SYSTEM TESTING

Voice Assistant

FINISHED WORKING ON THIS DOCUMENT ON THE 13/05/19.

Author

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TABLE OF CONTENTS

ABSTRACT

The Voice Assistant is a voice controlled device that can assist you with a wide variety of task's such as controlling a television or smart home device, reading or sending emails, playing music, receiving news and weather updates.

USER ACCEPTANCE TESTING

LAYOUT

As part of my user acceptance testing, I carried out two protocol levels of testing. Each protocol consisted of 5 test cases with 10 participants. The first protocol will consist of users carrying out a number of tasks without being told what to say. In the second protocol users will be told exactly what to say. The test environment consisted of a quiet room with only the participant and I. Each participant was positioned in the same position.

I carried out Protocol 1 test first with each participant to ensure that it was their first time using the device.

PROTOCOL 1 TEST CASES

Preliminary: The hotword/wakeword to activate the device is "Snow-boy", once activated the device will make a "ding" sound and it will be ready to listen for your command. When you're ready, start on test case 1.

Test Case 1: Send an email to Alex with subject "this is a test" and body "how are you".
Test Case 2: Get the weather forecast.
Test Case 3: Turn on the plug.
Test Case 4: Read email inbox.
Test Case 5: Turn on the candle.

PROTOCOL 2 TEST CASES

Preliminary: The hotword/wakeword to activate the device is “Snow-boy”, once activated the device will make a ding sound and it will be ready to listen for your command. When you’re ready, start on test case 1.

Test Case 1

Say the hotword.

After the ding sound, say “play calvin harris summer”.

Test Case 2

Say the hotword.

After the ding sound, say “what are the news headlines”.

Test Case 3

Say the hotword.

After the ding sound, say “what is a dog”.

Test Case 4

Say the hotword.

After the ding sound, say “turn off the plug”.

Test Case 5

Say the hotword.

After the ding sound, say “translate how are you to french”.

PROTOCOL 1 RESULTS

User 1 (Sophie)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 2 (Nicky)

- **Test Case 1:** Test case passed.
- **Test Case 2:** System translated to whether instead of weather.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 3 (Nick)

- **Test Case 1:** Test case failed, timing lead to full email contents being sent.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 4 (Alex)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 5 (Grace)

- **Test Case 1:** User didn't correctly hear device, lead to shortened email being sent.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 6 (Josh)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 7 (Adam)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case failed, background noise lead to incorrect translation of the word candle. Translated to handle instead.

User 8 (Matthew)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 9 (David)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** User said check email instead of read email.
- **Test Case 5:** Test case passed.

User 10 (Calvin)

- **Test Case 1:** User didn't read preliminary correctly and said "alexa" instead of snow-boy.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

