

**APPENDIX I**  
**SURVEY OF ASSISTIVE TECHNOLOGY FOR USER**

1. What is your age?

|                                       |                                  |
|---------------------------------------|----------------------------------|
| <input type="checkbox"/> 20 and below | <input type="checkbox"/> 41 - 50 |
| <input type="checkbox"/> 21 - 30      | <input type="checkbox"/> 51 - 60 |
| <input type="checkbox"/> 31 - 40      | <input type="checkbox"/> above   |
2. Do you live alone or with other people?

|  |
|--|
| <input type="checkbox"/> Living alone                              |
| <input type="checkbox"/> Living with people who provide assistance |
3. Please indicate if you have difficulty in the following functions.

|   |
|---|
| <input type="checkbox"/> Head movement e.g. nodding |
| <input type="checkbox"/> Eye twitching or blinking  |
| <input type="checkbox"/> Mouth gripping             |
| <input type="checkbox"/> Speaking                   |
4. What is your current method to trigger a switch action (e.g. turning on computer)?  

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5. Why did you decide to use the current method?  

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6. What are your main factors in choosing an assistive technology to trigger a switch action?  

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7. What kind of actions do you want to trigger by assistive technology? (e.g. texting, calling, sending commands to wheelchair)  

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8. What do you think about using touch sensor to trigger a switch action?  

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9. How often do you think the assistive device should be charged?  

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\_\_\_\_\_ hours/days
10. How much do you expect a touch sensor to cost?  

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11. What do you think of other assistive technology to trigger a switch action, e.g. voice recognition device?  

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## SURVEY OF ASSISTIVE TECHNOLOGY FOR RELATIVES AND CLINICIANS

1. Please indicate who is completing this survey

- ☐ Patient's family
- ☐ Caregiver
- ☐ Doctor
- ☐ Other health professional, please specify: \_\_\_\_\_

2. Does tetraplegic patient require any assistance from you?

- ☐ Yes  
If yes, please indicate the activities that require your assistance.

\_\_\_\_\_

- ☐ No  
If no, is there any other form of assistance for the patient?

\_\_\_\_\_

3. Based on your experience, what is the best assistive technology to trigger a switch action?

\_\_\_\_\_  
\_\_\_\_\_

4. What do you consider in choosing an assistive technology to trigger a switch action for your patient/relative?

\_\_\_\_\_  
\_\_\_\_\_

5. What do you think about using touch sensor to trigger a switch action?

\_\_\_\_\_  
\_\_\_\_\_

6. How often do you think the assistive device should be charged?

\_\_\_\_\_ hours/days

7. How much do you expect a touch sensor to cost?

\_\_\_\_\_

8. What do you think of other assistive technology to trigger a switch action, e.g. voice recognition device?

\_\_\_\_\_  
\_\_\_\_\_

**APPENDIX II**  
**SURVEY OF ASSISTIVE TECHNOLOGY FOR USER - FILLED**

1. What is your age?
  - 20 and below
  - 21 - 30
  - 31 - 40
  - 41 - 50
  - 51 - 60
  - above
2. Do you live alone or with other people?
  - Living alone
  - Living with people who provide assistance YES
3. Please indicate if you have difficulty in the following functions.
  - Head movement e.g. nodding
  - Eye twitching or blinking
  - Mouth gripping
  - Speaking
4. What is your current method to trigger a switch action (e.g. turning on computer)?  
None \_\_\_\_\_
5. Why did you decide to use the current method?  
n/a
6. What are your main factors in choosing an assistive technology to trigger a switch action?  
Reliability and consistency. Inconspicuous.
7. What kind of actions do you want to trigger by assistive technology? (e.g. texting, calling, sending commands to wheelchair)  
Could be a number of possible uses. If it is easy to operate then I think it would have a wide application
8. What do you think about using touch sensor to trigger a switch action?  
Depends on the way I would need to touch the device.
9. How often do you think the assistive device should be charged?  
Every 2-3 days  
\_\_\_\_\_ hours/days
10. How much do you expect a touch sensor to cost?  
<£100
11. What do you think of other assistive technology to trigger a switch action, e.g. voice recognition device?  
OK providing it meets other criteria.\_

## SURVEY OF ASSISTIVE TECHNOLOGY FOR RELATIVES AND CLINICIANS - FILLED

1. Please indicate who is completing this survey

- Patient's family
- Caregiver
- Doctor
- Other health professional, please specify: Assistive Technology Specialist

1. Does tetraplegic patient require any assistance from you?

- Yes

If yes, please indicate the activities that require your assistance.  
Help with selection of Assistive devices for computer access\_

- No

If no, is there any other form of assistance for the patient?

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3. Based on your experience, what is the best assistive technology to trigger a switch action?

It depends in what context the switch is being used and what movement is available to the user. With a high level injury there are limited options available.

4. What do you consider in choosing an assistive technology to trigger a switch action for your patient/relative?

Reliability and consistency of operation. Inconspicuous.

5. What do you think about using touch sensor to trigger a switch action?

I am unable to touch with my hands - it would depend on how I am able to activate it.

6. How often do you think the assistive device should be charged?

Once every 2-3 days would be best.

\_\_\_\_\_hours/days

7. How much do you expect a touch sensor to cost?

If it does the job well then it will be worth a premium price. Typically switches should be

<£100

8. What do you think of other assistive technology to trigger a switch action, e.g. voice recognition device?

Voice is fine, providing it is reliable and consistent and I can use independently.

