International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Blind User's Participation in Software Development Life Cycle: Expert's Perspective

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Abstract

In this era of information and communication, technology has become indispensible for everyone including people with blindness. It is noticed that for visually challenged users, the progress has been a much slower as compared to normal people. There are number of visually impaired users who demands special application that could assist them in their routine tasks. User participation is a significant matter of the time that researched and discussed in software development industry. Software development knowledge reflects that participation of different users in the process of software development lifecycle (SDLC), can participate to usability of software. Necessary inclusion for having better usability and accessibility are generally lacking in software engineering procedures. The study outline that is established to inquire the importance of blind people participation in the software development. The main aim of the research is to explore the level of visually impaired participation in SDLC process. In the study the model; Blind User System Development Life Cycle (BUSDLC) is proposed. In the study a survey with 32 software experts is included. This paper attempts to bring attention towards visually challenged people and establish Blind user centered SDLC for visually challenged people.

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This will help to improve software development process. Moreover the proposed BUSDLC can be implemented in any software development industry to prove its effectiveness.

Keywords: Blind user centered SDLC; Computer human interface; Functional requirements; Human computer interaction; Non-functional requirements

1. Introduction

Proper access to applications has emerged as an essential need for all kinds of groups in society. Numerous user studies suggest that the totally blind encounter more difficulty than those with other sensory disabilities (such as low vision, motor or hearing impairments) when performing specific tasks. Different life cycles such as waterfall, prototype etc. ensure that the system meets the needs of people without disabilities. However, the requirements of people with disabilities are often overlooked thus resulting in systems that are inaccessible and unusable to them. User interests and incorporating their viewpoint are quite essential for any information system (IS) acquisition projects. System users play a vital role in carrying out processes to meet organizational objectives. Information systems provide the necessary interface, called as "computer human interface (CHI), in an organization to achieve objectives in an effective way [1,2]. Systems development life cycle (SDLC) process provides an opportunity to the systems planners to encourage CHI capabilities through user participation, capturing user requirements and incorporating them appropriately [3,4].

According to the World Health Organization (WHO), in June, 2012 more than 285 million people worldwide were visually challenged, 39 million were blind and 246 had low vision. More than 82% of them were 50 years of age & older and 90% of the world of visually challenged people lived in developing countries [5]. Pakistan has 4.48 million people who are disabled. Around two million people are completely blind in Pakistan [6].In order to develop software; an organization needs to strategize user participation in SDLC so that CHI issues are addressed collaboratively. The capabilities of users to collaborate in the process are important at this phase to bridge the gap among process owners, IT experts and IT users in general. The fast growing technologies for blind users have attracted many researchers to get involved in developing and improving software and system applications, particularly useful for the visually impaired people [8].

There are number of people who had done research in different areas for visually impaired people. In Pakistan, this is a relatively un-broached domain of research in software industry. Students of special education at public sector universities have done studies concerning blind students at special institutes in some cities and areas, but there is no standardized data available . It is very essential to keep consideration of user participation while designing and developing applications, because as with the cutting edge of technology around the globe is growing on rapidly, the number of blind people worldwide could increase from 37 million in 2008 to 75 million by 2020 [9]. By 2030, medical experts and health officials predict that rates of vision loss and severe visual impairment in the United States will be doubled as America's 78 million aging people reach retirement age and beyond [10]. In Pakistan approximately one in ten people are visually impaired, with more than two million people are fully blind [11].

There are different foundations and research organizations that are working for blind people. In modern software development life cycle models focused mainly on requirements of organizations than user requirements [12].

