A Grounded Theory Approach for Designing Communication and Collaboration System for Visually Impaired Chess Players

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Abstract. Social interactions for visually impaired take place in the traditional way, such as meeting and calling, digital platforms are largely not utilized by them. Empirical research for visually impaired has focused largely on accessibility, usability and is yet to understand the problems from CSCW aspect holistically. We carried out a qualitative study of communication and collaboration activities for 43 visually impaired chess players in India. Through semi-structured interviews, the participants' experiences in using existing collaboration and communication channels were noted. A Grounded Theory based analysis was performed using Atlas.ti and themes were identified. Research indicates that - social collaboration and 'staying in touch', searching and sharing new information, exploiting existing ways of mobile interactions, and having several interests help visually impaired in their daily lives for social collaboration and communication. This study provides insights concerning designing CSCW mediums for them.

Keywords: Grounded theory · Visually impaired · Human-computer interaction · Communication and collaboration mechanism · Computer Supported Collaborative Work

1 Introduction

Social networking and mobile technology have made social interactions easy. Users create content such as images, videos and text, and share them among different social groups on WhatsApp, Facebook and Twitter. These social platforms have rich interfaces and heavy content for the users. As technology progresses, older interfaces and interactions become obsolete, and new modes of interactions are introduced. Rapid changes in interfaces are daunting for everyone including visually impaired (VI). Assistive tools such as screen readers - JAWS and Talks exist, but the tools are yet to reach the masses [15]. These tools are expensive and support a few languages only. Besides, they are not compatible with many mobile devices and apps. Though visually impaired have started adapting themselves to the social networking sites [3], social interactions for them are still restricted to meetings and calling. Literature study shows accessibility and usability

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as a major research area for VI [2, 3, 10] and we are yet to understand problems from Computer Supported Collaborative Work (CSCW) perspective in totality.

As per global statistics, the estimated visually impaired population is 239 million [9]. A significant number of them reside in developing countries and about 5 million reside in India [7]. A large visually impaired population from developing countries belongs to low income group [14] who do not afford smartphones and Internet; they use basic mobile phones. Though mobile technology has integrated into their lives, communication and collaboration for the geographically dispersed visually impaired is yet to take place holistically. Effective design intervention is required while taking holistic perspective towards the users, context and problems. We need to design socio-technical systems that capture these factors and bridge the gap between users and the world.

This paper presents a qualitative study of phenomena - communication and collaboration for 43 geographically dispersed visually impaired chess players, who attended blind chess tournament in Hyderabad, India. We investigated the participants' existing ways of communicating and collaborating, and delved into the details of their exposure to Information and Communications Technology (ICT) tools. This qualitative research was embarked with data collection and subsequent data analysis using Atlas.ti. We audio recorded the interviews and identified quotations, codes, categories and core theme for data categorization. We developed a theoretical model for the phenomena. This work provides a holistic way for HCI designers to design socio-technical systems for the VI and does not focus on the specific cases of interface or interaction.

2 Background

There are a few researchers who investigated usability, accessibility, interface design aspects of collaboration and communication for the visually impaired. Studies in the developed countries have evaluated social apps such as Twitter [3] and Facebook [2], and usability evaluation of both the apps shows that many tasks cannot be performed by a visually impaired even with a screen reader. Even though W3C has developed web accessibility guidelines [18], many of them are not followed. Besides, screen reader restricts users to perform sequential content consumption. In addition, users feel that a lot of content is not relevant or interesting for them. To overcome this, users develop their own strategies for consuming the content from these sites [10]. As the studies were performed with a few participants only, further large scale research is required.

Geographical location of the participants seems to play an important role in effectiveness of communication and collaboration. A research shows that physical proximity of the participants helped to increase collaboration. 'Social awareness network' helped people to identify other visually impaired in the vicinity and to initiate interactions with them [8]. Researchers have investigated the use of handheld devices for remote collaboration [17]. Survey shows that 'distributed collaboration' has been in focus in both synchronous and asynchronous way. In fact, people do not get time for synchronous collaboration because of time and place constraints. An investigation of asynchronous collaboration among visually impaired is required, which has not been the focus of investigation.

A research on mobility explored various aspects of mobility in CSCW such as micro mobility, remote mobility, and remote and local mobility [12]. They emphasized on the fact that mobility can improve collaboration and reveal newer opportunities. Telephone, which has only sound as output and keys and sound as input, has a huge potential for different applications. Resnick [16] carried out a survey of telephone based applications and tools for applications development for cooperative work. The study identified factors such as expressiveness of voice, anonymity, needs to remember large chunks of information, cost, and benefits among users influenced the success and failure of any application. Though these studies are not related to the visually impaired, they provide insights which could be adopted into design for them.

