \) | 1- The report function is not interoperable with the phone gallery.  
   2- The map response time is very slow.  
   3- User is facing problem in locating position on the map.  
   4- User is facing problems in locating buttons related to report function. |
| User\( ^6 \) | 1- Street view function does not give any indication to the user about the searched item. The street view always creates confusion for the user that what to do next in context of street view option? |
| User\( ^7 \) | 1- The map response time sometimes irritates user.  
   2- User is facing problem because when user relates picture with augment project she almost lost herself in the system. |
| User\( ^8 \) | 1- User feels comfortable with the functionality.  
   2- User is facing problems with finding icons on the map because the map loading time is very slow. |
| User\( ^9 \) | 1- The slow function of map makes user irritated by the software.  
   2- Without getting any solid output user always tries other function and that at last results in user irritation and leaving application. |
| User\( ^10 \) | 1- The map response time is slow. |
| User\( ^11 \) | 1- In start user feels it interesting but with the passage of time user feels irritation after not receiving the required result.  
   2- The user feels that the map response time is very slow. |
<p>| User( ^12 ) |  |</p>
<table>
<thead>
<tr>
<th>User</th>
<th>1-</th>
<th>2-</th>
<th>3-</th>
</tr>
</thead>
<tbody>
<tr>
<td>User13</td>
<td>There are no options to go back on previous step.</td>
<td>Map response time is very low.</td>
<td>If the system is get crashed than user has to start the application from first step.</td>
</tr>
<tr>
<td>User14</td>
<td>The options to go back in application are very low.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3-Time spent on errors

<table>
<thead>
<tr>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>User1</td>
</tr>
<tr>
<td>User2</td>
</tr>
<tr>
<td>User3</td>
</tr>
<tr>
<td>User4</td>
</tr>
</tbody>
</table>

### 4-Error’s percentage

<table>
<thead>
<tr>
<th>User</th>
<th>1-</th>
</tr>
</thead>
<tbody>
<tr>
<td>User1</td>
<td>Sometimes application get crashed on option like(adjust position and wrong pressed button)</td>
</tr>
<tr>
<td>User2</td>
<td></td>
</tr>
<tr>
<td>User3</td>
<td>Most of the time software stops working on adjust position Icon that make user more confuse.</td>
</tr>
<tr>
<td>User4</td>
<td>The software is with a lot of errors.</td>
</tr>
<tr>
<td>User</td>
<td>1-</td>
</tr>
<tr>
<td>-------</td>
<td>----</td>
</tr>
<tr>
<td>User5</td>
<td>The system is not user friendly and sometimes application automatically get crashed when user click on wrong button.</td>
</tr>
<tr>
<td>User6</td>
<td>There are many functionalities are missing and sometimes do not work that creates a confusion in user’s mind whether he/she has completed the function or not.</td>
</tr>
<tr>
<td>User7</td>
<td></td>
</tr>
<tr>
<td>User8</td>
<td></td>
</tr>
<tr>
<td>User9</td>
<td>User identified that there is no any fault tolerance in this software.</td>
</tr>
<tr>
<td>User10</td>
<td></td>
</tr>
<tr>
<td>User11</td>
<td></td>
</tr>
<tr>
<td>User12</td>
<td>System sometimes automatically crash when user clicked on adjust position button.</td>
</tr>
<tr>
<td>User13</td>
<td>The system is not reliable because in many steps the software suddenly gets crashed</td>
</tr>
<tr>
<td>User14</td>
<td></td>
</tr>
</tbody>
</table>