**APPENDIX III**  
**RESULTS OF EXPERIMENT 1 TESTING SHORT COMMANDS BY DIFFERENT SUBJECTS:**  
**FUNCTIONAL TESTING**

| Test № | Voice owner | Tester | Testing distance     | Trial | Commands    |          |            |           |          |
|--------|-------------|--------|----------------------|-------|-------------|----------|------------|-----------|----------|
|        |             |        |                      |       | Turn yellow | Turn red | Turn green | Right     | Left     |
| 1      | S1          | S1     | 12 cm                | 1     | +           | +        | +          | +         | +        |
|        |             |        |                      | 2     | +           | +        | +          | +         | -        |
|        |             |        |                      | 3     | +           | +        | +          | +         | +        |
|        |             |        |                      | 4     | +           | +        | +          | +         | +        |
|        |             |        |                      | 5     | +           | +        | +          | +         | +        |
| 2      | S1          | S3     | 12 cm                | 1     | -(red)      | +        | +          | +         | -        |
|        |             |        |                      | 2     | -           | +        | -          | +         | -        |
|        |             |        |                      | 3     | -(red)      | +        | -          | -         | -        |
|        |             |        |                      | 4     | -(red)      | +        | +          | +         | -        |
|        |             |        |                      | 5     | -(red)      | +        | -          | +         | -        |
| 3      | S1          | S2     | 12 cm                | 1     | -           | -        | -          | -         | +        |
|        |             |        |                      | 2     | -           | -        | -          | -(left)   | +        |
|        |             |        |                      | 3     | -           | -        | -          | -(green)  | -(right) |
|        |             |        |                      | 4     | -           | -        | -          | -(yellow) | -(right) |
|        |             |        |                      | 5     | -           | -        | -          | -(left)   | -(right) |
| 4      | S1          | S3     | As close as possible | 1     | +           | +        | +          | -(red)    | +        |
|        |             |        |                      | 2     | +           | +        | -(noice)   | +         | +        |
|        |             |        |                      | 3     | -(red)      | +        | +          | +         | +        |
|        |             |        |                      | 4     | -           | +        | +          | +         | -(right) |
|        |             |        |                      | 5     | +           | +        | -          | +         | -(right) |
| 5      | S1          | S2     | As close as possible | 1     | -(right)    | -(left)  | +          | -(left)   | -(right) |
|        |             |        |                      | 2     | -           | -(left)  | +          | -(yellow) | +        |
|        |             |        |                      | 3     | -           | -(left)  | -(left)    | -(left)   | +        |
|        |             |        |                      | 4     | -(left)     | -(right) | -(left)    | -(left)   | +        |
|        |             |        |                      | 5     | -           | -(right) | -(right)   | +         | +        |
| 6      | S2          | S2     | 12 cm                | 1     | +           | +        | +          | +         | +        |
|        |             |        |                      | 2     | +           | +        | +          | +         | +        |
|        |             |        |                      | 3     | +           | +        | +          | +         | +        |
|        |             |        |                      | 4     | +           | +        | +          | +         | +        |
|        |             |        |                      | 5     | +           | +        | +          | +         | +        |
| 7      | S2          | S3     | 12 cm                | 1     | +           | -        | -(red)     | +         | -        |
|        |             |        |                      | 2     | -           | -        | +          | -         | -        |
|        |             |        |                      | 3     | -           | -        | +          | +         | -        |
|        |             |        |                      | 4     | -           | -        | +          | -         | -        |
|        |             |        |                      | 5     | -           | -        | +          | +         | -        |
| 8      | S2          | S1     | 12 cm                | 1     | +           | -        | +          | -(left)   | +        |
|        |             |        |                      | 2     | -           | -        | +          | -(left)   | +        |

|    |    |    |                      |   |         |          |         |         |          |
|----|----|----|----------------------|---|---------|----------|---------|---------|----------|
|    |    |    |                      | 3 | -       | -        | +       | -(left) | +        |
|    |    |    |                      | 4 | -       | -        | +       | -(left) | +        |
|    |    |    |                      | 5 | -       | (green)  | +       | -(left) | +        |
| 9  | S2 | S3 | As close as possible | 1 | -(red)  | +        | +       | +       | +        |
|    |    |    |                      | 2 | +       | +        | -(red)  | +       | +        |
|    |    |    |                      | 3 | +       | +        | +       | +       | +        |
|    |    |    |                      | 4 | +       | +        | -(red)  | +       | +        |
|    |    |    |                      | 5 | +       | +        | +       | +       | +        |
| 10 | S2 | S1 | As close as possible | 1 | -       | (green)  | +       | +       | -(left)  |
|    |    |    |                      | 2 | +       | +        | +       | -(left) | +        |
|    |    |    |                      | 3 | +       | +        | +       | +       | +        |
|    |    |    |                      | 4 | +       | +        | +       | -(left) | +        |
|    |    |    |                      | 5 | +       | +        | +       | +       | +        |
| 11 | S3 | S3 | 12 cm                | 1 | +       | +        | +       | +       | +        |
|    |    |    |                      | 2 | +       | +        | +       | +       | +        |
|    |    |    |                      | 3 | +       | +        | +       | +       | +        |
|    |    |    |                      | 4 | +       | +        | +       | +       | +        |
|    |    |    |                      | 5 | +       | +        | +       | +       | +        |
| 12 | S3 | S2 | 12 cm                | 1 | +       | +        | -       | +       | +        |
|    |    |    |                      | 2 | -(red)  | +        | -(left) | +       | +        |
|    |    |    |                      | 3 | -(red)  | -right   | +       | +       | +        |
|    |    |    |                      | 4 | -(red)  | -(left)  | -(left) | +       | +        |
|    |    |    |                      | 5 | -(red)  | -(left)  | +       | +       | +        |
| 13 | S3 | S1 | 12 cm                | 1 | -(red)  | +        | -(red)  | +       | +        |
|    |    |    |                      | 2 | +       | +        | +       | +       | -(right) |
|    |    |    |                      | 3 | +       | -        | -       | +       | -(right) |
|    |    |    |                      | 4 | +       | +        | +       | +       | +        |
|    |    |    |                      | 5 | +       | (green)  | +       | +       | +        |
| 14 | S3 | S2 | As close as possible | 1 | -       | +        | +       | +       | +        |
|    |    |    |                      | 2 | -       | -(right) | +       | -(left) | +        |
|    |    |    |                      | 3 | -(red)  | -(left)  | -(left) | -(left) | +        |
|    |    |    |                      | 4 | -(left) | -(left)  | +       | +       | +        |
|    |    |    |                      | 5 | -       | -(left)  | -(red)  | -(left) | +        |
| 15 | S3 | S1 | As close as possible | 1 | -(left) | +        | -(red)  | +       | +        |
|    |    |    |                      | 2 | +       | -        | -(red)  | +       | +        |
|    |    |    |                      | 3 | +       | -        | -(red)  | +       | +        |
|    |    |    |                      | 4 | +       | (yellow) | +       | -(left) | -(right) |
|    |    |    |                      | 5 | +       | +        | -       | -(left) | +        |