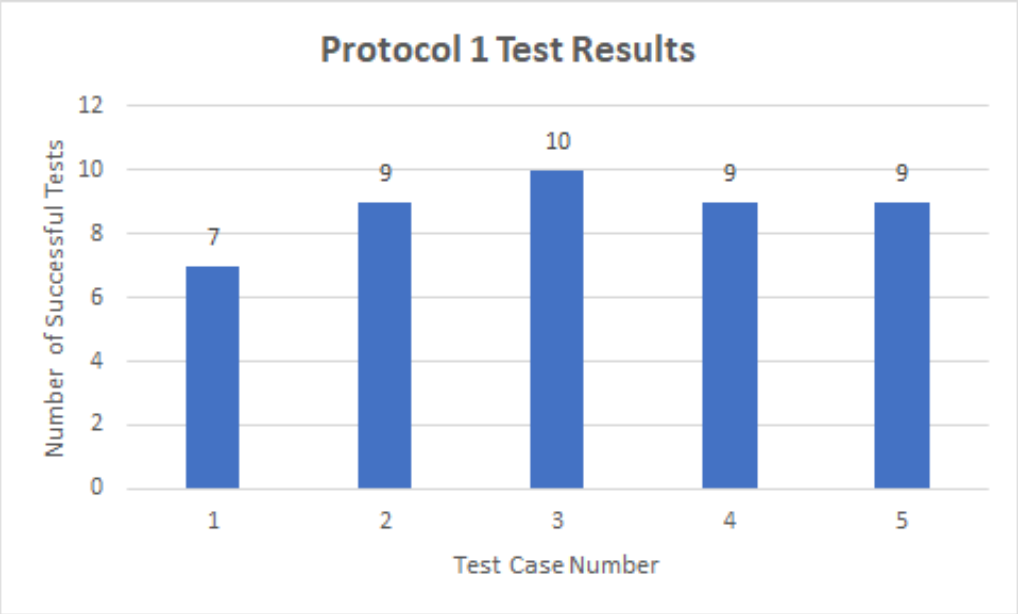

Figure 1.1 Protocol 1 Test Results

PROTOCOL 2 RESULTS

User 1 (Sophie)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 2 (Nicky)

- **Test Case 1:** Test failed, full song name not heard, played normal calvin harris song.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 3 (Nick)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 4 (Alex)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case failed, system translated to door instead of dog.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 5 (Grace)

- **Test Case 1:** Test case passed.
- **Test Case 2:** Test case passed.
- **Test Case 3:** Test case passed.
- **Test Case 4:** Test case passed.
- **Test Case 5:** Test case passed.

User 6 (Josh)

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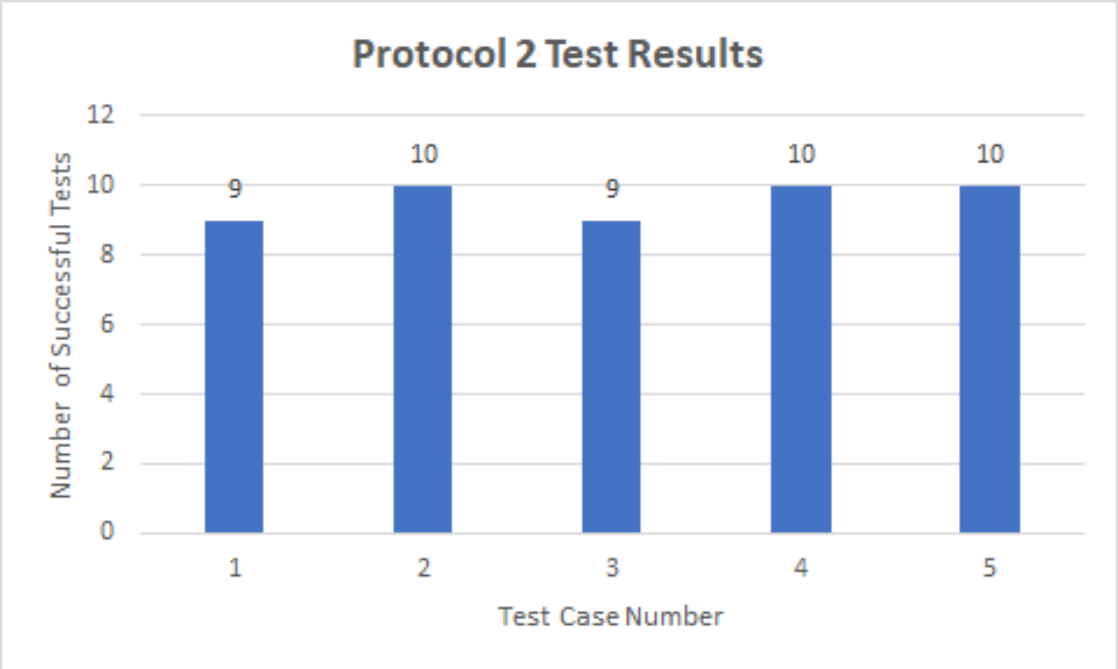

Figure 1.2 Protcol 2 Test Results

PROTOCOL RESULTS COMPARISON

- Protocol 1 had a lower test pass rate with 44/50 test cases passing which is 88%.
- Protocol 2 had a lower test pass rate with 48/50 test cases passing which is 96%.
- It was expected that Protocol 1 would have a lower pass rate as the users weren't told what to say and different people use different words.
- The test failure reasons can be categorized into two main categories, these were user generated faults or system generated.
- The system generated faults were mainly associated with the length of time that users are given to activate the command.