The incomplete and poor design can be due to the failure of system designer and software developer. The study of human computer interaction were concentrate on user requirements and the need of human computer interaction from user view [13, 14, 15], and on human computer interaction inclusion in the software development process [16]. Through this paper, we aim to promote research in the field of software development process for visually challenged people by proposing BUSDLC for visually challenged people. The aim is to enhance the accessibility of applications by proposing blind user SDLC that will assist blind people. This paper includes ii) related work, iii) existent SDLC and user participation, iv) proposed BUSDLC v) research methodology vi) analysis and findings vii)conclusion

2. Related Work

2.1 Participation of blind users and human computer interaction

Participation of users in the software life cycle is very well documented and it is generally recognized that the benefits of user participation and participation are greatest at the beginning of the design process, however it minimizes as the product pass through the several phases of life cycle[17].User Centered Design [18], Usability Engineering [19] and Participatory Design [20] are different the procedures of usability that concentrate on the participation of end users in the development process of applications. The value of Human Computer Interaction; force on usability, practical contact , design problems, furthermore relate with accomplished business, organization, have been accepted to some extent by experts [21].Participation of human factors in the earliest phases of the process ensures that a product is defined in terms of the user's requirements. Human factors embedded at these phases also help project management to redirect resources to implementation approaches. This is likely to have great benefit to users, when such changes are still relatively easy to make. Participation throughout the process results in catching difficulties at the starting phase, and so minimizes overall cost of the project [22].

Blind user participation is a undertaken actions where blind users perform their act at each and every phase of software development to flourish product that fulfill demands of the users in all respects. The act of blind user participation can be inspecting from several outlooks such as theoretical, practical and public affairs [23].Using a user centered design working jointly with visually impaired people; a basic blind user interface is to be implemented. While interacting with computer, users usually used the existing mental model and when it comes to the new software, they will create a new mental model on how the system behaves. The unsuitability between the existing mental model with the new system application creates a problem for users.The rapid development of software has determined over the last year. There are number of reasonsfor this rapid emergence of technology: the dissemination of computing among a variety of users, the optimum comfort requirement of computer systems, the need for reaching a top market etc. As a result, number of tool and techniques has been introduced that can provide interface for disable users[24].

For years, the main activity of people working in the area of rehabilitation technology was the adaptation of commercially available computers to the possibilities of users with physical disabilities. Assistive technology is *"any application or device that is used to increase, maintain or improve physical ability or academic performance"* [25].When the problem of gaining access to PC (Personal Computer) is solved the user faces other difficulties while using commercial software. Many applications have been designed without taking into account that they can be used by people using assistive technology [25] and therefore have unnecessary barriers for these users to overcome. The most auspicious fact in human computer interaction among the manifold interface design is to subsist with non-standard interaction. Human computer interaction is a train that focuses on the software usability. Among the six characteristics of software quality "*which concerns on understandability, learnability, operability, attractiveness and compliance of the software system, usability is one of them*" [26]. Olsson [26] in his study argues that *"we declare repeatedly that users should be involved in the design and development of computer systems, without questioning the reasons and motives behind this declaration"*. In the outcome software product, blind users participation has a significant obligation [27].

3. Existing SDLC and user participation

According to M. Akmanligil, [28], enhancing the potency and efficiency of evolution is the important issue for the management of information system. Turban [29] defines that for solving traditional issues of information system, software development life cycle is the traditional model that can resolve these problems by repeating its several phases. In [30] Haag considered software development life cycle as step by step structured technique for augmented information system. Traditionally, software developers use a formal system development approach called System Development Life Cycle (SDLC). System developments are the activities that go into producing an information systems solution to an organizational problem or opportunity [31].The existing software development life cycle (SDLC) [32] which concentrate on services that is distinct from the suggested Blind user centered software development life cycle (BUSDLC) in multiple ways as in Figure 1and Figure 2.Software development life cycle represents a set of general group that represent the main important steps of an information system development project. The system analysis ,first phase identifies the issue of software ,highlights its reasons, provided with stand by solution and highlights the requirements of information system The, System Analysis defines the problem, identifies its cause, offers alternate and specific solution, and identifies the information requirement.

Hoffer et al. [33] manifest that amid the different software development practices and techniques, the SDLC model is an often approved latest patterned avenue to mark out the intricate problems in software development. But existing development life cycle focuses a lot on the requirements of organizations that concentrate on functional requirements as compared to human requirements like subjective and physical abilities, personality traits, and touchy requirements and conditional aspects[34].