**APPENDIX IV**  
**RESULTS OF EXPERIMENT 2 TESTING LONG COMMANDS BY DIFFERENT SUBJECTS: COMMAND LENGTHS**

| Test № | Voice owner | Tester | Testing distance     | Trial | Commands                 |                       |                         |                      |                   |
|--------|-------------|--------|----------------------|-------|--------------------------|-----------------------|-------------------------|----------------------|-------------------|
|        |             |        |                      |       | Turn the yellow light on | Turn the red light on | Turn the green light on | Make a right click   | Make a left click |
| 1      | S1          | S1     | 12 cm                | 1     | -(red)                   | +                     | +                       | -(make a left click) | +                 |
|        |             |        |                      | 2     | -(red)                   | +                     | +                       | -(make a left click) | +                 |
|        |             |        |                      | 3     | -(red)                   | +                     | +                       | -(make a left click) | +                 |
|        |             |        |                      | 4     | +                        | +                     | +                       | -(make a left click) | +                 |
|        |             |        |                      | 5     | +                        | +                     | +                       | -(make a left click) | +                 |
| 2      | S1          | S4     | 12 cm                | 1     | -                        | +                     | -                       | -(make a left click) | +                 |
|        |             |        |                      | 2     | -                        | -                     | -                       | -                    | -                 |
|        |             |        |                      | 3     | -                        | -                     | -                       | -(make a left click) | -                 |
|        |             |        |                      | 4     | +                        | -                     | +                       | -(make a left click) | +                 |
|        |             |        |                      | 5     | -                        | -                     | -                       | -(make a left click) | +                 |
| 3      | S1          | S2     | 12 cm                | 1     | -                        | -                     | -                       | -                    | +                 |
|        |             |        |                      | 2     | -                        | +                     | -                       | -                    | -                 |
|        |             |        |                      | 3     | -                        | -                     | +                       | -                    | -                 |
|        |             |        |                      | 4     | -                        | -                     | -                       | -                    | -                 |
|        |             |        |                      | 5     | -                        | -                     | +                       | -                    | -                 |
| 4      | S1          | S4     | As close as possible | 1     | -                        | -                     | -(make a right click)   | -(make a left click) | +                 |
|        |             |        |                      | 2     | -                        | -(make a left click)  | -(make a left click)    | -(make a left click) | +                 |
|        |             |        |                      | 3     | +                        | -(green)              | -                       | -(make a left click) | -                 |
|        |             |        |                      | 4     | -                        | -(make a left click)  | -                       | -(make a left click) | +                 |
|        |             |        |                      | 5     | +                        | -                     | -                       | -(make a left click) | +                 |
| 5      | S1          | S2     | As close as possible | 1     | -(make a left click)     | -(green)              | -                       | -(make a left click) | +                 |
|        |             |        |                      | 2     | -                        | -                     | +                       | -(make a left click) | +                 |
|        |             |        |                      | 3     | -                        | -                     | +                       | -                    | +                 |
|        |             |        |                      | 4     | -                        | -                     | -(make a left click)    | -(make a left click) | +                 |