Voice has been a well-known medium for interactions and interface design for visually impaired. A voice based social network exists, but it is not well-known and used. Klango.net [11] is a social network for visually impaired, which provides voice messaging, audio themes and voice forums. But, the social network is a Web site and people with no Internet cannot access it. Furthermore, Klango users are native English speakers, and low literate population in India is not comfortable with English. Thus, it poses barriers of communication among geographically dispersed users. Though, Klango is helping in communication for a user base, a significant population from other contexts is left out.

Researchers have identified 'awareness' as a key for collaboration and have performed empirical studies for collaborative tasks such as graphs reading by the visually impaired [13]. Audio and haptic tool were found to facilitate collaborative activities [13]. But, communication and collaboration challenges of the visually impaired from developing countries is yet to be discovered. As Activity Theory advocates understanding user activities, context and building theoretical foundations for the designers, we need to investigate the field from a holistic perspective. The present study is our first step towards designing a collaboration and communication platform for the visually impaired.

3 Methodology

The objective of the study was to investigate the ways in which geographically dispersed visually impaired communicate and collaborate among themselves. Further, our objective was to investigate different communication mediums used and challenges faced while using the mediums. Qualitative methods for data collection, analysis and modeling were used as it would reveal issues that experimental research may have overlooked.

As the visually impaired from various parts of India were supposed to gather for the chess competition in Hyderabad, India; we selected it as the venue for our data collection. The tournament was funded by Devnar School for the Blind and arranged by All India Chess Federation for the Blind.

3.1 Participants

43 visually impaired people, in the age group of 15–64 years (SD = 11.46), participated in the study. The participants were in various occupations - student, telephone operator,

retired lecturer, and so on. Largely, participants from Mumbai, Maharashtra had participated and remaining participants belonged to other parts of India. 25 participants were completely blind and 18 partially blind. Except school students, all the other participants had mobile phones. 20 participants had accounts either on Facebook or Twitter. About 28 users were using Internet either on personal computer or mobile phone. Participants with screen reader on their handset could use some of its features such as playing songs, using WhatsApp.

3.2 Procedure

After procuring necessary permissions and assuring no interference during the tournament, we started interacting with the participants. We collected data for four days of the tournament. We did not have a preplanned participant recruitment plan as we did not know who would be participating.

We randomly selected the participants for interview based on age. As a standard protocol, we informed participants about voice recording; obtained verbal consent and started recording. We told them the objective of our study and that the information shared with us would be used for the research only. We informed the participants that they could skip a question, if it felt inappropriate, or could stop us any time during the interview. As we selected participants who had completed their rounds of chess, we did not have any incident of a participant leaving the interview midway. We conducted one-on-one semi-structured interviews for 30–45 min each.

Initially, we tried to build rapport with the participants with questions related to chess. Later, we asked questions such as “Which different modes have you used for connecting with people and sharing information with them?”, “Could you share your experience of playing chess over telephone?”, “What kind of challenges did you face in playing over telephone?”, and “What issues did you face using the social networks? How do you use them?” All the interviews were in Hindi and a few in Telugu; field notes were prepared and voice recordings were transcribed and then analyzed using Atlas.ti.

We followed Strauss’s method for Grounded Theory based analysis [5]. Initially we used open coding for new codes and later we compared data and selected earlier codes, if they felt appropriate. In vivo coding was not used except for a few quotations, for instance, ‘Voice has its own effect’. To keep a log of the thoughts, memos were used and memos were found useful for getting appropriate direction for the analysis. We followed Kathy Charmaz style of coding as ‘code data as actions’ [4].

We followed axial coding after open coding, to capture the relationship between codes and make connections. Finally, we used selective coding to come up with themes as a part of analysis. We refined themes and used appropriate names for the themes. Finally, we had 199 codes, which were categorized as follows: causal conditions, phenomena (causes), context, strategies and consequences.