5-**Documentation or help’s use frequency**

<table>
<thead>
<tr>
<th>User</th>
<th>1-</th>
<th>2-</th>
<th>3-</th>
</tr>
</thead>
<tbody>
<tr>
<td>User1</td>
<td>Lack of learnability and user always looking for evaluators help.</td>
<td>Street view is not understandable because there is no any guidance that how to use this particular option.</td>
<td>User has to remind all steps again and again but still unable to perform the exact function.</td>
</tr>
<tr>
<td>User2</td>
<td>It is difficult procedure to share the picture with augment.</td>
<td>User having problems in identification of icon on map.</td>
<td>User feels memorizing problem while performing all tasks.</td>
</tr>
<tr>
<td>User3</td>
<td>The system is all depends on short term memorization but there is lack of learnability.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User4</td>
<td>According to user it is not and there are many problems related to report function. As there is no interoperability between Augment and cell phone’s gallery.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User5</td>
<td>The report function is not interoperable with the phone gallery.</td>
<td>For report function user has to memorize all steps.</td>
<td>Report function steps are very difficult to perform and there is no any hierarchy in steps.</td>
</tr>
<tr>
<td>User6</td>
<td>There is no any hierarchy in steps and user always tries to find and remember what could be next step.</td>
<td>There are many functionalities are missing and sometimes do not work that creates a confusion in user’s mind whether he/she has completed the function or not.</td>
<td>Large number of report function steps creates problems for user to memorize and it also creates boring environment for the user.</td>
</tr>
<tr>
<td>User7</td>
<td>The user has to memorize all steps and when she click on any step she has to remind what could be the next step.</td>
<td>Every time she requires more instruction from the evaluators to perform the remaining steps.</td>
<td></td>
</tr>
<tr>
<td>User</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User8</td>
<td>1- When user mistakenly clicked on wrong button then suddenly system stopped and terminated.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| User9 | 1- When user clicks on other Icon rather than augment during report function then augment suddenly terminates.  
2- In every function user needs to remind the next steps.  
3- Without getting any solid output user always tries other function and that at last results in user irritation and leaving application. |
| User10 | 1- The software takes a lot of times for learning the process and after short time user forgets all the steps requires performing function. |
| User11 | 1- User always needs guidance to complete steps. |
| User12 | 1- User always unaware about the next step while performing “include me” function or “report” function.  
2- User feels that this application lacks short and long term memory for learnability of available functions.  
3- The user cannot understand the usage of application.  
4- User always looking for evaluator’s guidance while performing tasks. |
| User13 | 1- User feels difficulty in memorizing steps. |

**6-Repetition's number of failed commands**

<table>
<thead>
<tr>
<th>User</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>User1</td>
<td>1- There are many options like (All categories, detail, and street views) that are available but not in function.</td>
</tr>
<tr>
<td>User2</td>
<td>1- There are many options like (All categories, detail, and street views) that are available but not in function.</td>
</tr>
<tr>
<td>User3</td>
<td>1- There are many options like (All categories, detail, and street views) that are available but not in function.</td>
</tr>
<tr>
<td>User4</td>
<td></td>
</tr>
<tr>
<td>User5</td>
<td></td>
</tr>
<tr>
<td>User6</td>
<td></td>
</tr>
<tr>
<td>User7</td>
<td></td>
</tr>
<tr>
<td>User8</td>
<td></td>
</tr>
<tr>
<td>User9</td>
<td></td>
</tr>
</tbody>
</table>
| User10 | 1- The system crashed when user clicked on wrong button.  
2- User needs guidance to perform steps. |
| User11 |   |
| User12 |   |
### 7-Number of available commands not called upon

<table>
<thead>
<tr>
<th>User</th>
<th>1-</th>
<th>There are many options that are available but not in function and it creates bad impact on user.</th>
</tr>
</thead>
<tbody>
<tr>
<td>User2</td>
<td>1-</td>
<td>Options like (All categories, detail, and street views) that are available but not in function.</td>
</tr>
<tr>
<td>User3</td>
<td>1-</td>
<td>Options like (All categories, detail, and street views) that are available but not in function.</td>
</tr>
</tbody>
</table>

#### 10.2 Interviews:

#### 10.2.1 First Interview

The first interview was conducted with Peter Anderberg, from School of Health sciences, Dept of Applied Health, Blekinge Institute of Technology (BTH), Sweden. He is working at BTH as Professor Adjunct.

**Question 1: What is Augment and have you used it earlier?**

According to interviewee the main idea behind this project was to deal with accessibility issues. The project “Augment“ uses Google map wiki based pictures. He further explained that by using wiki the user can update and validate him/her. He says in Accessibility projects always we let users to get in. It is applicable for smartphone and pads.

**Question 2: Which Accessibility tool have you used for this application?**
Appendix - A:

Interviewee explained that they have already passed the Mock ups phase for project “Augment”. According to interviewee we must get an idea about user’s Observations, user’s interview and user feedback in any way using accessibility tools.

**Question 3: What are the performance aspects which should be considered to make this application better?**

According to interviewee the application should be fast, swift and good. He suggested that from his point view there should be one click strategy to perform the most important aspects. When you use more click it stars losing interest. He says if you have loose mussels then you cannot hold it for a long time. It should be that if you click once all the operations should be done at once. He also suggested that text comments should be added at home not only at the spot, if a person goes home then he should be able to comment there. User should access picture there which he uploaded and do it home. User facilitation and low threshold is always a keen aspect for a product to work. The other thing is if you have strong mussels then it is difficult to maneuvering the pictures. It is should be one button click but if you want to do some ordinary then you need to click the other button.