|    |    |    |                      |   |          |                       |                       |                       |                       |
|----|----|----|----------------------|---|----------|-----------------------|-----------------------|-----------------------|-----------------------|
|    |    |    |                      | 5 | -        | -                     | +                     | - (make a left click) | +                     |
| 6  | S2 | S2 | 12 cm                | 1 | -(red)   | +                     | +                     | +                     | +                     |
|    |    |    |                      | 2 | +        | +                     | +                     | +                     | +                     |
|    |    |    |                      | 3 | +        | +                     | +                     | +                     | +                     |
|    |    |    |                      | 4 | -        | -(green)              | +                     | +                     | +                     |
|    |    |    |                      | 5 | -        | +                     | +                     | +                     | +                     |
| 7  | S2 | S4 | 12 cm                | 1 | -(green) | -                     | +                     | +                     | -(make a right click) |
|    |    |    |                      | 2 | -        | -(make a right click) | +                     | +                     | -(make a right click) |
|    |    |    |                      | 3 | -        | -                     | -                     | +                     | -(make a right click) |
|    |    |    |                      | 4 | -        | -                     | +                     | +                     | -                     |
|    |    |    |                      | 5 | -        | -                     | +                     | +                     | -                     |
| 8  | S2 | S1 | 12 cm                | 1 | -(red)   | +                     | -                     | -                     | +                     |
|    |    |    |                      | 2 | -(green) | +                     | -                     | -                     | +                     |
|    |    |    |                      | 3 | -        | +                     | -                     | -                     | +                     |
|    |    |    |                      | 4 | -        | -                     | -                     | -                     | -                     |
|    |    |    |                      | 5 | -(red)   | -                     | -                     | -                     | -                     |
| 9  | S2 | S4 | As close as possible | 1 | -(red)   | +                     | -                     | +                     | -(make a right click) |
|    |    |    |                      | 2 | -(red)   | -(make a right click) | -(make a right click) | +                     | -(make a right click) |
|    |    |    |                      | 3 | -        | +                     | -(make a right click) | +                     | -(make a right click) |
|    |    |    |                      | 4 | -        | +                     | -(make a right click) | +                     | -(make a right click) |
|    |    |    |                      | 5 | -        | +                     | +                     | +                     | +                     |
| 10 | S2 | S1 | As close as possible | 1 | -        | +                     | -(red)                | +                     | -                     |
|    |    |    |                      | 2 | -        | +                     | -(red)                | +                     | -(make a right click) |
|    |    |    |                      | 3 | -(red)   | +                     | +                     | +                     | -(make a right click) |
|    |    |    |                      | 4 | -        | +                     | -(red)                | +                     | +                     |
|    |    |    |                      | 5 | -        | -                     | -(red)                | +                     | +                     |
| 11 | S4 | S4 | 12 cm                | 1 | +        | -(green)              | +                     | -                     | +                     |
|    |    |    |                      | 2 | +        | +                     | +                     | +                     | +                     |
|    |    |    |                      | 3 | +        | +                     | +                     | +                     | +                     |
|    |    |    |                      | 4 | +        | +                     | +                     | +                     | +                     |
|    |    |    |                      | 5 | +        | -                     | +                     | +                     | +                     |
| 12 | S4 | S2 | 12 cm                | 1 | -        | +                     | -                     | -                     | -                     |
|    |    |    |                      | 2 | -        | +                     | -                     | +                     | +                     |



|    |    |    |                      |   |   |           |           |                       |                       |
|----|----|----|----------------------|---|---|-----------|-----------|-----------------------|-----------------------|
|    |    |    |                      | 3 | - | -         | -         | -                     | -                     |
|    |    |    |                      | 4 | - | +         | -         | -                     | -                     |
|    |    |    |                      | 5 | - | +         | -         | -                     | -(make a right click) |
| 13 | S4 | S1 | 12 cm                | 1 | + | -(yellow) | -(yellow) | -                     | -                     |
|    |    |    |                      | 2 | - | -(yellow) | -(yellow) | -                     | -                     |
|    |    |    |                      | 3 | + | -         | -(yellow) | - (make a left click) | -                     |
|    |    |    |                      | 4 | + | -         | -(yellow) | -                     | +                     |
|    |    |    |                      | 5 | + | -(yellow) | -         | -                     | +                     |
| 14 | S4 | S2 | As close as possible | 1 | - | +         | +         | -                     | +                     |
|    |    |    |                      | 2 | - | +         | -(yellow) | +                     | +                     |
|    |    |    |                      | 3 | - | +         | -         | +                     | +                     |
|    |    |    |                      | 4 | - | +         | -         | - (make a left click) | -(make a right click) |
|    |    |    |                      | 5 | + | +         | -         | +                     | +                     |
| 15 | S4 | S1 | As close as possible | 1 | + | -(yellow) | -(yellow) | -                     | +                     |
|    |    |    |                      | 2 | + | -         | -(yellow) | - (make a left click) | -(make a right click) |
|    |    |    |                      | 3 | + | -(yellow) | -(yellow) | - (make a left click) | +                     |
|    |    |    |                      | 4 | + | -(yellow) | -(yellow) | - (make a left click) | -(make a right click) |
|    |    |    |                      | 5 | + | -(yellow) | -(yellow) | - (make a left click) | +                     |

**APPENDIX V**  
**RESULTS OF EXPERIMENT 3: ENVIRONMENTAL TESTING**

**Quiet environment**

| <b>№ trial</b> | <b>Left mouse</b> | <b>Right click</b> | <b>Open file</b> | <b>Drag n drop</b> | <b>Email reader</b> |
|----------------|-------------------|--------------------|------------------|--------------------|---------------------|
| <b>1</b>       | +                 | +                  | +                | +                  | +                   |
| <b>2</b>       | -                 | -                  | -                | -                  | +                   |
| <b>3</b>       | +                 | -                  | +                | +                  | +                   |
| <b>4</b>       | +                 | +                  | +                | +                  | +                   |
| <b>5</b>       | +                 | -                  | +                | +                  | +                   |

**Street**

| <b>№ trial</b> | <b>Left mouse</b> | <b>Right click</b> | <b>Open file</b> | <b>Drag and drop</b> | <b>Email reader</b> |
|----------------|-------------------|--------------------|------------------|----------------------|---------------------|
| <b>1</b>       | +                 | +                  | -                | +                    | +                   |
| <b>2</b>       | +                 | +                  | -                | +                    | +                   |
| <b>3</b>       | +                 | +                  | +                | +                    | +                   |
| <b>4</b>       | -                 | -                  | +                | +                    | +                   |
| <b>5</b>       | +                 | -                  | -                | +                    | +                   |

**Coffee shop**

| <b>№ trial</b> | <b>Left mouse</b> | <b>Right click</b> | <b>Open file</b> | <b>Drag and drop</b> | <b>Email reader</b> |
|----------------|-------------------|--------------------|------------------|----------------------|---------------------|
| <b>1</b>       | +                 | +                  | -                | +                    | +                   |
| <b>2</b>       | +                 | -                  | +                | -                    | +                   |
| <b>3</b>       | +                 | -                  | +                | -                    | +                   |
| <b>4</b>       | +                 | +                  | +                | +                    | +                   |
| <b>5</b>       | +                 | -                  | +                | +                    | +                   |