UNIT TESTING

I carried out numerous unit test using Python's Unit Testing module. These test scripts are located in the 2019-ca400-randlea2/src/testing/unit_testing directory.

MAIN UNIT TEST CASES

The unit tests I carried out on the following components will be highlighted as I feel these components are the most important from the system. These components include:

- **Hotword Detector -** high accuracy and low false detection rates.
- **Speech - To - Text translator -** choosing the most accurate service and fastest.
- **Keyword matching** - what command keywords does the user's sentence match.
- **Command finder** - will it find the correct command given a specified sentence.
- **Module finder** - will it find the correct module for a given command.
- **Email contact** - will it find the correct contact for the user sentence.
- **Translate language** - will it identify the intended target language.

HOTWORD DETECTION

Ran test script, /home/pi/2019-ca400-randlea2/src/testing/unit_testing/test_hotword/test_snowboy.py script with sensitivities ranging from 0.1 - 2.0 in intervals of 0.2. While these we running, I said the the hotword 10 times and recorded there detection rates.

TEST RESULTS

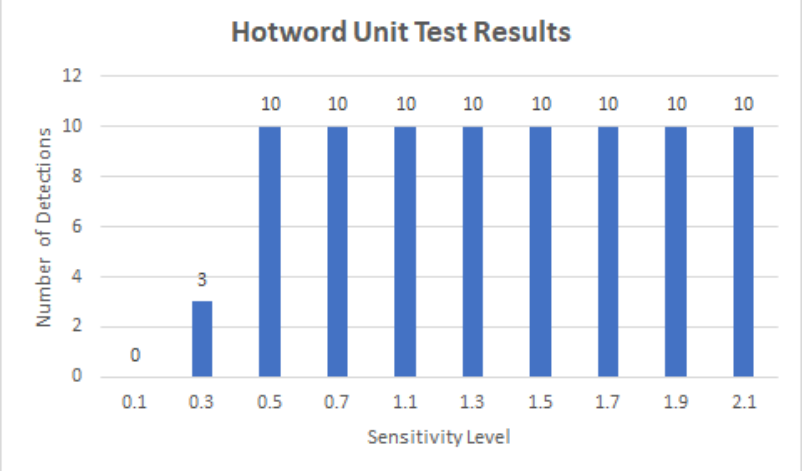

Figure 2.1 Hotword unit test results

Results conclusion - All sensitivity levels between 0.5 - 2.1 had 100% detection rate.

FALSE DETECTION'S

- Through my research and experimentation I found that Snowboy hotword detector was the only reliable hotword detector for the python on the Raspberry Pi. Any of the other reliable hotword detectors were either written in a different language or consumed too much memory.
- I Created a script that would take a sensitivity level as an argument and would run and record the hotword detection rate for a 10 minute period. I played the following youtube clip (https://www.youtube.com/watch?v=DQqETh7E0LM) at the same volume to simulate background noise.
- I decided to pick 4 sensitivity levels: 0.5, 1.0, 1.5 and 2.0. I chose 0.5 as my testing showed that any value below this would make it difficult to activate the device.
- This script is located in src/testing/unit_testing/test_hotword/test_snowboy.py.
- The results can be found in src/testing/unit_testing/test_hotword/test_results.txt.

