Single touch based interaction for people with symptoms of Parkinson’s disease.

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STATEMENT OF THE PROBLEM
The purpose of this study is to develop application software (app) for touch input based mobile device (to be used for single touch type of interaction). Targeted users for this app are the people, who have a condition of shaking hands, while touching display area i.e. they have a spatial variation or inaccuracy over a point on responsive display screen due to some health conditions like Parkinson’s disease.

RESEARCH QUESTIONS AND/OR HYPOTHESES
The system, (refers to a mobile here) is assumed to be used by a single user, which should adapt to user, counter the involuntary movement of the user’s hand. Parkinson’s disease is progressive in nature and hence the system needs to periodically monitor the extent of the shake in hands. This varies depending on the stage of the disease. The effect of this shake in hand can cause wrong input to the device. For instance, on a menu screen, the screen may get scrolled instead of selection of an icon because of these movements in the hand. A study has to be done while designing the screen (font-size, buttons etc.) and the app should be user-friendly. The system should be intelligent to adapt to user’s needs.

METHODS AND PROCEDURES
The app should be designed so that the mobile device automatically runs it every month or a user can initiate it. It will be designed to have 3 modes of operation and will adapt based on the symptoms (stage) of the user - low, medium and high.

Two modes of detection of the extent of spatial variation of input will be used:

1. The user needs to place the device in a fixed position and show the hand in front of the camera. The camera captures the video in terms of frames per second. Based on the analysis of these different frames, the extent of user’s disability can be calculated.

2. Based on the input from the camera, a “training sequence” is made for selecting the mode of operation. The system displays a sequence of buttons and icons (of different sizes and fonts). The user has to click each of them and based on this, the system learns the behavior of a user.

Based on this, the operating system will adjust the icon and the font size displayed, making it easier for the user to navigate. The system will also accordingly change the speed of swipe functionality.

Variables
Some variables here are age, gender, finger size, stage of the disease, number of training sequences needed to judge the extent of user’s disability, readiness of the users to adapt to this system, user-friendly interface, size of display, touch surface sensitivity etc.

Sampling
Participant-oriented methodology will be employed here. The experiment will be conducted for a total of 15 people (8 men and 7 women, preferably in different age groups covering 30 to 80 years) with different stages of Parkinson’s disease. They will be asked to use both systems (with and without the app installed) and feedback is collected from each of them.

Users will be put through the two steps of training of system and based on this the mode gets selected. The users will then be asked to use the device for a time period of 10 minutes on various times of the day and data will be collected to observe the variation in the user’s input response. The operations they need to perform will be defined, e.g. touch an icon, scroll the menu, type text on the on-screen keyboard etc.

Instrumentation
Based on the tests described in previous section, the “success rate” of achieving the prescribed tasks will be considered. And user experience feedback from each participant about using both mobile phones (with and without this app) is obtained. This will be based on a scale of 1-5, where 1 is very difficult to use interface even with the app and 5 is that the app has an easy-to-use interface.
As there will be no prior training given to users, observations will be done if they are comfortable using the app, especially the training sequence.

**Data analysis**
The data collected based on the number of users, number of samples from each user will be then statistically analyzed.

Extent of variation from targeted input (assuming a dot) will be plotted with respect to number of samples per user, to observe the distribution, standard deviation and variance. The variation of a user’s accuracy in repeating a sequence of the shaking hands will be analyzed based on the tests done on multiple times of a day. Variation of the users’ disability (though in the same stage of disease) will be analyzed to see if the training sequence can be improved or simplified based on the stage of illness.

Excel will be primarily used for this analysis.

**LIMITATIONS AND DELIMITATIONS**
This app can be utilized by very limited number of people as it does not suit for other hand disorders like- finger contractures, limited wrist functionality etc. The scenarios where people may use a stylus to point out objects are not considered here. Also, while using a phone, it is not fixed, i.e. there is a shake in both hands; the performance of the system needs to be studied in that scenario. An input from accelerometer can be used to take into account the shaking of the phone by the user (when held in one hand), but this is out of the scope of this study. The average screen size of applicability of this app may increase due to this.

Delimitations include – app is only for single touch gesture which has minimal functionalities like selecting, scrolling, swiping, messaging through virtual keyboard, speed dialing etc. It doesn’t include other gestures. The system can later be extended for multiple users, where each user could be identified using bio-metric system (by creating user profiles) while user logs in. This app retains its mode till the system logs off.

**SIGNIFICANCE**
Recently, touch screen phones have become very common and is utilized by majority of people. Applications should not be always “designed for average people”. Also touch screens or touch based public utility systems (either on display, holographic etc.) are becoming very ubiquitous, like ticket booking kiosk, ATMs etc. Hence this study has very high relevance to the future system needs.

**REFERENCES**
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