Haptic Vision

can we feel what we see using the sense of touch?

Investigating a new generation of smart tablets that allow the user to feel textures and vibrations on the screen. And the effects and limitations of the technology for blind and partially sighted individuals.

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A joint project between the university of Newcastle and university of Helwan, Egypt. With the support of Tanvas providing the tablets.

1.Introduction

- 800,000 individuals suffer from **blindness** in Egypt, And many more here in the UK-usually more than 50 years of age.
- In the 21st century and there are more and more emerging technologies with **Touch screen interfaces**.
- **Accessibility** on these devices such as voice feedback specially Smart phones, is a big issue.
- Blind individuals focus on **Sense of Touch** because it is Very intuitive for them.
- The **tablets** provided by Tanvas allows the users to feel objects on the screen as different textures and vibrations. This is known as **local vibration**.
- There is also a **global vibration** which is created by the vibrations in the tablets frame.
- Together local and global vibrations will open a new door to the future of **accessible games and interfaces** for blind and partially sighted patients.

2.Aims and Objectives

- Aim: Creating an android app that investigates global vibrations both in a accessible game and a user interface.

Objectives:

- Investigate the performance of the app.
- Investigate the user experience with the game.
- Investigate different global vibrations rhythms.
- Investigate design limitations for the user interface.

3.Approach

- The app was constructed from 3 smaller applets:

The Blind Maze
A simple maze with a twist: the user can't see anything and have to navigate through with the help of the phones vibrations. Gets harder everytime the user wins.

The BuzzShape app
a simple app that draws shapes on the screen that vibrate when touched. it app can change size to mimic the size of boundaries and layouts, it can also change vibration patterns to help with the object identification

The TestApp
A simple applet that enables vibrations on text. This is good for integrating with parsing apps that allows users to read what is on the screen.

4.Results

- **4.1 BuzzShape app:**

Resolution: Is defined here as the act of determining whether a tactile object is touched. By looking at Figure1 after a certain point the rectangles are too small to even touch, this defines a threshold for the size of the objects on the screen. Passed which the object can no longer be resolved by touch. Especially that visually impaired users need to navigate by touch as well.
General recommendation is to keep buttons more than 48 Density-independent Pixels (dp) in size. App and notification bars can be decreased to about 24dp. Smaller objects can still be touched by sighted people, however makes it crucially difficult to navigate and find the object which is any smaller than these thresholds.

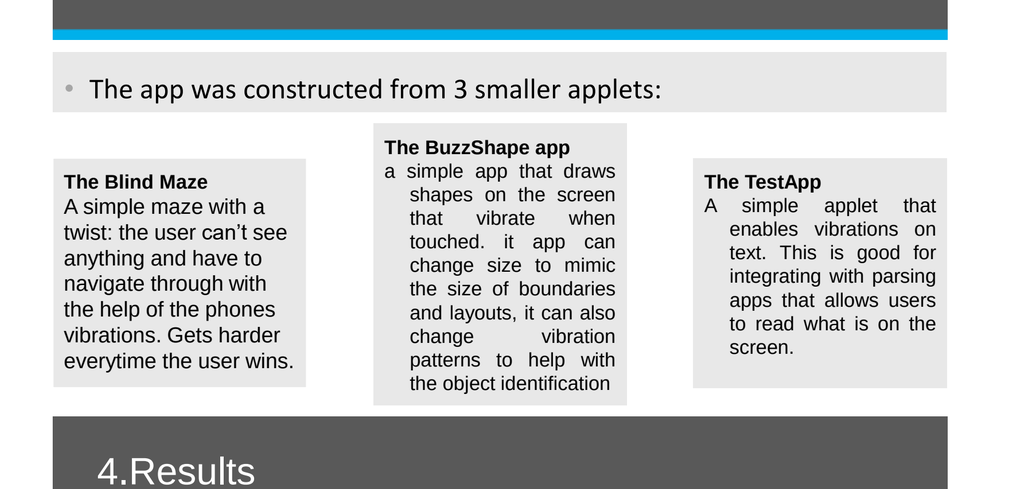

Figure1, illustrates the UI for the buzz shape app page1. As it can be seen the rectangle can be scaled to different sizes.

4.Results

- **Performance**: The less memory allocated the better, faster and more reliable an app is. The Memory graph shows in figure 2 shows the amount of data allocated in Mega bytes against time in seconds. The CPU graph shows the %CPU used against time. As it can be seen, it is not very heavy on the memory, the significan rise in memory allocation is when the BuzzShapeTest is run. This is because the number of objects drawn are almost 4 times more than before so the Android system has to allocate more memory for this. Lastly the CPU is barley used at all as the app is very simple and light.

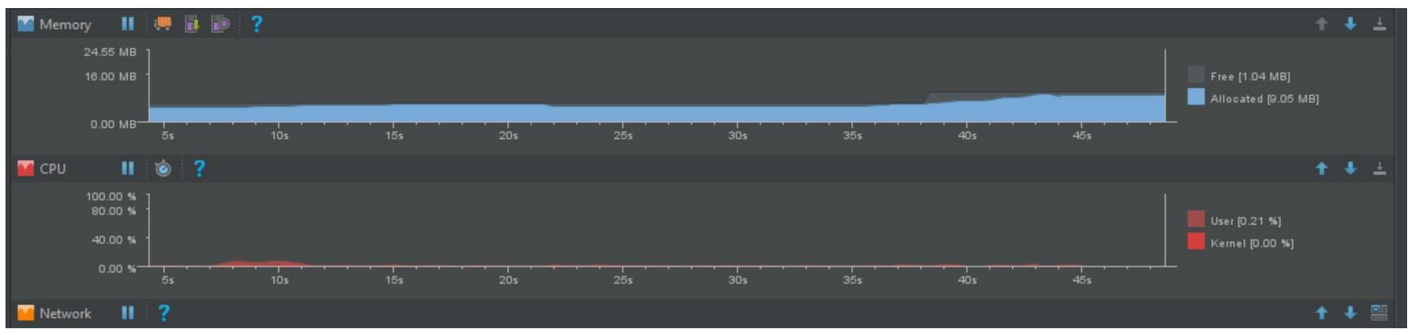

Figure 2 , illustrates the CPU and memory allocation for the Blind maze app.