**Question 3: What are the main qualities, which should be improved for this application?**

According to interview, the first thing is that the application should not be allowed to crash because this is the main thing by which people get irritated. He explained that the number of application crashes depends on the stages where the application is. The Alpha version should be allowed to crash but it Beta version should not. The main thing is, if you use an Alpha product and you test it for many users then definitely the whole project will sink. He explained that the map response time should not be slow though you are using 3G, user should not download heavy objects. He said one button press strategy should be used in order to provide user satisfaction. He identified that the main qualities to improve should be easy to use, and fast use of main application in which photo load should also be easy.

He explained that this is Alpha version that is still in design process and Beta version should be allowed to use for people. He further explained that this application requires good memory. According to him when the product goes to market it should be fast in completion of available functions. There should be a large icon and follow the GUI. The application should always tell what to do next.

He explained that if he will face many errors and slow speed with any application then he will delete the program. He says in design process you should give this application for those only who have the resilience to use it like if the system crashes then the user should have patience to reuse it.

**Question 4: What would be the most important tool for mobile enhanced accessibility evaluation?**

According to interviewee, you have to communicate with the people for project “Augment”, evaluation. Interview could also be a good idea, for evaluation. He explained that the important thing is user observation. He explained that the “Focus Group” could be better if you have more users because user can share their ideas with each other during discussion session. Group based study should be considered like a group-based study of people who have mobility problems, because it is not easy to fulfill everyone desire. He told that use case testing is good and it is a good way to get user interaction. He explained that the other thing is scenario change when you ask the person to do or he himself is ready to do any task. He suggested that if you are doing use case testing then you should be aware of the risks and how these risks can be minimized.
10.2.2 Second Interview

The second interview was conducted with Dr. Sara Eriksson, from School of computer sciences, Dept of Informatics, Blekinge Institute of Technology (BTH), Sweden. She is working at BTH as Professor.

**Question 1: What is Augment?**

According to interviewee the project “Augment”, is a map based application which is designed by Blekinge municipality, and then it would be the responsibility of the municipality for this application accessibility.

**Question 2: What do you think about the design perspectives of this application?**

Interviewee says that they are not been able to test this application as an application in real sense. The project “Augment” is a research based project that depends on funding. She explained that they can move ahead gradually as we get the funding for research. She said that they are spending time for research funding but not in application development as the development is dependent on funding. She said that because of funding the development aspect of this application has been neglected obviously. She said they are lack in usability interfaces and they do not have users to test the application. He identified that on the other aspect they have users on wheel chair but they there is some problem in development perspective because there is a short time line for the development. She explained that the main reason is that the developer want user on demand and they want design on demand.

**Question 3: Do you think the application should be launched with errors?**

She explained that the BTH innovation is a small innovation so it is affecting its development and they are trying to shift the development to Stockholm. According to her it is a good concept and they hope that after error removal it will present a good concept.

**Question 4: What do you think about the performance of application?**

According to her performance is definitely a major aspect of this application. She explained that the reason of not having performance according to expectation is that the BTH innovation is hiring people for short term and she does not know how much those people are aware about this application. She explained that they are trying to complete the application as soon and they think about the quality of the proof of concept. She explained that the developers need users to test the application but on their part they think that how it could be tested when the performance is very low.

**Question 5: Do you think is it a good idea to include those function which are not working in the application?**

According to her the application should be error free on its first launch. She explained that it will be good to work with just story board or sketches and you have the sketches to show application’s working. According to her if you have mobile phone in hand for testing application and you face that the things are not working then it is irritating. According to her it is better to show its work using mock ups although it is not real thing but at least it shows that how application will work.

**Question 6: Do you think this application is easy for the people of short term memory?**

The interviewee is agreed on point that the application lacks of short term memory. She said that it is a big issue but it is related to the design and that is why they are conducting test to know about the errors and the needs.

**Question 7: What are the major qualities which should be improved for this application?**
She explained that the application should have major qualities like simplicity of use, intuitively of use, as well as the learning process should be as it is possible. The intuitive mean that user could be able recognize without reading, communicative interfaces, functionality, as well as the performance should be good. The routing for finding your way and for the identification or marking or updating the information should be added.

**Question 7: What are the evaluation tools used for mobile enhanced accessibility evaluation?**

She explained that focus Group could be a good tool because in focus group you have discussion on strategies of continuous development. She also explained that the help desk is also a good for Project “Augment”, evaluation. In Helpdesk when any company commercialize product then they need feedback from the customers for the continuity of the design like a lifecycle perspective. There is no consultation with the user in the beginning of the product launch but you require continues feedback from the market.