A more selected knowing of several human appropriate, behavioral, subjective, perceptual circumstances concerned with user assignments, to address these issues interaction and process contexts are the demand [35].

The blind user requirements are least considered in software development life cycle, outcome as a space in an assuring organizational demands and acquiring blind user demands. These problems can be encountered throughout the blind user software development processes.

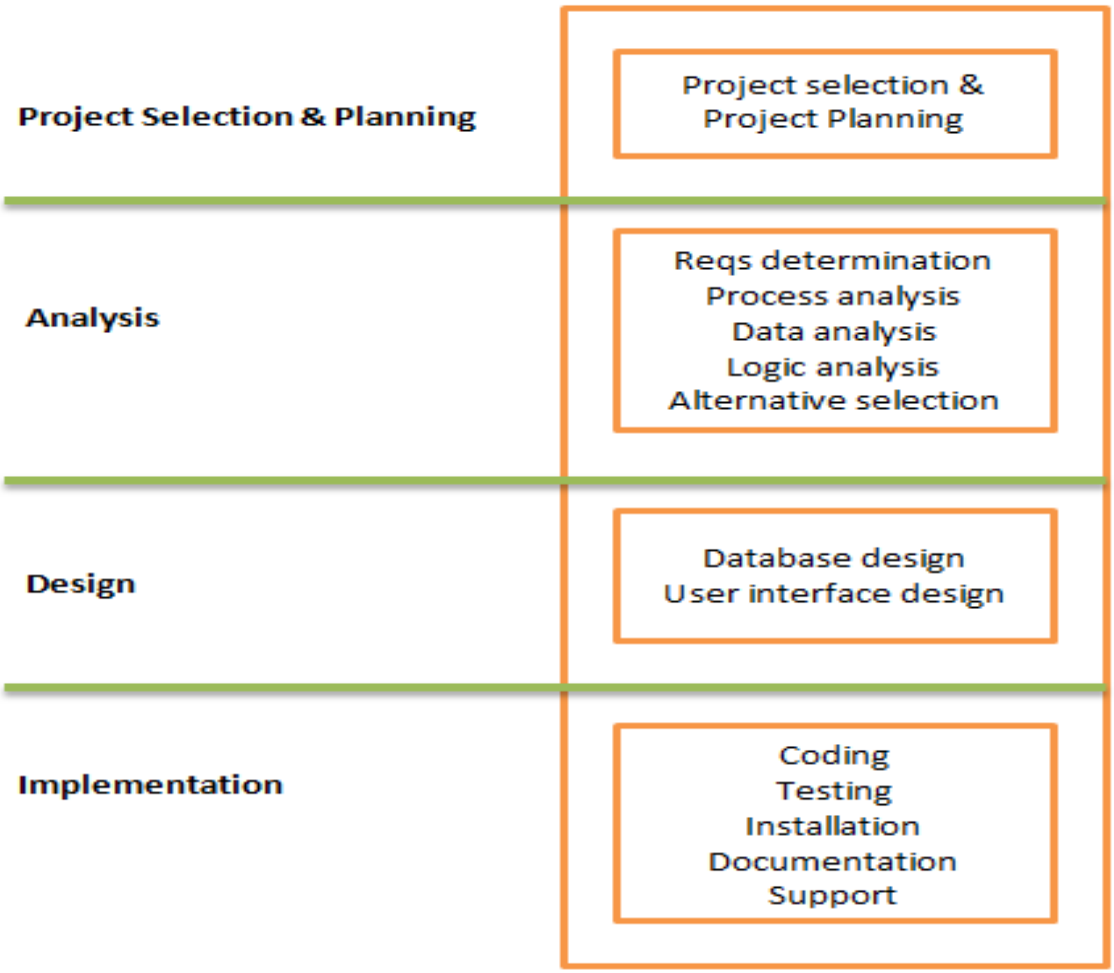

Fig. 1.traditional SDLC [32]

It is necessary to know the application requirements at the early phase and the another important matter is to consider human computer interaction (HCI) from start of the development till end[36].