4 Analysis

After rigorous coding, sorting, and code comparisons with interviews, we identified themes under Causal Conditions, Phenomena i.e. Causes, Strategies, Context and

Consequences as proposed by Strauss [5]. We restricted our themes to those that correlate with the core category - communication and collaboration among visually impaired. Following sub-categories were identified: Common Interests, Unawareness, No Friend in Vicinity, Feeling Helplessness, Feeling Technology Gap, Search for Information, Understanding Technology Limitations, Technology Exposure, Group Formation, Developing Interests, Consciousness, Visualization and Memorization, Social Networking, Information Sharing, Affordability Considerations, and Technology Adoption. The themes are described under sections as follows, but the intricate connections among the themes may seem overlapping in different sections (Fig. 1).

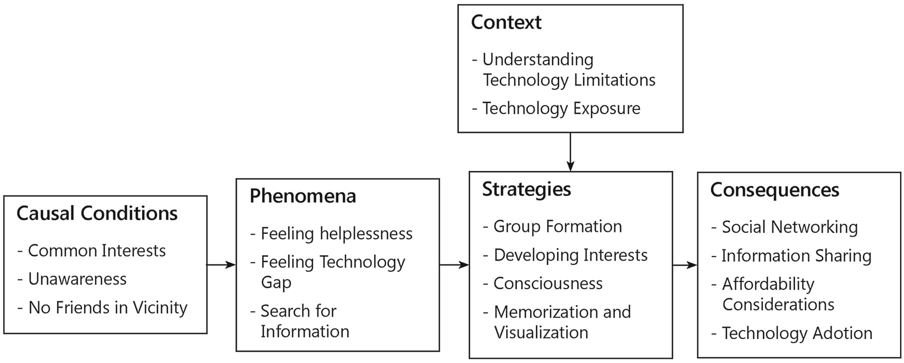

Fig. 1. Theoretical model for communication and collaboration among visually impaired chess players

4.1 Causal Conditions Related to Communication and Collaboration

We found three types of causal conditions that led to communication and collaboration - common interests, unawareness and no friend in vicinity. A significant number of participants shared that they do not have friends staying nearby their place. They could play with sighted people, but they are proficient in chess language, and many people do not know the chess language. For students who stay in hostel, playing chess is a regular activity. They do not 'find' friends near their home, thus, tournaments become a place to play. Tournaments give them access to the 'resources' and enable them to play their interested game. Local and national organizations do organize chess tournaments for them regularly, and they have 'groups' where they get this information.

> *"Only my friends who stay in hostel can play daily. I play very rarely as there is no one to play at home, but during tournaments, I play a lot. No one from my village knows chess language."*

Chess playing has been a common interest among visually impaired. Most of them start playing chess from a very young age. People who developed blindness after birth were not interested in chess initially; they developed it later as they attended tournaments or watched other visually impaired playing it. Most of them had chess ranks and they were proud of it. Participants who had a laptop or desktop play daily. But, many of them did not have access to a laptop or personal computer and hence, chess playing had become a tournament phenomenon. Parents were the motivating factor for them; participants who had lost vision after birth were inspired by friends. Observing peer play and enjoy chess make them learn and take interest in the play. This makes them a part of the "small" community and they are not left out of the community.

> *"My mother taught me chess. Whenever I get time, I start playing it. It is not the game I practice, I play it for enjoyment. I play chess every morning while having breakfast."*

There were two types of the participants, those who were in connected with other visually impaired and those who were not. Students depend on the peer network for getting new information by meeting people and telephony. Getting new information for participants who had basic phone was difficult. They could neither use screen reader nor had apps on their phone. Only a small group of visually impaired had "access to information" and others were "unawareness" of the happenings. Participants from cities had an edge over their counterparts. They had access to Internet on their phones and had screen reader. They were active on WhatsApp and Facebook and would get new information and share with friends. Tournament participation would become occasion for exchange of information.

4.2 Phenomena Resulting from Causal Conditions

The causal conditions resulted in the following three phenomena - feeling helplessness, feeling technology gap and search for information. To use the mobile phone, they have to either use screen reader or depend upon others. Participants who had basic phone could not read the SMSs and had to request others to read to them. Hence, they preferred talking and requested people to call. They feel they do not have control over the actions they perform using mobile phone. "We cannot handle it.", "I used to send message from my Nokia phone, but this touch screen is very difficult to type. We can't type confidently."

> *"There is always a tension that no one should hear what you say. So, (SMS) is kind of unsecure at public places. I face difficulties many times because of SMSs. I have to depend on others even for storing contacts, but now I memorize them."*

Some of the participants were using Facebook and Twitter using Talks from their phone, but many features are not accessible to them. Their friends would share photographs, which they cannot read. This resulted in low usage of the social networking sites. When they share something on Facebook, the post would go down the timeline (different people keep writing on the timeline). Hence, they would not get any response on what they share. They 'feel' their post should get response. If they are not frequent user, then they would build 'expectations' for a response. Thus, some of the participants wanted to 'pin' their post on Facebook groups.

