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Fig1.   Participant playing the game used for gathering data.

TOUCHSENSE
COMPLEMENTING SMARTPHONE'S TOUCH SCREEN DATA

Touch Sense is a MSc thesis proposed by Fraunhofer AICOS with the objective of complementing the information given by the smartphone touch screen with information given by the accelerometer and gyroscope. The goal of this new combination is to provide new ways to characterize touch interaction with a smartphone.

Motivation

Despite plenty work related with the use of accelerometer and gyroscope in smartphones can be found on the current literature (e.g. activity recognition), using the combination of these two sensors to detect touch events is currently a topic not well explored as the few approaches that could be found only explored this topic superficially.

This MSc thesis goal was to go further, extracting new information about touch events in order to improve the user interaction experience with the smartphone.

These new touch features can be very useful to better evaluate the smartphone usage as it complements touch data already given by the touch screen. It also can enable a host of new functionalities as for example adding a strength dimension to touch events or additionally as older adults are very prone to input errors this data could prove useful to discard unwanted touches.

The Project

In order to be possible to detect and characterize touch events using the

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New features

- How the user is holding the device

- Which hand is holding the device

- Which finger is being used to touch the device

- Impact force of a touch event

- Frustration while interacting with a smartphone (by measuring the impact force of each touch)

accelerometer and gyroscope 5 algorithms had to be developed with different functionalities:

- Detect where the smartphone is (on a surface, being hold still or moving);

- Detect touch events using the accelerometer and the gyroscope;

- Assess which hand is holding the device (right or left);

- Assess which finger is being used to touch on smartphone (index finger or thumb);

- Calculate the impact force of the touch event.

Validation

In order to test and evaluate the developed algorithms a simple game was used (Fig2.). This game was played holding the smartphone on different conditions and participants were divided into two groups: a younger group with mean age of 20.7 and an older group with mean age of 71.6.

Results

Both the algorithm that can determine how the smartphone is being used and the algorithm that can detect touch events had an excellent performance for both groups (precisions higher than 95%). Similar precisions were achieved from the other algorithms, all of them above 70%.

Regarding the difference between the two groups, as expected the younger group had better results (hovering around 90%) yet the performance achieved on the older group was not so far behind (hovering around 83%).

Conclusion

The algorithms developed had a good performance with the two test groups. The difference of results between the two groups can be explained by the older participants' inexperience with smartphones (for the algorithm that assesses which hand is holding the device) or for the thick fingers common among elderly people (for the algorithm which assesses the finger is being used).
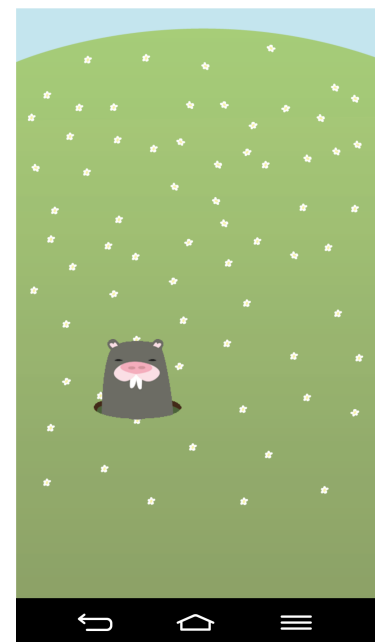

Fig2. Screenshot of the game used to data collection.