In the frame of reference of BUSDLC, blind user requirements and the communication are considered in the whole development process [37, 38, 39].

The authors in [40] maintain that participation of user is an essential aspect for the accomplishment of a task and is the finest choice for number of enterprises. The connection of user and the system is characterized in a framework as follows: *"The scenario identifies the person as having certain motivations toward the system, describes the actions taken and some reasons why these actions were taken, and characterizes the results in terms of the user's motivations and expectations"*

Jacobson described [39], that in requirements analysis phase, an in actor is the identified attitude of one taking part. The interaction of system with user and external environment are described by actor in a use case model. Here, responsibilities isolated may not permit the analyst to achieve rooted awareness of the blind user of software. Enclosed by provided responsibility, there could be various categories of application's end users. This plot has accomplished ideas to hold crank as a pattern expertise to have settlement in space of trouper and buyer.

4. Proposed BUSDLC

Figure 2 shows the proposed blind user SDLC to improve development of software product for user with special need of blindness

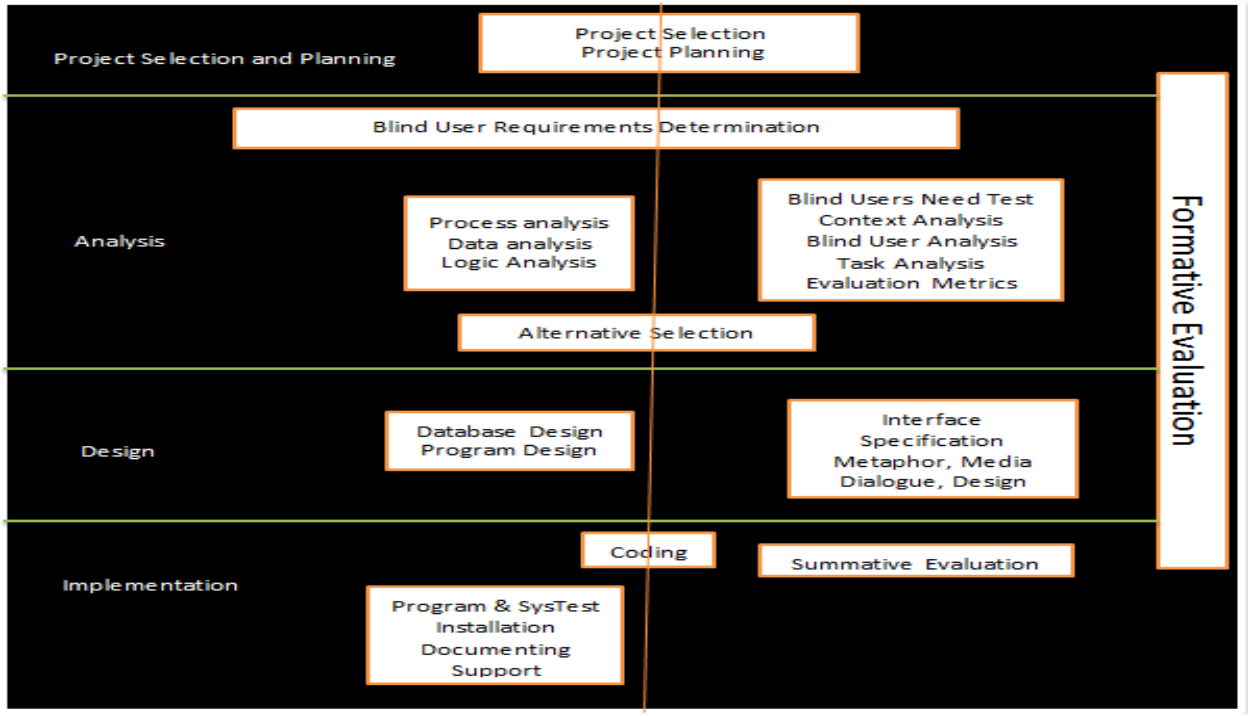

Fig. 2. Proposed BUSDLC

It indicates how blind users are involved in different phases of blind users' software development life cycle. The multiple phases mentioned in the BUSDLC are selection of project and project planning, software analysis, software design and finally the implementation.