**Bus stop**

| <b>№ trial</b> | <b>Left mouse</b> | <b>Right click</b> | <b>Open file</b> | <b>Drag and drop</b> | <b>Email reader</b> |
|----------------|-------------------|--------------------|------------------|----------------------|---------------------|
| <b>1</b>       | +                 | +                  | +                | +                    | +                   |
| <b>2</b>       | +                 | +                  | +                | +                    | +                   |
| <b>3</b>       | -                 | -                  | +                | +                    | +                   |
| <b>4</b>       | -                 | -                  | +                | +                    | -                   |

|   |   |   |   |   |   |
|---|---|---|---|---|---|
| 5 | + | + | + | + | + |
|---|---|---|---|---|---|

#### Bar

| № trial | Left mouse | Right click | Open file | Drag and drop | Email reader |
|---------|------------|-------------|-----------|---------------|--------------|
| 1       | -          | +           | -         | -             | -            |
| 2       | +          | +           | -         | +             | -            |
| 3       | +          | -           | -         | +             | +            |
| 4       | +          | -           | +         | +             | +            |
| 5       | -          | +           | -         | -             | -            |

#### Classroom

| № trial | Left mouse | Right click | Open file | Drag and drop | Email reader |
|---------|------------|-------------|-----------|---------------|--------------|
| 1       | +          | +           | +         | +             | +            |
| 2       | +          | -           | +         | -             | +            |
| 3       | +          | -           | -         | +             | +            |
| 4       | +          | -           | +         | +             | +            |
| 5       | +          | +           | -         | -             | +            |

**APPENDIX VI**  
**RESULTS OF EXPERIMENT 4: FALSE POSITIVE TESTING**

| <b>№ trial</b> | <b>Left house</b> | <b>Right blick</b> | <b>Open smile</b> | <b>Dark and drop</b> | <b>Email speeder</b> |
|----------------|-------------------|--------------------|-------------------|----------------------|----------------------|
| <b>1</b>       | -                 | -                  | +                 | +                    | +                    |
| <b>2</b>       | -                 | +                  | +                 | +                    | +                    |
| <b>3</b>       | +                 | -                  | +                 | +                    | +                    |
| <b>4</b>       | +                 | -                  | -                 | +                    | +                    |
| <b>5</b>       | +                 | +                  | +                 | -                    | +                    |

| <b>№ trial</b> | <b>Mouse</b> | <b>Click</b> | <b>File</b> | <b>Drag</b>    | <b>Email</b> |
|----------------|--------------|--------------|-------------|----------------|--------------|
| <b>1</b>       | +            | +            | -           | -(right click) | +            |
| <b>2</b>       | +            | +            | -           | -(right click) | -            |
| <b>3</b>       | +            | +            | +           | -(right click) | -            |
| <b>4</b>       | +            | +            | -           | -              | -            |
| <b>5</b>       | +            | +            | -           | -(right click) | -            |

**APPENDIX VII**  
**RESULTS OF EXPERIMENT 5: DISTANCE TESTING**

**Distance - bluetooth 1m**

| <b>№ trial</b> | <b>Left mouse</b> | <b>Right click</b> | <b>Open file</b> | <b>Drag and drop</b> | <b>Email reader</b> |
|----------------|-------------------|--------------------|------------------|----------------------|---------------------|
| <b>1</b>       | +                 | -                  | +                | +                    | +                   |
| <b>2</b>       | +                 | +                  | +                | +                    | +                   |
| <b>3</b>       | +                 | +                  | +                | -                    | +                   |
| <b>4</b>       | +                 | +                  | +                | +                    | +                   |
| <b>5</b>       | +                 | +                  | +                | +                    | +                   |

**Distance – bluetooth 2m**

| <b>№ trial</b> | <b>Left mouse</b> | <b>Right click</b> | <b>Open file</b> | <b>Drag and drop</b> | <b>Email reader</b> |
|----------------|-------------------|--------------------|------------------|----------------------|---------------------|
| <b>1</b>       | +                 | -                  | -                | +                    | +                   |
| <b>2</b>       | +                 | +                  | +                | +                    | +                   |
| <b>3</b>       | +                 | +                  | +                | +                    | +                   |
| <b>4</b>       | +                 | +                  | -                | +                    | +                   |
| <b>5</b>       | +                 | +                  | +                | +                    | +                   |