TEST RESULTS

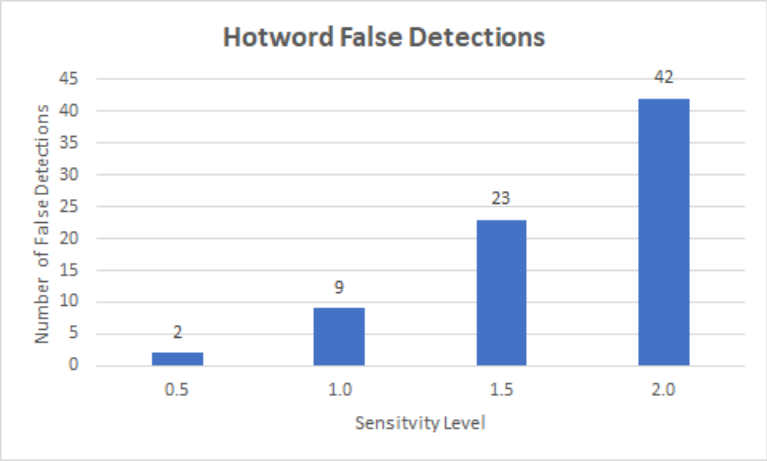

Figure 2.2 False detections results

Results conclusion- sensitivity 0.5 offers the least amount of false detections.

SPEECH-TO-TEXT TRANSLATOR

- Test script - /src/testing/unit_testing/test_translation_services
- I recorded 4 different people saying the sentence ‘this is user testing for the voice assistant’
- I then translated these recordings using different voice to speech services.
- I rated there reliability by how quickly they returned a result and how accurate the translation was.

TEST RESULTS

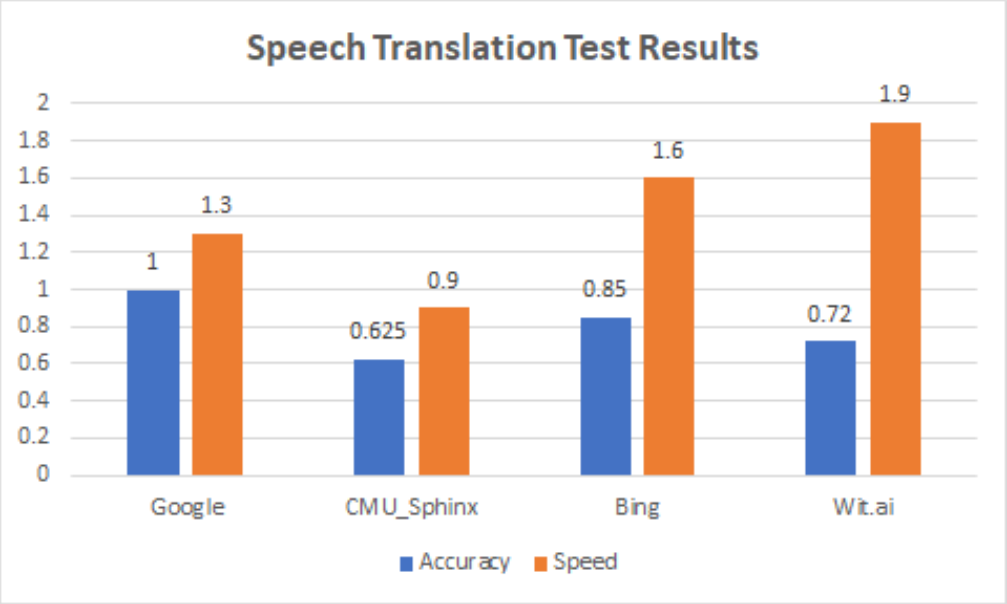

Figure 2.3 Speech-To-Text unit test resuls

- Google speech services were chosen for my project despite having the second fastest response time, I believe accuracy is more important for my system.

TESTING LAYOUT - OTHER COMPONENTS

- For running other test I would for the most part require a user to say a sentence.I decided to simulate these using a JSON file which would consist of the command which is being tested mapped to a list of sentences that should activate the command.
- This JSON file can be found in /src/testing/unit_testing/sentences.json

```
{

  "news": {
  "sentences": [
    "is there any news",
    "tell me the news",
    "what are the news headlines",
    "any news for today",
    "news"
  ]
  },
```