Once the project selection and planning phase is complete, the proposed model moves onto the **analysis phase**. In this phase, unlike the traditional SDLC, the requirements are gathered along with the major stakeholder i.e. blind users themselves. Since the blind users are part of the requirements gathering process, they are there to correct the requirements engineer if he is going in the wrong direction. After this the usual process, data and logic analysis is carried out like in traditional SDLC. Henceforth, the blind user is once again consulted to review the analysis phase. Here the blind users carry out the blind users need test, context analysis, blind user analysis and task analysis. This results in the formulation of the evaluation metrics. If the evaluation is

successful, we onto the next phase otherwise alternative selection, i.e. repeating the whole analysis phase is carried out.

Next we move onto the **design phase**. Here the database design and the program design are formulated as per the traditional SDLC. After this, the opinion blind users are again sought after to ensure that the interface specific metaphor, media dialogue and hence the design are all suitable to be used by the blind users. In case there is some ambiguity, the design is restructured until it is fit for the stakeholder's use.

The next and the final phase is the **implementation phase**. Here the actual coding of the app is carried out. The blind users periodically consulted to ensure that the coding and the hence, the final product is fit for their use. Once the coding is complete and the blind users have given a green signal, summative evaluation is carried out. After this, quality assurance techniques are carried out to conduct the program and system test installation. This and followed by the application documentation finally the system support is ensured.

In traditional development model users didn't appear to be heavily involved throughout the development phases. Traditional development approach leaves the main responsibility for analyzing requirements and designing the appropriate system to the software development staff. While proposed model keeps participation of blind users throughout the development to develop more usable system for blind users. The approach used in BUSDLC is the adoption of human computer interaction, to improve the participation of blind user

4.1 Related human computer interaction studies

There are capacity for Human computer interaction requirement engineering and the user Interface localization process adjusted to specific socio-cultural needs, countries or region legal privacy and even for user privacy preferences "Human Computer Interaction – Privacy (HCI-P) is an emerging area of the application of Human Computer Interaction in the area of personal data processing and privacy"[41].

There are a number of studies conducted in Malaysia that argue the importance of HCI. HCI deals with mental processes and behavior of users interacting with computers [42].

In [43] Hisham concentrate on maturity and civilization in user layout. Malaysian older adults issue was also discussed, and they contend that the designed layout is not according to their culture and it is totally out. And because of this they were facing difficulties while interacting with systems.

[44] Investigates human computer interaction deliberation in the development process of process from the perspective of expert. This research recommends that non-functional requirements like affective and cultural problems have not been forced by experts.

5. Research Methodology

To validate the proposed model, we approached 32 experts of software industries such as software designer, developer, tester etc. from Pakistan and China. A set of questionnaire was flourished sited on BUSDLC model

to highlight user participation as well as blind user's participation in SDLC. Data shows that 64% of the respondents have 5 to 9 years' experience and 28% have more than 10 years' experience in software industry. The designed questionnaire was according to the BUSDLC as in Figure 2. Just like the existing software development life cycle, the phases highlighted in the BUSDLC are selection of project and software planning, software analysis, software design and software implementation. The main contretemps in these two models are the BUSDLC espouse the Human computer interaction notion. The questionnaire was distributed among 50 experts in electronic text file format but only 32 experts responded.

All experts filled out the questionnaire and sent it back to us by email. It was assured to all the participants of the study that their personal data would be kept confidential. The questionnaire were having twenty one questions based on Likert-scale (strongly disagree, disagree, neutral, agree, strongly agree) to identify and evaluate user participation (Normal/Blind) in software development phases.

5.1 Respondents of research survey

In the study survey 32 people of software industries from two different countries participated who were the experts consists of software programmer, web application designer, software engineer, computer engineer, information technology officers officer, software architects and system analyst. All software organizations have multiple international clients and doing worldwide business.

