A Survey on Technology Exposure and Range of Abilities of Elderly and Disabled Users in India

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Abstract. This paper reports a survey on people with age-related and physical impairments in India. The survey evaluates functional parameters related to human computer interaction and reports subjective attitude and exposure of users towards technology. We found a significant cognitive decline in elderly users while their functional parameters are sufficient to use existing electronic devices. However young disabled users are found to be experienced with computer but could not have access to appropriate assistive devices, which would benefit them. Most users used desktop computers and mobile phone but none used tablet, smartphone or kiosks though they are keen to learn new technologies. Overall we hope that our results will be useful for HCI practitioners in developing countries.

1 Introduction

HCI is about knowing the user, which becomes more important while we consider users with different range of abilities in a developing country. This paper reports a survey to estimate Indian elderly and disabled users' perceptual, cognitive and motor capabilities and also their experience and attitude towards technology. Previous surveys either concentrated on ergonomics or demographic details of users or focused on a particular device like digital TV or mobile phones. The survey was conducted at Mandi and Kolkata and later will be continued at other parts of India.

We have initially identified functional parameters [2, 3] that can affect their interaction with electronic devices and combined both objective metrics on functional parameters and subjective attitude towards technology. Additionally similar survey was not conducted before in India from a Human-computer Interaction (HCI) point of view and independent off a particular application or software.

Initial results suggest that users with physical and age related impairment are enthusiastic to use new technical devices, but they also emphasize on need of training. There is a strong decline in cognitive abilities in elderly users and a few have poor eye sight. We need to consider users who can not read English and there is a need for voice based, multilingual and iconic interfaces. We also found that many physically impaired users do not have access to assistive devices and integrating assistive interaction techniques into mainstream systems will immensely help them.

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2 Survey

We have conducted a survey to estimate users' perceptual, cognitive and motor capabilities and also their experience and attitude towards technology. Previous surveys either concentrated on ergonomics or demographic details of users or focused on a particular device like digital TV or mobile phones. We have initially identified functional parameters [1, 2, 3] that can affect their interaction with electronic devices and combined both objective metrics on functional parameters and subjective attitude towards technology.

2.1 Place of Survey

The survey was conducted at Mandi, Himchal Pradesh and Kolkata, West Bengal. We plan to continue this survey in other parts of India considering Bangalore or Chennai in particular.

2.2 Functional Parameters Measurement

We measured objective parameters about perceptual, cognitive and motor abilities of users using standard test batteries. We have measured the following parameters based on our previous studies which identified them as relevant for interaction with electronic devices.

Minimum Font Size (FS). We measured it using a Snellen chart calibrated for a 1024 × 768 display screen and recorded the last line users can read correctly from 3ft distance using identical screen for all users. Based on that we can calculate the minimum visual angle required for different users and can convert it into different units of specifying font size like point, pixel or em.

Colour Blindness (CB). We measured the presence and type of colour blindness using the plates 16 and 17 of Ishihara Test. People with dichromatic colour blindness can only read one digit – people with Protanopia can only read the left hand side digit while with Deuteranopia can only read right hand side digit.

Grip Strength(GS) measures how much force a person can exert gripping with the hand. We measured it using a mechanical dynamometer.

Active Range of Motion (ROMW) of Wrist is measured as the summation of Radial and Ulnar deviation. Radial deviation is the motion that rotates the wrist away from the midline of the body when the person is standing in the standard anatomical position [4]. When the hand is placed over a table with palm facing down, this motion rotates the hand about the wrist towards the thumb. Ulnar deviation is the motion that rotates the wrist towards the midline of the body when the person is

Fig. 1. Snellen Chart used in the study

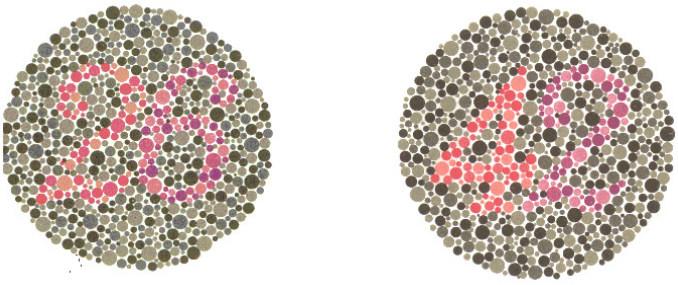


Fig. 2. Plates 16 and 17 of Ishihara Test

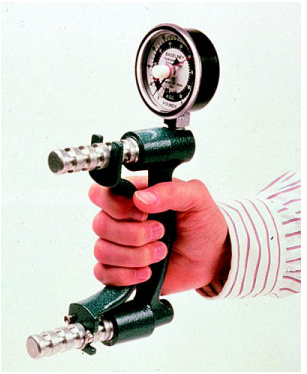
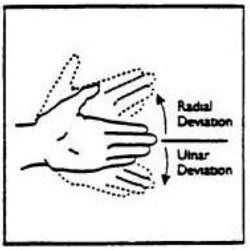


Fig. 3. Measuring Grip Strength



Range of Motion of wrist (Palm facing down)

Measuring Radial Deviation

Measuring Ulnar Deviation

Fig. 4. Measuring Active ROM of Wrist

standing in the standard anatomical position. When the hand is placed over a tablewith palm facing down, this motion rotates the hand about the wrist towards the little finger. We measured the deviations with the goniometer.