# APPENDIX VIII

## DATA COLLECTION AND DATA ANALYSIS OF EXPERIMENT 1: FUNCTIONAL TESTING

| Data collection |          |        |          |    |    |    |    |    |    |    |    |
|-----------------|----------|--------|----------|----|----|----|----|----|----|----|----|
| Test            | Recorder | Tester | Distance | TN | FN | PN | FP | TP | PY | AN | AY |
| 1               | S1       | S1     | 12 cm    | 0  | 0  | 0  | 1  | 24 | 25 | 1  | 24 |
| 2               | S1       | S3     | 12 cm    | 0  | 4  | 4  | 10 | 11 | 21 | 10 | 15 |
| 3               | S1       | S2     | 12 cm    | 0  | 7  | 7  | 16 | 2  | 18 | 16 | 9  |
| 4               | S1       | S3     | Closest  | 0  | 5  | 5  | 2  | 18 | 20 | 2  | 23 |
| 5               | S1       | S2     | Closest  | 0  | 15 | 15 | 3  | 7  | 10 | 3  | 22 |
| 6               | S2       | S2     | 12 cm    | 0  | 0  | 0  | 0  | 25 | 25 | 0  | 25 |
| 7               | S2       | S3     | 12 cm    | 0  | 1  | 1  | 16 | 8  | 24 | 16 | 9  |
| 8               | S2       | S1     | 12 cm    | 0  | 6  | 6  | 8  | 11 | 19 | 8  | 17 |
| 9               | S2       | S1     | Closest  | 0  | 4  | 4  | 0  | 20 | 20 | 0  | 24 |
| 10              | S2       | S3     | Closest  | 0  | 0  | 0  | 3  | 22 | 25 | 3  | 22 |
| 11              | S3       | S3     | 12 cm    | 0  | 0  | 0  | 0  | 25 | 25 | 0  | 25 |
| 12              | S3       | S2     | 12 cm    | 0  | 9  | 9  | 1  | 15 | 16 | 1  | 24 |
| 13              | S3       | S1     | 12 cm    | 0  | 5  | 5  | 2  | 18 | 20 | 2  | 23 |
| 14              | S3       | S2     | Closest  | 0  | 11 | 11 | 3  | 11 | 14 | 3  | 22 |
| 15              | S3       | S1     | Closest  | 0  | 8  | 8  | 3  | 14 | 17 | 3  | 22 |

| Data analysis                             |          |        |          |          |             |           |            |
|---|----------|--------|----------|----------|-------------|-----------|------------|
| Test                                      | Recorder | Tester | Distance | Accuracy | Sensitivity | Precision | Prevalence |
| 1   | S1       | S1     | 12 cm    | 96.00%   | 100.00%     | 96.00%    | 96.00%     |
| 2   | S1       | S3     | 12 cm    | 44.00%   | 73.33%      | 52.38%    | 60.00%     |
| 3   | S1       | S2     | 12 cm    | 8.00%    | 22.22%      | 11.11%    | 36.00%     |
| 4   | S1       | S3     | Closest  | 72.00%   | 78.26%      | 90.00%    | 92.00%     |
| 5   | S1       | S2     | Closest  | 28.00%   | 31.82%      | 70.00%    | 88.00%     |
| 6   | S2       | S2     | 12 cm    | 100.00%  | 100.00%     | 100.00%   | 100.00%    |
| 7   | S2       | S3     | 12 cm    | 32.00%   | 88.89%      | 33.33%    | 36.00%     |
| 8   | S2       | S1     | 12 cm    | 44.00%   | 64.71%      | 57.89%    | 68.00%     |
| 9   | S2       | S1     | Closest  | 80.00%   | 83.33%      | 100.00%   | 96.00%     |
| 10  | S2       | S3     | Closest  | 88.00%   | 100.00%     | 88.00%    | 88.00%     |
| 11  | S3       | S3     | 12 cm    | 100.00%  | 100.00%     | 100.00%   | 100.00%    |
| 12  | S3       | S2     | 12 cm    | 60.00%   | 62.50%      | 93.75%    | 96.00%     |
| 13  | S3       | S1     | 12 cm    | 72.00%   | 78.26%      | 90.00%    | 92.00%     |
| 14  | S3       | S2     | Closest  | 44.00%   | 50.00%      | 78.57%    | 88.00%     |
| 15  | S3       | S1     | Closest  | 56.00%   | 63.64%      | 82.35%    | 88.00%     |
| Testing their own voice in 12 cm distance |          |        |          | Average  | 98.67%      | 100.00%   | 98.67%     |
|   |          |        |          | S.D.     | 2.31%       | 0.00%     | 2.31%      |
| Testing other's voice in closest distance |          |        |          | Average  | 61.33%      | 67.84%    | 84.82%     |
|   |          |        |          | S.D.     | 22.86%      | 24.56%    | 10.32%     |
| Testing other's voice in 12 cm distance   |          |        |          | Average  | 43.33%      | 64.99%    | 56.41%     |
|   |          |        |          | S.D.     | 22.26%      | 23.03%    | 32.02%     |

**APPENDIX IX**  
**DATA COLLECTION AND DATA ANALYSIS OF EXPERIMENT 2: COMMAND LENGTHS**

| Data collection |          |        |          |    |    |    |    |    |    |    |    |
|-----------------|----------|--------|----------|----|----|----|----|----|----|----|----|
| Test            | Recorder | Tester | Distance | TN | FN | PN | FP | TP | PY | AN | AY |
| 1               | S1       | S1     | 12 cm    | 0  | 8  | 8  | 0  | 17 | 17 | 0  | 25 |
| 2               | S1       | S4     | 12 cm    | 0  | 4  | 4  | 15 | 6  | 21 | 15 | 10 |
| 3               | S1       | S2     | 12 cm    | 0  | 0  | 0  | 21 | 4  | 25 | 21 | 4  |
| 4               | S1       | S4     | Closest  | 0  | 10 | 10 | 9  | 6  | 15 | 9  | 16 |
| 5               | S1       | S2     | Closest  | 0  | 7  | 7  | 10 | 8  | 18 | 10 | 15 |
| 6               | S2       | S2     | 12 cm    | 0  | 2  | 2  | 2  | 21 | 23 | 2  | 23 |
| 7               | S2       | S4     | 12 cm    | 0  | 5  | 5  | 11 | 9  | 20 | 11 | 14 |
| 8               | S2       | S1     | 12 cm    | 0  | 3  | 3  | 16 | 6  | 22 | 16 | 9  |
| 9               | S2       | S4     | Closest  | 0  | 10 | 10 | 4  | 11 | 15 | 4  | 21 |
| 10              | S2       | S1     | Closest  | 0  | 7  | 7  | 6  | 12 | 18 | 6  | 19 |