6. Analysis and Findings

To analysis data SPSS software was used. The result of the analyzed data would be illustrated in detailed statistics

6.1 Normal User and Blind User participation in Software Development Life Cycle

The study outcome on the user participation in all the phases of software development life cycle is shown in Table 1. The outcome of the research shows that 85.29% participants cope users in software development life cycle. Regardless, the percentage of user participation fluctuates in different phases. The outcome shows that the participation of users in requirement phase is highest as 67.22% and testing and deployment as 56.72 %, software project selection and software planning 43.42% and system design phase 26.53% and the percentage of development has 1.14% user participation.

Table 1. Normal User participation in Software Development Life Cycle phases

Phase	*Percentage %*
Project Selection and Planning	43.42
Requirement Analysis	67.22

System Design	26.53
Development	10.14
Testing and Deployment	56.72

Table 2 highlights the outcome of the study on the blind user participation in all the software development life cycle phases. The result of the survey highlights that few of participants (31.7%) have involved blind users in their whole SDLC. Therefore, the number of participation of blind users also varies just like normal users from one phase to the other. Respondents also told us that most of the time they did not involve blind users in SDLC, they just start developing application without involving blind users.

The outcome shows the maximum percentage of blind users' participation in requirement analysis phase 27.42%, and the software testing and deployment has 7.63%, project selection & planning 4.5 %, and system Design phase 3.48% and the development phase has the least percentage of user participation 2.42 %.

Table 2. Blind User participation in Software Development Life Cycle phases

Phase	Percentage
Project Selection and Planning	4.5
Requirement Analysis	27.42
System Design	3.48
Development	2.42
Testing and Deployment	7.63

These outcomes exhibit that in few phases, the participation of normal and blind users are negligible, especially in the design phase and in the development phase. From the outcome it is deduced that participation of users whether they are normal users or blind users, are not given importance in SDLC by the experts in Pakistan and China.

From the research study, it is revealed that in the software design phase and development phase, the user participation is negligible. This could be due to the kind of the phases that have to do with scientific know how, that the experts were of the opinion that user is shortfall.

Bryant [44] proclaims that participation of users in these phases will participate in non-functional requirement from the human factor's perspective. In these phases, participation of user is necessary as to make available knowledge in respect of their expertise and awareness.

6.2 Discernment about user participation in Software development Life Cycle

Table 3 shows the discernment of people about user participation in SDLC

Table 3. Discernment of user participation in SDLC

Questions	Strongly Disagree	Disagree	Neutral	Strongly Agree	Agree
User participation in software design is a big resistance	62%	22%	1%	0%	0%
Users are unable to effectively communicate their requirements	13%	49%	4%	21%	4%
User lack of familiarity with software development technologies make their participation difficult	15%	41%	21%	23%	3%
User stated requirements often differs	2%	17%	6%	54%	13%
Users involved in system development are unfamiliar with tradition system development life cycle	3%	29%	24%	37%	2%

The response indicates that user could participate in system development without being familiar with system development techniques –this opposed to 26% feelings that it was difficult for users to participate in system, development without familiarity with techniques. This suggests that there are some concerns over a possible lack of user knowledge

6.3 Validation of BUSDLC by experts

Proposed BUSDLC was validated by questionnaire survey. Different experts rated it according to their experience in industry as shown in Table 4.

The 75 percent response indicates that BUSDLC is good enough to be implemented in software industry .And it will definitely make improvement in the development of software's that are specially build for visually impaired people. It is also indicated that it this model is focusing both on organizational and visually impaired people's need. Experts also evaluated the overall usability of proposed BUSDLC as shown in figure 3.

The survey result also provided us with the rating of overall usability of BUSDLC in software industry.74% experts found it usable for software industry while 23% experts didn't find it usable for software industry.

