A MULTIMODAL APPROACH TO INTRODUCTORY CODING

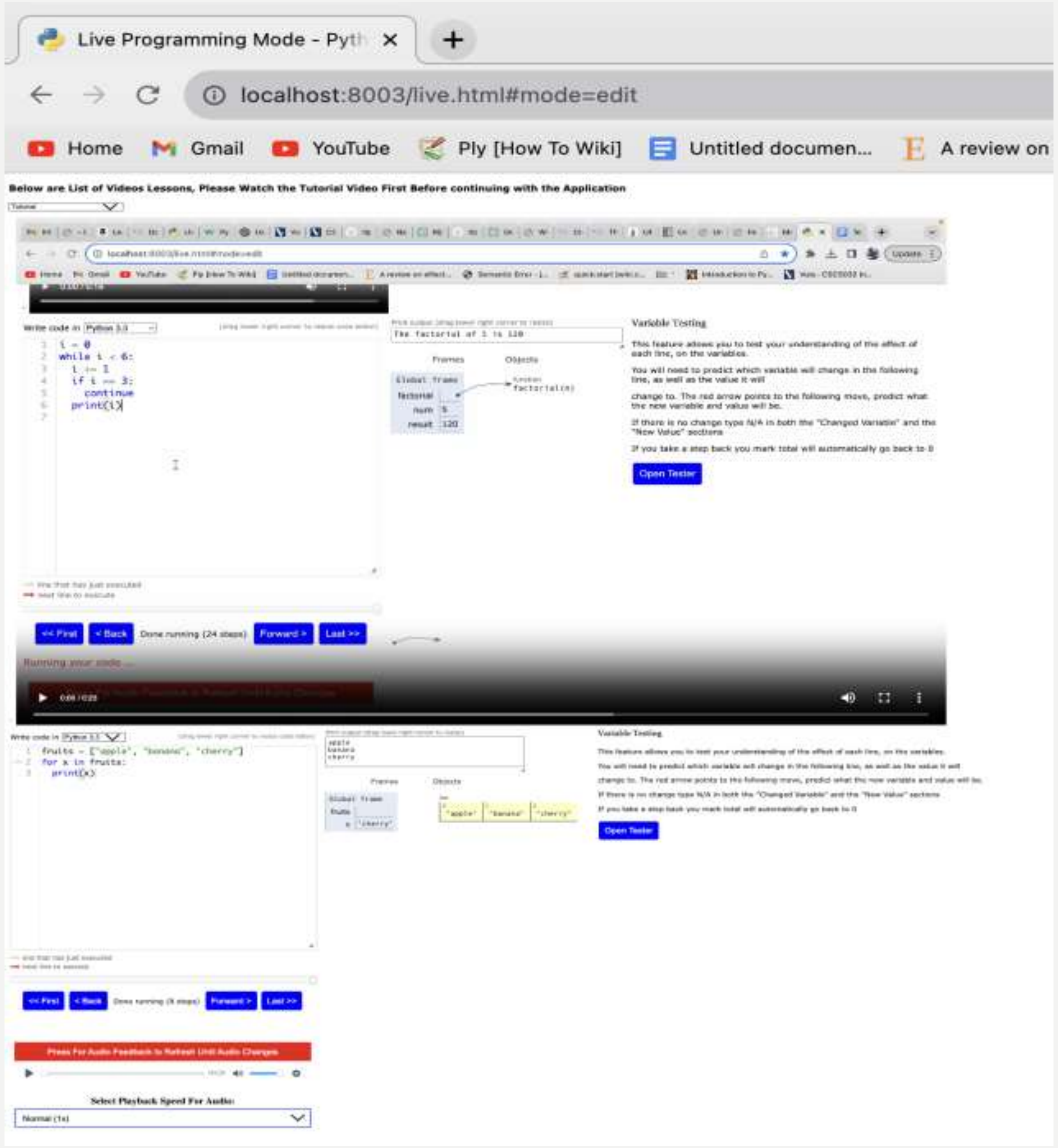
FINAL DEMONSTRATION:
MUFHULUFHELI MABILO

TASK LIST (COMPLETED TASK)

- Reduce context switching.
- Video lessons provided by Mr. Gary Stewart that includes both theory and coding lessons.
- An audio explanation of each code a student inputs in the code input plane.

REDUCE CONTEXT SWITCHING

- Everything in the Web application is on one page , so that we can increase attention and concertation of students and enagament of students.
- Context switching showed a great advantage when it comes to watching video lessons as students were trying to code what they learned in the coding lessons after they have watched them, as they didn’t have to go to a different page.



Below are List of Videos Lessons, Please Watch the Tutorial Video First Before continuing with the Application

Write code in Python 3.3

```
i = 0
while i < 6:
  i += 1
  if i == 3:
    continue
  print(i)
```

```
The factorial of 5 is 120
```

Variable Testing

This feature allows you to test your understanding of the effect of each line, on the variables.

