INTRODUCTION

Project Rustica is a research project conducted by SAP Research Pretoria. The objective of this project is to implement a system of a virtual buying co-operative within a specific area of the Sekhukhane rural living lab (Kgautswane) and to measure the effects of this intervention on the social and economic development in this community. As part of this intervention a mobile phone based ICT solution will be introduced to the small traders (within the Kgautswane community), providing them with the means to participate in the collaboration procurement system.

The main objective this project was to investigate the usability (efficiency) of the Rustica mobile ordering system using eye-tracking as the primary methodology. The usability study was conducted in the HCI lab at UNISA, Pretoria.

The UNISA HCI laboratory consists of an observer room and a participant room, separated by a one-way mirror. The participant room is equipped with a 17” TFT monitor with resolution of 1280x1024 and a Tobii 1750 eye tracker, allowing the eye movement of participants on the screen to be recorded. The fixation radius was set at 35 pixels. A 9-point eye tracking calibration was used at all times. The calibration process requires a participant to look at several points/marks on the screen in order to set up the eye tracker and to ensure accuracy. During this calibration the eye tracker records the value that corresponds to each gaze position. Eye tracking video recordings included a cursor which indicates the participant’s eye movements. Eye tracking data files were also recorded.

Additional data were collected through live video recordings (including the screen, the participant’s face and mouse/keyboard actions) and a post-test, informal interview.

Eye tracking analysis of interactive applications has limitations – when a changing interface is evaluated, more planning needs to be done to analyse the data. When progression through the tasks and the on-screen events are different for each player, we needed to identify interaction periods where screen elements remain in a consistent position to do a meaningful analysis. For example, for each participant in this study we generated fixation and heat maps from the moment they first clicked on the Order Stock button up to the moment they first clicked on the edit box next to the Vodacom airtime voucher.

Below we report on the results of analysing the eye tracking videos for each participant. We end with a summary of the problems identified and recommendations for improving the interface.
PARTICIPANTS

The following five participants used the on-screen simulation for which eye tracking data was captured

<table>
<thead>
<tr>
<th>Participant</th>
<th>Home language</th>
<th>Grade passed</th>
<th>Used computer?</th>
<th>Cell phone use?</th>
<th>Cell phone functions?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Tswana</td>
<td>Matric</td>
<td>Never</td>
<td>2-5 times a day</td>
<td>More than basic</td>
</tr>
<tr>
<td>2</td>
<td>Tsonga</td>
<td>Matric</td>
<td>3-10 times</td>
<td>&gt;5 times a day</td>
<td>More than basic</td>
</tr>
<tr>
<td>3</td>
<td>Ndebele</td>
<td>Grade 11</td>
<td>Never</td>
<td>&gt;5 times a day</td>
<td>Make, receive calls and sms’s</td>
</tr>
<tr>
<td>4</td>
<td>Tswana</td>
<td>Grade 8</td>
<td>Never</td>
<td>2-5 times a day</td>
<td>Make, receive calls, receive sms’s</td>
</tr>
<tr>
<td>5</td>
<td>Tsonga</td>
<td>Matric</td>
<td>Never</td>
<td>2-5 times a day</td>
<td>More than basic</td>
</tr>
</tbody>
</table>

The following five participants used the system on a cell phone (no eye tracking data available for these):

<table>
<thead>
<tr>
<th>Participant</th>
<th>Home language</th>
<th>Grade passed</th>
<th>Used computer?</th>
<th>Cell phone use?</th>
<th>Cell phone functions?</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Sepedi</td>
<td>Bsc</td>
<td>&gt;10 times</td>
<td>&gt;5 times a day</td>
<td>More than basic</td>
</tr>
<tr>
<td>7</td>
<td>Tswana</td>
<td>Grade 11</td>
<td>&gt;10 times</td>
<td>&gt;5 times a day</td>
<td>More than basic</td>
</tr>
<tr>
<td>8</td>
<td>Tswana</td>
<td>Grade 8</td>
<td>Never</td>
<td>&gt;5 times a day</td>
<td>More than basic</td>
</tr>
<tr>
<td>9</td>
<td>Ndebele</td>
<td>Grade 11</td>
<td>Twice</td>
<td>2-5 times a day</td>
<td>Make, receive calls and sms</td>
</tr>
<tr>
<td>10</td>
<td>Tsonga</td>
<td>Matric</td>
<td>&gt;10 times</td>
<td>&gt;5 times</td>
<td>More than basic</td>
</tr>
</tbody>
</table>

ANALYSIS OF EYE TRACKING DATA PER PARTICIPANT

Participant 1

When given the task to order R10.99 Vodacom vouchers, she identified the Stock Order button very easily, but struggled to click on the right spot on the button (successful on 3rd click).