10.2.3 Third Interview

The third interview was conducted with Gert Massson, from PROCESSTOD TILLGANGLIGHET in Ronneby, Sweden. He is working as Regioncoach.

**Question 1: What are your observations towards this project “Augment”?**

The interviewee explained that if anyone will travel on wheel chair then this application will help him/her to find a place where she/he wants to go. This application should also help others to take decision that if they should go toward one place or other. He says that this project will be helpful for him/her me in future. He explained that this Project will also help him where to go and how to go.

**Question 2: What are the performance aspects which you need in the application?**

He explained that he needs a map show me right location. The application should be easy to use. He said that he has three different degree of use one is that he is on crouches and the second is when he is on wheel chair and the third is when he is on the bed when there is bad weather.

**Question 3: What are the main aspects of application which should be considered in the next iterations?**

According to him the most important issue is the application should be easy to use. He said that he has a lot of friends on wheel chair and their first priority is easy to use and understandable design. He also explained that the quality of application is very important on which user can trust.

**Question 4: Does slow process of application affect you or not?**

According to interviewee is always prefer a application that always guides him towards right destination and the fastness of application attributes come at next priority.

**Question 5: Do you think application design should be easy for the user to add something?**

According to interviewee the application should be easy to use. But as the interviewee has not used the application by himself so he could not say anything about this application.

**Question 6: How do you think, this application can be made user friendly?**
He explained that to make user-friendly, the application should be easy to use, easy to find location on map, easy to write some information like comments, and easy to find useable toilets. He identified that the thing is that it should also be included that there are hills on the way.

**Question 7: Do you consider time factor important in application or not?**

He agreed that the time factor is very important, if an application time delays for 5 seconds, then some people try to move their hands. But he explained that in his perspective the first thing is right information even its delays.

**Question 8: What would be your reaction after finding errors in the application?**

He explained in detail that he will first consider that how often these errors occur if they are sudden or daily, then it will be a problem but it happens in a week then that could be good for me and if it happens monthly then I have no problem.

He explained in detail that if system crashes while using, then he will restart it, because some time while working with computers and other electronics devices we come across sudden problems so we restart it and it start working good. According to him in context of this application if he will have idea that it will not affect anything then he will start it anew.

10.2.4 Fourth Interview

The fourth interview was conducted with Annelie Eklin, from School of engineering, Dept of Informatics, Blekinge Institute of Technology (BTH), Sweden. He is working in BTH as Researcher.

**Question 1: How this application could be helpful for all type of impairments?**

She explained that this application could be helpful in different phases of your life. User could develop a platform and then user can move in all directions and user can add more features in it.

**Question 2: What are the performance aspects which should be considered for the Augment application?**

He explained that the highly important thing is the granularity of information. He also explained that another important thing could be the adaptability in the society like if you have or you feel such type of disability, then you can use this application and this should be made in one clicked.

**Question 3: What are the performance qualities should be considered in this application?**

According to interviewee in this application there should be user friendliness, intuitive operating an application and simplicity of use.

**Question 4: What is the evaluation tool for mobile enhanced accessibility evaluation?**

According to interviewee, it could be a focus group, user observation, and user interaction so you can record, visualize, and you write user observations.

10.2.5 Fifth Interview

The fifth interview was conducted with Eillife, from BTH Innovation. He is working at BTH Innovation as Project manager for this project.
Question 1: What is this application for?
He explained that this application is helpful for mobility. This is a kind of social application for disable persons to share information within them so that they navigate in the society.

Question 2: Is this application is easy to use?
He explained that this application is easy to use but this could be easier. He further explained that the main focus of the project to share information among handicapped persons and this application is not designed in such a way that anyone can use it. He said that the application must focus on easy to use.

Question 3: Are you satisfied with the application performance?
He explained his idea that he is definitely not satisfied with the performance of this application because it is only a proof of concept. They had not tested on performance base and they do not have requirements for this as well. He further explained that they have only considered relevant parts. He said that to increase the performance they are now focusing to use local street view maps rather than Google map.

Question 5: What are the qualities that should be considered for the next iteration?
According to interviewee it depends on users because users are the ultimate people who will use this. He further explained that user interface, usability and performance should be considered for next iteration.

He explained that It is not important that system will work on just one click, the main thing is that it should be intuitive and easy to use so that you get the result according to your requirement. He explained that this version is not user friendly but they are trying to make it better. He identified that it could be made user friendly by adding some help icon in it.