Trail Making Test (TMT). The Trail Making Test is a neuropsychological test of visual attention and task switching. It consists of two parts in which the subject is instructed to connect a set of 25 dots as fast as possible while still maintaining accuracy. It can provide information about visual search speed, scanning, speed of processing, mental flexibility, as well as executive functioning. It is also sensitive to detecting several cognitive impairments such as Alzheimer's disease and dementia.

Digit Symbol Test (DST). It is a neuropsychological test sensitive to brain damage, dementia, age and depression. It consists of (e.g. nine) digit-symbol pairs (e.g. 1/-,2/⊥ ... 7/Λ,8/X,9/=) followed by a list of digits. Under each digit the subject should write down the corresponding symbol as fast as possible. The number of correct symbols within the allowed time (90 sec) is measured.

Besides these objective measurements, we also recorded presence of any particular impairment that may affect users' interaction with electronic interfaces.

2.3 Attitude and Experience Toward Technology

We conducted a semi structured interview and discussion with each user about their experience of using technology and their attitudes toward new electronic devices like Tablet Computers or Smart Phone. We used the following set of questionnaire to start discussion but also allowed users to speak freely about any particular issue or problem they would like to highlight. We took help from local language experts to communicate with users whenever needed.

1. I think that I need to use new technology
2. I consider myself having the necessary skills to manage to use new technology tools
3. I have problems to use these technologies properly even with practice
4. I'm afraid to touch a new technology tool in case I'll break it
5. I prefer to use an old fashion tool with fewer functions than a new one
6. Do you use
    a. Computer
    b. Tablet
    c. Kiosks, at railway station, community centre
    d. TV
    e. Mobile phone
    f. Smartphone
7. Peripherals used with Computer
8. Peripherals used with Tablet
9. Problems with Computer / Laptop
10. Problem with mobile phone
11. Do you have experience with any 'special' device
12. Problem with any other device

3 Results

We so far collected data from 19 users. Tables 1 and 2 below list the demographic information and functional parameters respectively.

We did not find any significant decline in physical abilities of elderly users compared to their able bodied counterpart though a couple of them have poor eye sights and will be benefitted with larger font size.

Except the last two participants, all of them have sufficient grip strength and active range of motion of wrist to operate mouse, trackball, touchscreen and similar interaction devices.

We found results from the cognitive tests have a strong bias on age (figures 5 and 6). The elderly population performed poorly in TMT and DST, though a few young participants also performed poorly in TMT test. The TMT test points poor context switching capability in elderly due to their diminished short term memory capacity, which is further confirmed by their scores in the DST test. In fact these two tests take less than five minutes to conduct and successfully indicate decline in short term memory, and so can be used in creating user profiles for human machine interaction models.

Table 1. Demographic detail

Age	Sex	Disability	Education	Profession	Height
26	F	Polio	School		121
30	F	Polio	School		152
25	F	Polio	Graduation		157
26	M	Polio	Graduation	Private Tutor	165
27	F	Birth Defect	Graduation		152
26	M	Birth Defect	Graduation		160
27	M	Accident	School	DataEntryOperator	165
28	M	Accident	School	Private Tutor	167
28	M	Polio	Graduation	Computer Trainer	165
80	M		Primary	HotelWorker	172
67	M		School	Farmer	160
64	M		School	Farmer	162
54	M		School	Physio Therapist's Assistant	152
68	M		School	Farmer	165
65	M		Primary	Farmer	160
66	M		School	Chef	165
74	M		Primary	Businessman	175
84	F		Illiterate	HouseWife	134
69	F		Illiterate	Farmer	144

Table 2. Functional parameters

GS	ROMW	TMT	TMT-Err	DST	DST-Err	FS	CB
22	100	45		39			
23	75	68		34			
25	65	55		40			
33	60	169		36	1		
19	60	28		43			
40	55	52	1	22	5		
40	110	229		25			
26	105	41		40			
32	85	35		41	1		Protanopia
25	85	184		4	2	12m	Other
28	55	87		13		9m	
37	70	78		11	2	4.5m	Protanopia
31	75	80	3	18	1	3m	
31	100	116		3	5	3m	
29	75	265	Help needed	1	4	9m	Other
23	45	133		6		4.5m	
20	65	200		1	4	4.5m	Other
11	50		Cant Complete	2	5	12m	
16	60		Cant Complete	1	6	15m	Protanomalous

Regarding attitude towards technology, all of them think that they need to use new technical devices while 63% of them think they have necessary skill to manage new technical tools. A few users (26%) are afraid that they can break a new device if they touched it and 21% users prefer to use old fashioned tool with fewer functions, though they think they need to use new technologies. The survey also pointed out specific problems which include issues with changing SIM card and battery in a mobile, handling too many buttons in a remote control or EPG application in TV and high prices of modern technologies.