On the Order Stock screen she immediately noticed the Vodacom voucher to order.

Often looks at the ‘Product’ heading at the top of the screen.

Long fixations on the price, but very few on the edit box. Also looked at the 1 tab often.

After clicking on the edit box she found the button to activate the numeric keyboard easily, but needed a little guidance to the Done button.
When asked to order MTN vouchers, again did not look at the Edit box. Clicked on the ‘Back’ arrow at the bottom of the screen twice and had to be guided to use the ‘Forward’ arrow to go back to the Order Stock screen.

Struggled to figure out that she should click on the Edit box to enter the number of MTN vouchers (did not recall from previous order). She seriously considered using the 2 tab as an Entry point. Even when prompted to think back to what she did before, she could not recall. The facilitator eventually told her to click on the Edit box.

The second time round she used the keyboard easily and remembered to use the Done button.

She struggled a lot with scrolling down and had to be helped a few times.

When asked to confirm the order she went to the Main menu via the arrow, but pressed it twice.

When the Confirm Order button was visible, she initially not look at it. She looked at the Total amount and then at the Clear button. When asked what she thinks she should do, she said she should use the Clear button. When asked what ‘clear’ means she realised her mistake and that she should use the Confirm order button.

A system error caused a high total that exceeded the available amount. She understood the message about this.

When asked to order 10 cans of Coca Cola she immediately understood that she had to find the right category. Tried a few categories (Toiletries, Groceries).

When asked what she thinks the 1 and 2 tabs mean, she didn’t know.

Found Coke after a long search (partly because of struggling to scroll).

Again had to be prompted to click on the Edit box.

When she entered a letter instead of the number, used the red ‘Cancel’ button at the top of the screen for this. Facilitator had to tell her how to delete a character.

When asked to place the order she did not remember about the Confirm Order button and had to be prompted to scroll down.

When asked during the post-test interview about her confusion regarding the Clear and Confirm buttons, she explained that ‘Clear’ could mean ‘I am clear now I know what I want to order’. Said Cancel would be better.

When asked why she clicked on the Back arrow, she said she was looking for the numbers. This is probably because the keyboard appeared at the bottom and she somehow linked the arrow to bringing up the keyboard.

**Participant 2**

Clicked on the Order Stock button immediately and on the Order Stock screen realised immediately that she had to use the Edit box for entering the number.
Struggled to get the numbers on the keyboard. She looked at 123 but did not use it. Used computer’s keyboard to delete incorrect entry. When eventually accepting her input there was a space that caused an ‘Invalid input’ message. She did not understand this at first.

When asked to order MTN vouchers she clicked on the MTN picture twice and did not look at the Edit box. Clicked on the picture for a third time before clicking on the Edit box and entering the number very easily.

When asked to confirm the order, she clicked on the Back arrow twice and had to be helped back.

Didn’t struggle with the scrolling and when the buttons were visible immediately knew to use the Confirm Order button and then on Order Now.

Ordered the Cokes without a problem. Immediately looked through the list of categories and found Beverages Cold. Completed the order very quickly.

This time she struggled with the scrolling, opening some categories while scrolling.

She understood the E-wallet exceeded message that appeared.

During the post-test interview she said that she did not realise she could keep on adding items when placing an order. She thought that for each item you first had to go back to the menu and click on Order Stock to add more items to the order.

**Participant 3**

She found the Order Stock button easily. Due to a system error all the Edit boxes contained the number 20. She interpreted this as R20.00.

Explained to her that the 20 meant the number of items to order and asked her to order 3 instead.

She focused on the 1 and 2 tabs and said there are only a 1 and 2 to click on, no 3.

She had no idea that she had to click on the Edit box to enter a number.

This participant wouldn’t do anything without help – kept on asking what she should do.

Her fixations on screen items were very random and she didn’t learn anything while doing it with help. Struggled equally with the second item she had to order.

Took a very long time to scroll down and did not understand what Confirm Order meant. She also did not understand the ‘E-wallet exceeded’ message.

She did, however, understand that Clear order will stop the order.

When asked to order Coca Cola she clicked on Order Stock, but then tried to click on the Product heading to see more products. Had to help her to scroll down. She understood that Beverages Cold will contain Coke but had to be prompted to click on it. Again could not use the on screen keyboard without help.

This time she knew that she had to click on Confirm Order.
During the interview she explained that she struggled to handle the mouse because her hand ‘is hard’.