To overcome these limitations and to get new information of interests, they would 'search' how to overcome the issues on websites. They would connect with friends, talk about the issues on social groups like Access India. Hence, they join NGO who regularly arrange gatherings, meeting, etc. Some of them follow people on Twitter, join Facebook and WhatsApp groups and have SMS subscription too.

> *"We follow certain people on Twitter so we come to know about tournaments. We have subscribed for SMSs, so we get SMSs. There is a site called chess-results.com where you can get all tournament related details."*

4.3 Context in Which Strategies Are Developed

The strategies were developed considering the technology limitations and the limited technology exposure. The strategies were developed when situation was out of control or with limited control. Participants play chess over phone, but due to network issues, they prefer playing face to face. They feel they have better 'control' on the moves and they can use their abilities when they have control. Control has been an important factor in their decision making. It even decides whether they would like to talk about personal information to people at public places. "*We avoid talking about personal things at public places, if it happens, then we talk in soft voice.*"

> *"When I am playing on telephone, if the other player does not know notations, I have to ask him repeatedly. Sometimes there is network issue and I cannot understand what the player is saying and we play wrong moves and we end up losing. But, when I play face to face, I can visualize what moves the player has played."*

The strategies were developed as they realized limitations of tools available for them. Talks software is useful for reading messages, but they avoid using at public places. Besides, messages sent by their friends in native language in Devanagari script are not read by Talks. Some of the participants use earphone, but they 'fear' that earphone may get entangled in something and they would lose control.

4.4 Strategies for Communication and Collaboration

Participants developed a few strategies such as Consciousness, Developing Interest, Group Formation, and Visualization and Memorization. Privacy has been a concern for them which they could not 'control'. They know a number based language which they use for talking privately at public places, and they are quite proficient in it. For instance, if they wants to say 'H', they would use a number associated with it. This number is also known to other visually impaired. Hence, number language sometimes becomes lingua franca.

> *"I feel that talking privately should be done in more calm (secretive voice), otherwise someone might listen it. Whenever I am at public place, I try to postpone the talk. We also have number language which I use."*

As they did not have 'friends in vicinity', they started playing chess over telephone, on computer and also joined chess classes. "*Yes, we play verbally!*" There were a few students who started playing chess recently. To understand and learn chess better, they started reading chess books. They started participating in chess tournaments.

For participants who lost vision by birth did not require chess board while playing over phone, they could memorize all the moves and play. Others keep chess board in front of them and played. They could visualize the chess board and pieces and would play.

"(In telephony) difference is that you need to visualize the board while playing orally, so this leads to increase in memory and concentration so that you can remember the whole board. So, it becomes easy when you play on actual board."

They formed and joined groups as Access India - email group for blind, SMS groups and WhatsApp groups. A few of them joined an international social network developed specially for blind - Klango.net. However, not many Indian blind people use this site and most of the conversations happen in local languages which is difficult for non-native.

"Yeah, I have joined some groups. There is a group for blind people in India called Access India. It is very good. I follow some people on twitter so we come to know and I have subscribed for SMSs."

To get new information, they started widening their friends circle. They enjoy while playing chess with people with similar needs. They play over phone by calling friends and keeping the chess board in front of them. Now every visually impaired owns a mobile phone. They prefer Nokia phone with keypad as it supports Talks and it has keypad. Typing with keypad is easier than using touch screen.

They were enthusiastic about the games and would dedicate four-five days for tournament. Participants come to "enjoy and meet people".

"I play before and during the competition period only. I practice (chess) on mobile with my friends. After the tournament I don't get time. I stay at my home, there is another blind person with me and that's my brother. When I come to play tournaments I got to make new friends; I have a lot of blind people around me."

4.5 Consequences of Strategies

The strategies developed by participants helped them stay motivated from other people in the group. They felt that technology is sometimes not affordable for them considering their occupation as the income is not much to afford expensive screen readers.

"I hear that there are software for the visually impaired which are too costly and there are many educated and working visually impaired people but they cannot use computers. So, even if technology is developed, it won't be used by the people. I have heard that there is software called Lekha for Hindi, but I don't have it as it costs a lot of money."