Figure 3.1 Extract from sentences.json file

RUNNING UNIT TEST

- Python's unit test module was used for most of the unit testing.
- Each test involved running a piece of component using each of the sentences from sentences.json until all test passed.

```
# test if system finds correct command for a string of words
import unittest
import sys
import json
from log_results import record
# unit being tested
from command_recogniser import find_command


# to run: python -m unittest test_command_finder
# example sentences
sentence_file = open("/home/pi/2019-ca400-randlea2/src/testing/unit_testing/sentences.json", "r")
sentences_json = json.load(sentence_file)


class TestCommandFinder(unittest.TestCase):
    # test_1 will check if the find_command function finds the
    # correct command for a sentence
    # test news command
    def test_1(self):
        #              (search,    example user sentence,     expected result)
        for sentence in sentences_json["news"]["sentences"]:
            print(sentence)
            self.assertEqual(find_command(sentence)[0], "news")
```

Figure 3.2 Extract from command finder unit test file

- Below shows the output I would need to mark a unit test as satisifcatory.

```
....
----------------------------------------------------------------------
Ran 4 tests in 0.019s

OK
```

Figure 3.3 Example output from a unit test

TEST PARTICIPANTS FORMS

Below is the participants completed informed consent form from the user acceptance testing.

Informed consent form

The school involved in this study is the school of computing. The principal investigator is Cathal gurrin who can be contacted on email at: cgurrin@computing.dcu.ie or on phone at: 01 700 5234. Other investigators are Alex Randles who can be contacted on email at: alex.randles2@mail.dcu.ie and phone at: 085 172 9483.

I will be asked to attend a meeting and test out a voice controlled computing system. After testing the system I will be asked to give general feedback on the system and complete a questionnaire of previously chosen questions that relate to my usage of the system. I may withdraw from the research study at any time. I am aware that data relating to me may be collected and stored.
Participant – please complete the following (Circle Yes or No for each question)

I have read the Plain Language Statement (or had it read to me) Yes/No
I understand the information provided Yes/No
I have had an opportunity to ask questions and discuss this study Yes/No
I have received satisfactory answers to all my questions Yes/No
I am aware that my interview will be videotaped Yes/No

I acknowledge that any information relating to my participation will be destroyed in September 2019.

I have read and understood the information in this form. My questions and concerns have been answered by the researchers, and I have a copy of this consent form. Therefore, I consent to take part in this research project

Participants Signature: Sophie Randles
Name in Block Capitals: SOPHIE RANDLES
Witness: Alex Randles
Date: 10/05/19

Participants 1 consent form

Informed consent form

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Participants Signature: Nicky Randles
Name in Block Capitals: NICKY RANDLES
Witness: Alex Randles
D**ate:** 10/05/19

Participants 2 consent form

Informed consent form

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Participants Signature: Nick Randles
Name in Block Capitals: NICK RANDLES
Witness: Alex Randles
Date: 10/05/19

Participants 3 consent form

Informed consent form

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Participants Signature: Alex Randles
Name in Block Capitals: ALEX RANDLES
Witness: Alex Randles
Date: 10/05/19

Participants 4 consent form

Informed consent form

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Participants Signature: Grace Randles
Name in Block Capitals: GRACE RANDLES
Witness: Alex Randles
Date: 10/05/19

Participants 5 consent form

Informed consent form

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Participants Signature: Josh Byrne
Name in Block Capitals: Josh Byrne
Witness: Alex Randles
Date: 10/05/19

Participants 6 consent form

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Participants Signature: Adam Carr
Name in Block Capitals: ADAM CARR
Witness: Alex Randles
Date: 10/05/19

Participants 7 consent form

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Participants Signature: Matthew Watters
Name in Block Capitals: MATTHEW WATTERS
Witness: Alex Randles
Date: 13/05/19

Participants 8 consent form

Informed consent form

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Participants Signature: David Murphy
Name in Block Capitals: DAVID MURPHY
Witness: Alex Randles
Date: 13/05/19

Participants 9 consent form

Informed consent form

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Participants Signature: Calvin Kavanagh
Name in Block Capitals: CALVIN KAVANAGH
Witness: Alex Randles
Date: 13/05/19

Participants 10 consent form