| Data analysis                                |          |        |          |          |             |           |            |
|--|----------|--------|----------|----------|-------------|-----------|------------|
| Test   | Recorder | Tester | Distance | Accuracy | Sensitivity | Precision | Prevalence |
| 1  | S1       | S1     | 12 cm    | 68.00%   | 68.00%      | 100.00%   | 100.00%    |
| 2  | S1       | S4     | 12 cm    | 24.00%   | 60.00%      | 28.57%    | 40.00%     |
| 3  | S1       | S2     | 12 cm    | 16.00%   | 100.00%     | 16.00%    | 16.00%     |
| 4  | S1       | S4     | Closest  | 24.00%   | 37.50%      | 40.00%    | 64.00%     |
| 5  | S1       | S2     | Closest  | 32.00%   | 53.33%      | 44.44%    | 60.00%     |
| 6  | S2       | S2     | 12 cm    | 84.00%   | 91.30%      | 91.30%    | 92.00%     |
| 7  | S2       | S4     | 12 cm    | 36.00%   | 64.29%      | 45.00%    | 56.00%     |
| 8  | S2       | S1     | 12 cm    | 24.00%   | 66.67%      | 27.27%    | 36.00%     |
| 9  | S2       | S4     | Closest  | 44.00%   | 52.38%      | 73.33%    | 84.00%     |
| 10   | S2       | S1     | Closest  | 48.00%   | 63.16%      | 66.67%    | 76.00%     |
| 11   | S4       | S4     | 12 cm    | 88.00%   | 95.65%      | 91.67%    | 92.00%     |
| 12   | S4       | S2     | 12 cm    | 24.00%   | 85.71%      | 25.00%    | 28.00%     |
| 13   | S4       | S1     | 12 cm    | 24.00%   | 42.86%      | 35.29%    | 56.00%     |
| 14   | S4       | S2     | Closest  | 56.00%   | 82.35%      | 63.64%    | 68.00%     |
| 15   | S4       | S1     | Closest  | 32.00%   | 34.78%      | 80.00%    | 92.00%     |
| Testing their own voice<br>in 12 cm distance |          |        |          | Average  | 80.00%      | 84.99%    | 94.32%     |
|  |          |        |          | S.D.     | 10.58%      | 14.87%    | 4.92%      |
| Testing other's voice<br>in closest distance |          |        |          | Average  | 39.33%      | 53.92%    | 61.35%     |
|  |          |        |          | S.D.     | 11.98%      | 17.51%    | 15.92%     |
| Testing other's voice<br>in 12 cm distance   |          |        |          | Average  | 24.67%      | 69.92%    | 29.52%     |
|  |          |        |          | S.D.     | 6.41%       | 20.14%    | 9.82%      |

**APPENDIX X**  
**DATA COLLECTION AND DATA ANALYSIS OF EXPERIMENT 3: ENVIRONMENTAL TESTING**

| Data collection |    |    |    |    |    |    |    |    |
|-----------------|----|----|----|----|----|----|----|----|
| Environment     | TN | FN | PN | FP | TP | PY | AN | AY |
| Quiet           | 0  | 6  | 6  | 0  | 19 | 19 | 0  | 25 |
| Street          | 0  | 6  | 6  | 0  | 19 | 19 | 0  | 25 |
| Coffee shop     | 0  | 6  | 6  | 0  | 19 | 19 | 0  | 25 |
| Bus stop        | 0  | 5  | 5  | 0  | 20 | 20 | 0  | 25 |
| Bar             | 0  | 13 | 13 | 0  | 12 | 12 | 0  | 25 |
| Classroom       | 0  | 7  | 7  | 0  | 18 | 18 | 0  | 25 |

| Data analysis  |             |          |             |           |            |
|----------------|-------------|----------|-------------|-----------|------------|
| Environment    |             | Accuracy | Sensitivity | Precision | Prevalence |
| Controlled     | Quiet       | 76.00%   | 76.00%      | 100.00%   | 100.00%    |
| Non-controlled | Street      | 76.00%   | 76.00%      | 100.00%   | 100.00%    |
|                | Coffee shop | 76.00%   | 76.00%      | 100.00%   | 100.00%    |
|                | Bus stop    | 80.00%   | 80.00%      | 100.00%   | 100.00%    |
|                | Bar         | 48.00%   | 48.00%      | 100.00%   | 100.00%    |
|                | Classroom   | 72.00%   | 72.00%      | 100.00%   | 100.00%    |
|                | Average     | 70.40%   | 70.40%      | 100.00%   | 100.00%    |
|                | S.D.        | 12.84%   | 12.84%      | 0.00%     | 0.00%      |



**APPENDIX XI**  
**DATA COLLECTION AND DATA ANALYSIS OF EXPERIMENT 4: FALSE POSITIVE TESTING**

| <b>Trial</b> | <b>Left house</b> | <b>Right blick</b> | <b>Open smile</b> | <b>Dark and drop</b> | <b>Email speeder</b> |
|--------------|-------------------|--------------------|-------------------|----------------------|----------------------|
| <b>1</b>     | -                 | -                  | +                 | +                    | +                    |
| <b>2</b>     | -                 | +                  | +                 | +                    | +                    |
| <b>3</b>     | +                 | -                  | +                 | +                    | +                    |
| <b>4</b>     | +                 | -                  | -                 | +                    | +                    |
| <b>5</b>     | +                 | +                  | +                 | -                    | +                    |

| <b>N=25</b>            | <b>Predicted:<br/>NO</b> | <b>Predicted:<br/>YES</b> |           |
|------------------------|--------------------------|---------------------------|-----------|
| <b>Actual:<br/>NO</b>  | <b>TN = 7</b>            | <b>FP = 0</b>             | <b>7</b>  |
| <b>Actual:<br/>YES</b> | <b>FN = 18</b>           | <b>TP = 0</b>             | <b>18</b> |
|                        | <b>25</b>                | <b>0</b>                  |           |