Table 4.Validation of BUSDLC by experts

Questions	**Strongly Agree**	**Agree**	**Strongly Disagree**	**Disagree**	**Neutral**
BUSDLC shows that participation of blind users that is very much important in all phases of system development	95%	81%	12%	10%	0
Proposed model BUSDLC is good enough to implement in industry	75%	84%	23%	5%	2%
BUSDLC has no use at all in industry	9%	16%	87%	94%	0
Proposed model focus on organizational need as well as on blind users' needs	96%	81%	17%	4%	0
BUSDLC has more focus on HCI rather than organizational need that is positive.	83%	77%	5%	2%	0
HCI is addressed in proposed model, will enhance system usability	87%	69%	32%	29%	4%

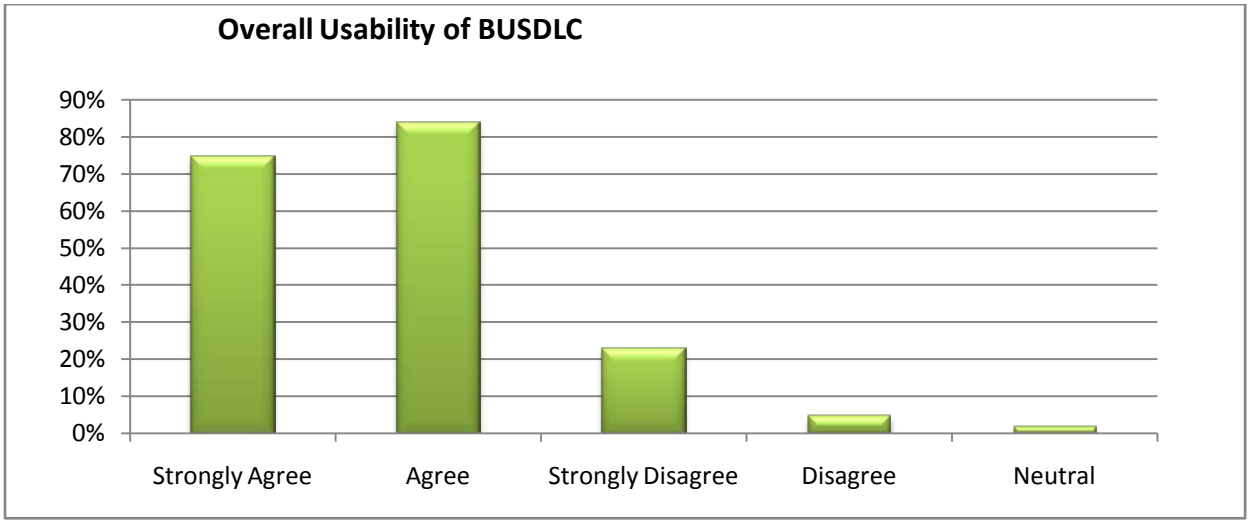

Fig. 3. Overall usability of BUSDLC

7. Conclusion and Future Work

In this era of globalization, adoption of technology is quite difficult for people with physical disabilities compared to people with normal abilities. The outcomes on participation of users have exhibit that experts keep on involvement of normal users as well as blind user in the development process. However, number of user participation differ at all phases of the software evolution process. With the augmentation of technology and the popularization of software products, visually challenged people have the essential needs to disperse into the information age, make up physical shortcomings and enhance their learnability effects and efficiency by using software products. This study considered that participation of users either they are normal user or blind users, is not highlighted at every phases of software development life cycle process. Besides in Human computer interaction, blind user participation is focused on the user act and participation regarding the non-functional requirement that concentrate on the software development that is purposeful, fit and fulfill the needs of blind people thus, it can be bring to an end that to have an assorted software application, the development process should target on the actual users and their requirements throughout the development process and in future this BUSDLC can be implemented in any software industry to validate it formally.

Acknowledgements

The authors acknowledge with gratitude the support and cooperation of those organizations and people who have participated in the study on smartphone's application. The invaluable facts and comments given by them are highly appreciated.

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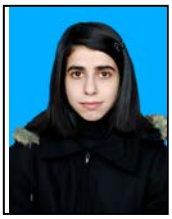

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