- **4.2 BlindMaze app:**

The blind maze didn't have much results as it was a game. Sometimes the app would generate mazes that could not be solved. This is because the maze was generated at random hence, the walls would be placed in such positions that the user could not pass through them. This is an area to consider for further improvements. The maze is shown in figure3.

- **Performance**: The same goes for the BlindMaze app in terms of the CPU, however this is where memory efficiency really shows itself. As it can be seen in figure4 the blind maze app requires much more memory. There are two peak points on the graph. The first one reading from left to right near the 5 seconds mark is when the actual app is run. It can be seen, that already the application requires more memory that the buzzshape app. This is because the maze itself is much more complicated also we have more graphics and colours on the screen. Also, there is a steady rise in the memory allocation every time the maze is restarted. This is very interesting.
- Although the maze restarts and essentially the blindmaze app is refreshed, the data stored from the previous version is not cleared out. So, the system allocates more and more memory. Until there is no more memory left to allocate to this app. This is where the app crashes.

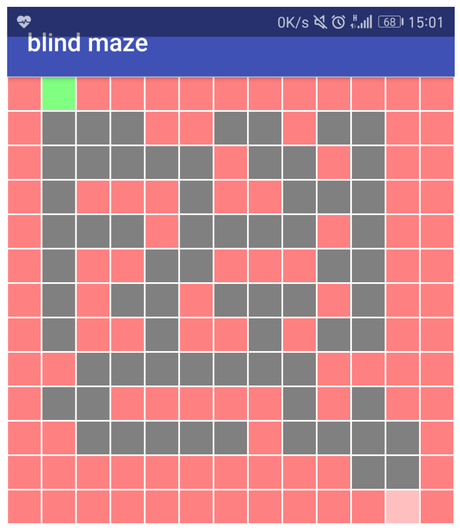

Figure 3, shows the BlindMaze App. This is in the visible state of the maze.by touching the eye icon the visibility can be toggled.

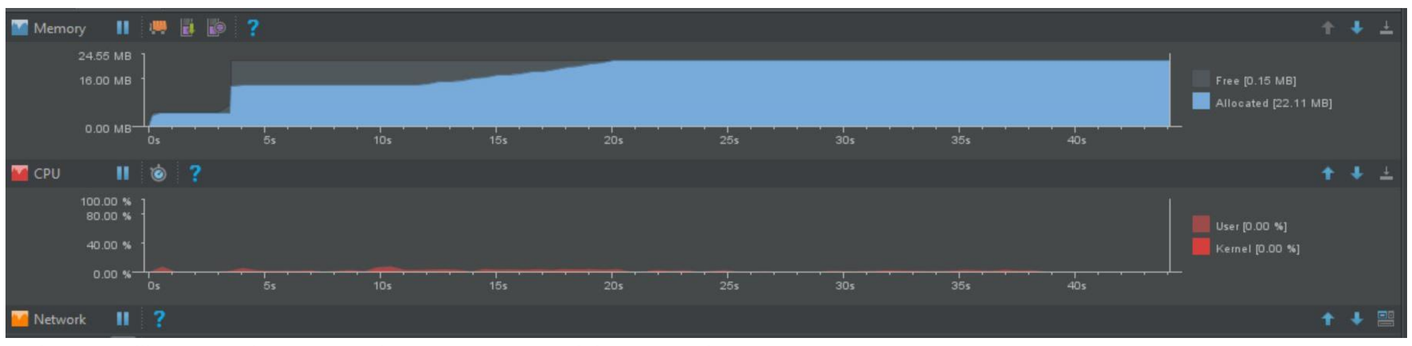

Figure 4 , illustrates the CPU and memory usage of the Buzz Shape app.

- **4.3 Test app:** this app enables vibrations on text. This was an area for further improvements. The original concept was to convert web pages to a form of text that vibrate as the user touches them. Then the text would be converted in to brail so that the blind could understand the different vibrations. This equipped with both the local and global vibrations would allow blind and partially sighted people to read webpages just as they would read any brail book or paper.

5.Discussion and Conclusion

- The haptics feedback on phones are very limited by UI design and the user input.
- By adding localized vibrations to global vibrations there might be a chance to introduce a new user interface in which the user can navigate through apps and screens using the sense of touch.
- As illustrated very simple games can be constructed using the idea of vibrations. This can be further developed with including local touch which can open a new door to accessibility on smartphones.
- This study shows that global vibration is just as important as local vibration for making games and UI.

6.Acknowledgements

Special thanks to Dr Patrick degenaar and Dr Walid Al-atabany , for thei excellent support and supervision of the project. And Newcastle University for being the source of funding for the project.

References:
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Tanvas website: https://tanvas.co/