**Participant 4**

This participant’s eyes were constantly only slightly open and one eye lid kept flickering. This hindered the eye tracking recording.

She found the order stock button but struggled to click on it. On the Order Stock button she clicked on the IP address at the top. Had no idea what to do. Did not look at the edit box. Eventually clicked on the Vodacom image. Had to guide her very carefully to click on the Edit box.

When asked to find numbers on the keyboard, she looked at the 1 and 2 tabs, clicked on one and lost the keyboard.

Struggled to get her to click on the Edit box again and had to guide her carefully to the 123 button where she thought clicking on that 3 will do the trick. She didn't notice the row of numbers that appeared at the top.

When asked to order MTN vouchers she clicked on the MTN image.

When ordering she entered 102 instead of 10 and also wanted to use the Cancel button at the top of the screen to delete characters. She often also looked at the computer desktop (i.e. off the simulation). Had to be helped to delete the incorrect number and type the correct one.

When asked to confirm the order she struggled to scroll down. When the buttons appeared she did not even look at them and just scrolled back up. When she came to them a second time she only read ‘Clear order’ and scrolled up again. The third time she was asked to read what was on all the buttons. Even when guided she took a long time to click on Confirm order. When the ‘E-wallet exceeded’ message appeared she did not understand it (read exceeded as exist).

When asked to order Coke she took a while and had to be helped to click on the Order Stock button.

Clicked on the Back arrow and then on Order Status. Realised her mistake but then just clicked randomly. Kept going back and forth between Order Stock and the Back arrow.

When she eventually found the Coke she seemed to remember well what to do. She clicked on the Edit box, then on the 123 button. She accidentally entered @ and remembered to use the delete button on the keyboard.

Again took a long time to find the confirm order button and clicked on Clear order instead.

During the interview she said that instead of Confirm order she would understand ‘I am happy with my order’ better. The Clear button should say ‘Cancel’.

On the Main menu, she thought the e-Wallet icon meant you can directly order wallets from there. The Order status button she interpreted as ‘Order stationary’
Participant 5

Clicked on Order Stock quickly and immediately knew to click on the Edit box to enter a number on the Order stock screen. He did however not know what to do when the keyboard came up. When the facilitator explained that he needs to say how many he wants to order he spoke out the words “I want 3” into the microphone. Since he only saw alphabetical characters he then wanted to type ‘three’ and had to be guided carefully to eventually notice the 123 button.

He used the computer’s keyboard to delete an incorrect entry.

He tried to enter a 3 by clicking on the 3 on the 123 button. The facilitator pointed out the row of numbers that appeared at the top, but he kept focussing on the 123 button. Eventually entered the number correctly and clicked on Done without a problem.

When asked to order MTN vouchers he again immediately clicked on the Edit box. On the keyboard he again thought he had to click on the 123 button to get numbers in the box. After reminding him of the numbers at the top he completed the order quickly.

This participant did not struggle with the scrolling and found the Confirm order button without problems. He did, however, click on Clear order instead. When asked about this he said that Confirm order means to see the total (probably because it appears directly under the Total amount). Wasn’t sure of the meaning of the word ‘confirm’.

When asked to order Coke he took a while on the Main menu and then clicked the Order Status button. With help he went back and then clicked Order Stock.

He searched through the categories, found Beverages Cold but did not click on it. Second time round he did click on it and found the Coke. Despite the fact that with the previous two orders he immediately clicked on the Edit box, this time he struggled before he did that and completed the order easily.
HEAT MAPS FOR THE 20 SECONDS BEFORE CLICKING ON THE ‘ORDER STOCK’ BUTTON THE FIRST TIME
HEAT MAPS FOR THE PERIOD FROM FIRST SEEING THE ‘ORDER STOCK’ SCREEN TO CLICKING ON THE EDIT BOX

The fact that none of these participants fixated on the edit box shows that they do not understand its purpose on the screen. The heat maps also indicate that they regard the 1 and 2 tabs as important.
HEAT MAPS FOR THE 20-40 SECONDS BEFORE CLICKING ON THE ‘CONFIRM ORDER’ BUTTON THE FIRST TIME