| <b>Trial</b> | <b>Mouse</b> | <b>Click</b> | <b>File</b> | <b>Drag</b>    | <b>Email</b> |
|--------------|--------------|--------------|-------------|----------------|--------------|
| <b>1</b>     | +            | +            | -           | -(right click) | +            |
| <b>2</b>     | +            | +            | -           | -(right click) | -            |
| <b>3</b>     | +            | +            | +           | -(right click) | -            |
| <b>4</b>     | +            | +            | -           | -              | -            |
| <b>5</b>     | +            | +            | -           | -(right click) | -            |

| <b>N=25</b>            | <b>Predicted:<br/>NO</b> | <b>Predicted:<br/>YES</b> |           |
|------------------------|--------------------------|---------------------------|-----------|
| <b>Actual:<br/>NO</b>  | <b>TN = 9</b>            | <b>FP = 0</b>             | <b>9</b>  |
| <b>Actual:<br/>YES</b> | <b>FN = 16</b>           | <b>TP = 0</b>             | <b>16</b> |
|                        | <b>25</b>                | <b>0</b>                  |           |

**APPENDIX XII**  
**DATA COLLECTION AND DATA ANALYSIS OF EXPERIMENT 5: DISTANCE TESTING**

| <b>Data collection</b> |           |           |           |           |           |           |           |           |
|------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>Distance</b>        | <b>TN</b> | <b>FN</b> | <b>PN</b> | <b>FP</b> | <b>TP</b> | <b>PY</b> | <b>AN</b> | <b>AY</b> |
| <b>1 metre</b>         | <b>0</b>  | <b>2</b>  | <b>2</b>  | <b>0</b>  | <b>23</b> | <b>23</b> | <b>0</b>  | <b>25</b> |
| <b>2 metre</b>         | <b>0</b>  | <b>3</b>  | <b>3</b>  | <b>0</b>  | <b>22</b> | <b>22</b> | <b>0</b>  | <b>25</b> |

| <b>Data analysis</b> |                 |                    |                  |                   |
|----------------------|-----------------|--------------------|------------------|-------------------|
| <b>Distance</b>      | <b>Accuracy</b> | <b>Sensitivity</b> | <b>Precision</b> | <b>Prevalence</b> |
| <b>1 metre</b>       | <b>92.00%</b>   | <b>92.00%</b>      | <b>100.00%</b>   | <b>100.00%</b>    |
| <b>2 metre</b>       | <b>88.00%</b>   | <b>88.00%</b>      | <b>100.00%</b>   | <b>100.00%</b>    |

**APPENDIX XI**  
**DATA COLLECTION AND DATA ANALYSIS OF EXPERIMENT 4: FALSE POSITIVE TESTING**

| Trial | Left house | Right blick | Open smile | Dark and drop | Email speeder |
|-------|------------|-------------|------------|---------------|---------------|
| 1     | -          | -           | +          | +             | +             |
| 2     | -          | +           | +          | +             | +             |
| 3     | +          | -           | +          | +             | +             |
| 4     | +          | -           | -          | +             | +             |
| 5     | +          | +           | +          | -             | +             |

| N=25           | Predicted:<br>NO | Predicted:<br>YES |    |
|----------------|------------------|-------------------|----|
| Actual:<br>NO  | TN = 7           | FP = 0            | 7  |
| Actual:<br>YES | FN = 18          | TP = 0            | 18 |
|                | 25               | 0                 |    |

| Trial | Mouse | Click | File | Drag           | Email |
|-------|-------|-------|------|----------------|-------|
| 1     | +     | +     | -    | -(right click) | +     |
| 2     | +     | +     | -    | -(right click) | -     |
| 3     | +     | +     | +    | -(right click) | -     |
| 4     | +     | +     | -    | -              | -     |
| 5     | +     | +     | -    | -(right click) | -     |

| N=25           | Predicted:<br>NO | Predicted:<br>YES |    |
|----------------|------------------|-------------------|----|
| Actual:<br>NO  | TN = 9           | FP = 0            | 9  |
| Actual:<br>YES | FN = 16          | TP = 0            | 16 |
|                | 25               | 0                 |    |

**APPENDIX XII**  
**DATA COLLECTION AND DATA ANALYSIS OF EXPERIMENT 5: DISTANCE TESTING**

| <b>Data collection</b> |           |           |           |           |           |           |           |           |
|------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>Distance</b>        | <b>TN</b> | <b>FN</b> | <b>PN</b> | <b>FP</b> | <b>TP</b> | <b>PY</b> | <b>AN</b> | <b>AY</b> |
| <b>1 metre</b>         | <b>0</b>  | <b>2</b>  | <b>2</b>  | <b>0</b>  | <b>23</b> | <b>23</b> | <b>0</b>  | <b>25</b> |
| <b>2 metre</b>         | <b>0</b>  | <b>3</b>  | <b>3</b>  | <b>0</b>  | <b>22</b> | <b>22</b> | <b>0</b>  | <b>25</b> |

| <b>Data analysis</b> |                 |                    |                  |                   |
|----------------------|-----------------|--------------------|------------------|-------------------|
| <b>Distance</b>      | <b>Accuracy</b> | <b>Sensitivity</b> | <b>Precision</b> | <b>Prevalence</b> |
| <b>1 metre</b>       | <b>92.00%</b>   | <b>92.00%</b>      | <b>100.00%</b>   | <b>100.00%</b>    |
| <b>2 metre</b>       | <b>88.00%</b>   | <b>88.00%</b>      | <b>100.00%</b>   | <b>100.00%</b>    |