We observed technology adoption by many visually impaired. They started playing on Skype, on mobile and computer. They could share tournaments information and places to meet with the help of Facebook and Twitter. People who had screen reader in their mobile phone could change their phone wallpapers and use many features of the phone. We found that many visually impaired could change their wallpaper, profile and ringtones for others to see. SMSs enable them asynchronous communication, hence they prefer it over other mediums of communication. Thus, Access India is popular among them.

> *"All are busy, so meeting them is not possible, so in free time, everyone prefers to use phone, while travelling,* etc. *They use Facebook to connect with friends. You can be in touch with your best friends all the time."*

The sharing trend was seen in visually impaired where they share many things with their friends on WhatsApp, Facebook and Twitter. These include interests, news, views, photos, opinions, interesting things, about chess, jobs and career guidance for visually impaired, difficulties, and so on. Many visually impaired don't have formal jobs; hence, sharing helps people to know jobs specifically for visually impaired. A significant number of people shared about chess games and the difficulties faced in their daily lives. It has led to increased communication and collaboration among visually impaired.

5 Discussion

We carried out a systematic study for investigating communication and collaboration among visually impaired chess players. Although there have been a few studies on a few aspects of communication and collaboration such as usability and usability evaluation of Facebook and Twitter for visually impaired, a systematic study to understand the phenomena was lacking. In this paper, we uncovered, practices followed by the visually impaired chess players for communication and collaboration. Further, we developed a theoretical model based upon the qualitative data analysis using grounded theory.

Visually impaired have adopted themselves to their mobile phone even when that doesn't support a screen reader. Using their memorability, they dial any number and # key to access contacts from their SIM card to dial a particular person, and it does not need screen reader. Use of chess language and playing chess over phone verbally, travelling to newer places by remembering the 'checkpoints' have convinced us to justify their choices. For privacy assurance, they disguise people by using 'codes' to talk to each other, whenever necessary, as well as using their handset such as to show people that they are partially impaired and not fully impaired. Constant search for new information useful to them and being part of the community, 'not to leave out', has resulted into collaboration. Mobile technology helped them to stay in touch with other chess players and to take part in social gathering, for instance, the chess tournaments. There are many social networking sites which provide both synchronous and asynchronous communication; it is interesting to understand that an email group keeps people updated and SMS subscriptions reach any time and at any place. Some of their sharing habits are coherent with the Facebook study [19]. It was found that slow response from friends, privacy and accessibility, etc. were major concerns. People use social networking sites such as Facebook and Twitter, but do not expect much from them. This is coherent with the study by Brady [1].

A strategy used by participants for playing chess over telephone – visualization and memorization - opens up new avenues for designing and developing solutions for the visually impaired. Audio interfaces especially Interactive Voice Response (IVR) Systems are being investigated in the domain on ICT4D. Considering the skills of visually impaired, audio and voice interfaces could be made richer, 'complex' audio interfaces could be designed which would be at par with the visual interfaces. Participants were quite fast with number processing for constructing digit strings for the text given to them, and text entry using numbers could be tested with the visually impaired on IVRS.

Presently, some of the participants follow people on Twitter for getting new information. They use SMS services and have email groups, but are restricted to people who have Internet connectivity. An IVR system could be designed to integrate Twitter content for the visually impaired people who do not have access to Internet. Besides, a collaboration system dedicated to the visually impaired could be designed where everyone creates content and shares with their friends in the form of audio clips. In addition, IVR games could be designed such as Chess, some of the number games played by the participants could be digitized and converted into asynchronous IVR games. Here, we would need to consider affordability in terms of monetary value and time value.

We evaluated the theory which emerged from the data. A primary validation is performed with the evaluation criteria by Strauss and Corbin [6]. During the analysis and comparison among the interview data, significant codes repeated which would ascertain a level of theory validation. Further research is required to validate the theory as a tool by its application in designing a communication and collaboration system.

6 Conclusion

This paper provides guidance for understanding collaboration and communication among visually impaired chess players. It suggests opportunities for designing applications and systems based on visualization, memorization, group formation, and constant search for information. It helps to understand technology adoption, which is required for successful ICTD research. In future, we need to investigate in detail the effect of chess playing on the cognitive abilities of visually impaired chess players. We need to further understand ways in the model could be evaluated, enhanced and abstracted to cater to large visually challenged population. It would help us to finalize approaches for designing cognitive interface for visually impaired at par with visual interfaces. We hope this paper encourages researchers in this field to take different aspects of CSCW research for the visually impaired.

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