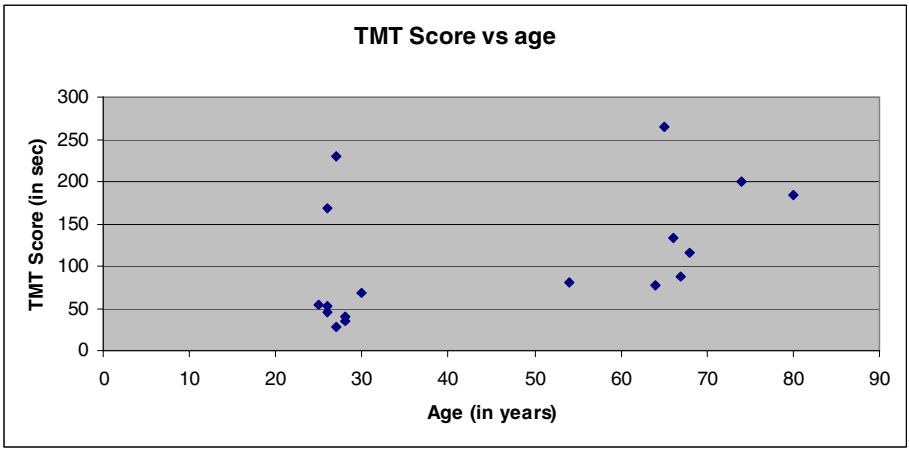


Fig. 5. Effect of age on Trail Making Test

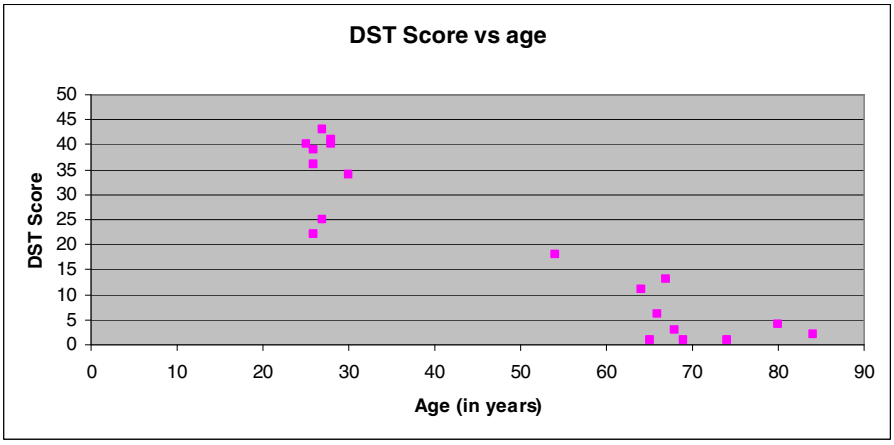


Fig. 6. Effect of age on Digit Symbol Test

Regarding technical exposure, all of them use TV and mobile phones and none used kiosks, smartphones, Tablet computers and any assistive devices. Young users are exposed to computers and elderly users did not yet use it though they have access to a desktop computer.

4 Conclusions

Users with physical and age related impairment are enthusiastic to use new technical devices, but they also emphasize on need of training. There is a strong decline in cognitive abilities in elderly users and a few have poor eye sight. We should consider users who can not read English while designing user interfaces and there is a need for

voice based, multilingual and iconic interfaces. We also found that many physically impaired users do not have access to assistive devices and integrating assistive interaction techniques into mainstream systems will immensely help them. We have already started to use the results to develop user models [1] for Indian population and hope these results will be useful for other HCI practitioners in developing countries.

References

1. Biswas, P., Robinson, P., Langdon, P.: Designing inclusive interfaces through user modelling and simulation. International Journal of Human-Computer Interaction 28(1) Print ISSN: 1044-7318
2. Biswas, P., Langdon, P.: Developing multimodal adaptation algorithm for mobility impaired users by evaluating their hand strength. Journal of Human-Computer Interaction 28(9) Print ISSN: 1044-7318
3. Biswas, P., Robinson, P.: Predicting pointing time from hand strength. In: Holzinger, A., Miesenberger, K. (eds.) USAB 2009. LNCS, vol. 5889, pp. 428–447. Springer, Heidelberg (2009)
4. Kaplan, R.J.: Physical medicine and rehabilitation review. MacGraw Hill Book Company (2006)