Participant 1

Participant 2

Participant 3

Participant 4

Participant 5
SOME QUANTITATIVE DATA ATTAINED WHILE ANALYSING THE EYE TRACKING DATA

**Time in minutes:seconds (first ‘Stock order’ task)**

<table>
<thead>
<tr>
<th>Participant</th>
<th>From first clicking on ‘Order Stock’ to clicking on the Edit box to enter the number of Vodacom vouchers to order</th>
<th>From clicking on the Edit box to clicking on Done after entering the no of Vodacom vouchers to order</th>
<th>From first clicking on ‘Order Stock’ to clicking on ‘Confirm order’ the first time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0:42</td>
<td>0:28</td>
<td>10:41</td>
</tr>
<tr>
<td>2</td>
<td>0:13</td>
<td>0:42</td>
<td>6:35</td>
</tr>
<tr>
<td>3</td>
<td>2:01</td>
<td>1:52</td>
<td>10:20</td>
</tr>
<tr>
<td>4</td>
<td>2:41</td>
<td>2:26</td>
<td>14:09</td>
</tr>
<tr>
<td>5</td>
<td>0:18</td>
<td>3:15</td>
<td>5:31 (‘Clear order’ button)</td>
</tr>
</tbody>
</table>

The minimum time taken to complete the order was 5:31 and the maximum 10:41. Given that they only had to order two items and that some help was available, this is very long.

**Time in minutes:seconds (second ‘Stock order’ task)**

<table>
<thead>
<tr>
<th>Participant</th>
<th>From first clicking on ‘Order Stock’ to clicking on the Beverages-Cold category</th>
<th>From clicking on Beverages-Cold to clicking the Edit box</th>
<th>From clicking on the Edit box to clicking on Done after entering the no of Cokes</th>
<th>From first clicking on ‘Order Stock’ to clicking on ‘Confirm order’</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3:28</td>
<td>1:34</td>
<td>0:50</td>
<td>7:14</td>
</tr>
<tr>
<td>2</td>
<td>0:12</td>
<td>0:05</td>
<td>0:10</td>
<td>2:03</td>
</tr>
<tr>
<td>3</td>
<td>1:53</td>
<td>0:14</td>
<td>0:44</td>
<td>3:38</td>
</tr>
<tr>
<td>4</td>
<td>2:59</td>
<td>0:15</td>
<td>1:32</td>
<td>5:32 (‘Clear order’ button)</td>
</tr>
<tr>
<td>5</td>
<td>2:05</td>
<td>0:55</td>
<td>0:21</td>
<td>4:07</td>
</tr>
</tbody>
</table>

On the second order the time taken to complete ranged from 2:03 to 7:14 which shows an improvement from the first order.

**FINDINGS (RECOMMENDATIONS)**

1. Design the interface so that there is a choice between all the different languages of potential users so that they can read all the instructions, product names, etc in their home language.
2. If the interface remains in English, much of the wording has to change. Some examples of terms and phrases that were misunderstood are:
   - Clear order (more than one user used this to confirm the order)
   - Confirm order
   - Beverages
   - Confectionary
   - Exceeds (read as exists)
   - Status (interpreted as Stationary)
3. Several of the participants clicked on the picture of the product when they wanted to enter the number of items to order. Clearly they are not familiar with the concept of an edit box. I suggest that they should be allowed to click on the picture and that when the message box giving information about the product comes up it also contains an edit box where the user can enter the amount. If they then click on OK the number is transferred to the box next to the product in the list. There can even be a prompt saying “Type the number you want to order in the box below”.

4. The list of products contains a lot of white space that is unnecessary. This requires a lot of scrolling to get to the Confirm order button. The Confirm order, Clear order and Menu buttons should preferably be visible all the time. Possible better captions for the Confirm order button are: Send the order now, Done with order, Continue with order. The Clear order button should rather say Delete order or Cancel order.

5. It may also be helpful to have the Trolley icon on the screen next to the Confirm button as well, (maybe with a label “View order”) for the purpose of reviewing the order so far. The screen that appears can be similar to the one that appears when Confirm order is clicked, so that they can just click on ‘Order now’ right there if they are happy with the current order.

6. The headings Product, Price, Total that appear at the top is unnecessary since they are not always visible and they seem to some user like clickable options.

7. On Main Menu, make the whole button clickable – not only the icon.

8. The tabs on the item lists confused users. Since they wanted to enter a number, some of them thought the numbers on the tabs were connected to the number of items they wanted to order.

9. When searching for a button to click on (e.g. Confirm Order) users tend to search from left to right, so place the Confirm Order button to the left of the Clear button.

10. Keep the Confirm Order, Clear order and Menu visible on the screen (if they should not be used at any point, deactivate them).

11. The large white arrows at the bottom seem to some users as a way out of their confusion (not sure why).

12. While scrolling down users often accidentally opened the categories which then required them to scroll down even further. Further reason to keep the Confirm button, etc on the screen all the time.

13. It seems from our observations that people with low levels of computer literacy easily adapt to the touch screen interface.