You will need to predict which variable will change in the following line, as well as the value it will

change to. The red arrow points to the following move, predict what the new variable and value will be.

If there is no change type N/A in both the "Changed Variable" and the "New Value" sections

If you take a step back you mark total will automatically go back to 0

Running your code ...

Write code in Python 3.3

```
fruits = ["apple", "banana", "cherry"]
for x in fruits:
  print(x)
```

```
apple
banana
cherry
```

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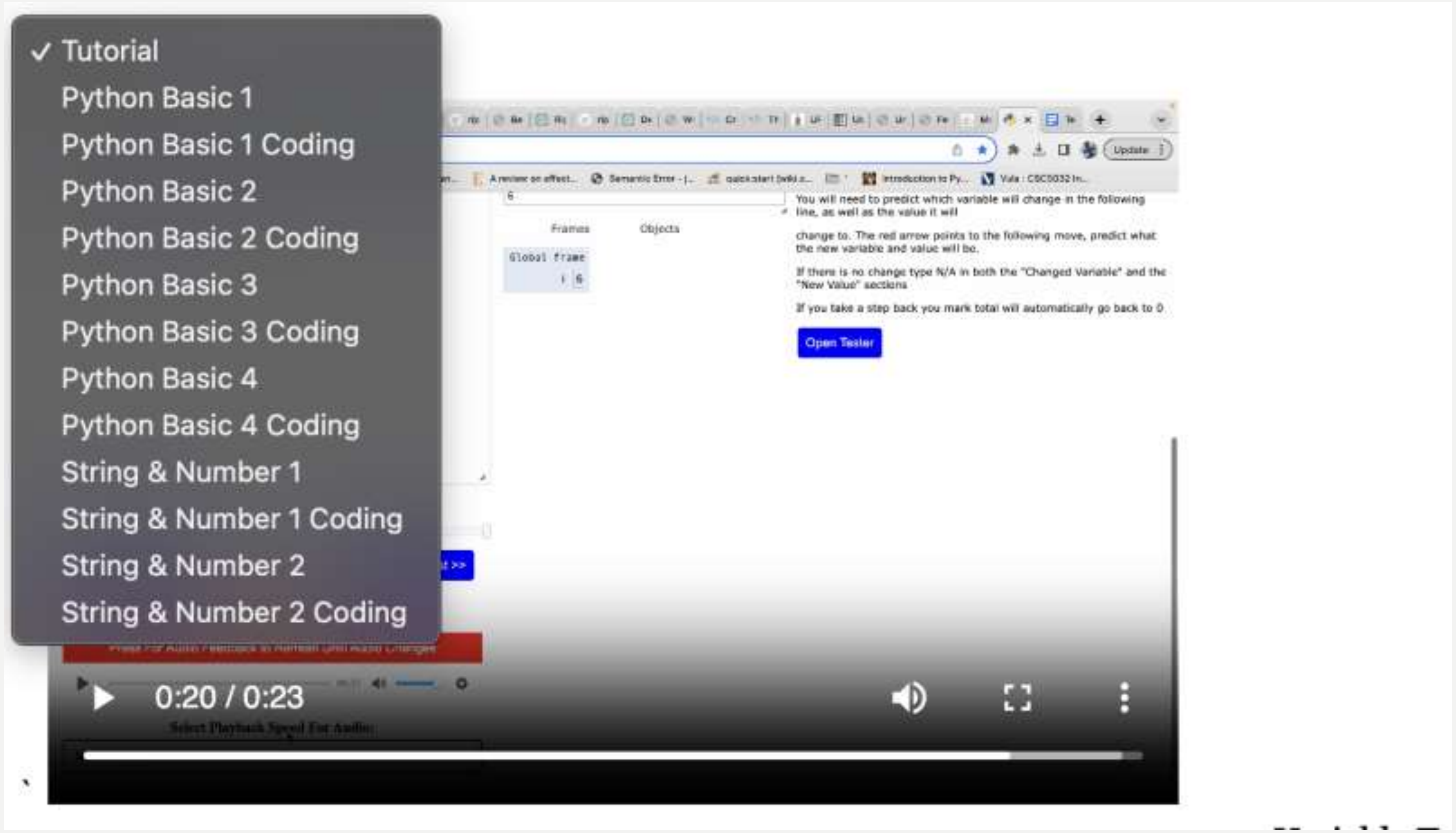
Select Playback Speed For Audio:

VIDEO LESSONS

- Mr Gary Stewart gave access to CSC1010H, so I can use the video lessons to provide them in the application.
- The length of the videos was long, so it resulted in them being stored on Firebase Storage, an online database that's free to individual users.
- The security around Firebase ensures that , a potential attack to the Database can't happen, as it allows only reading and not editing the data.



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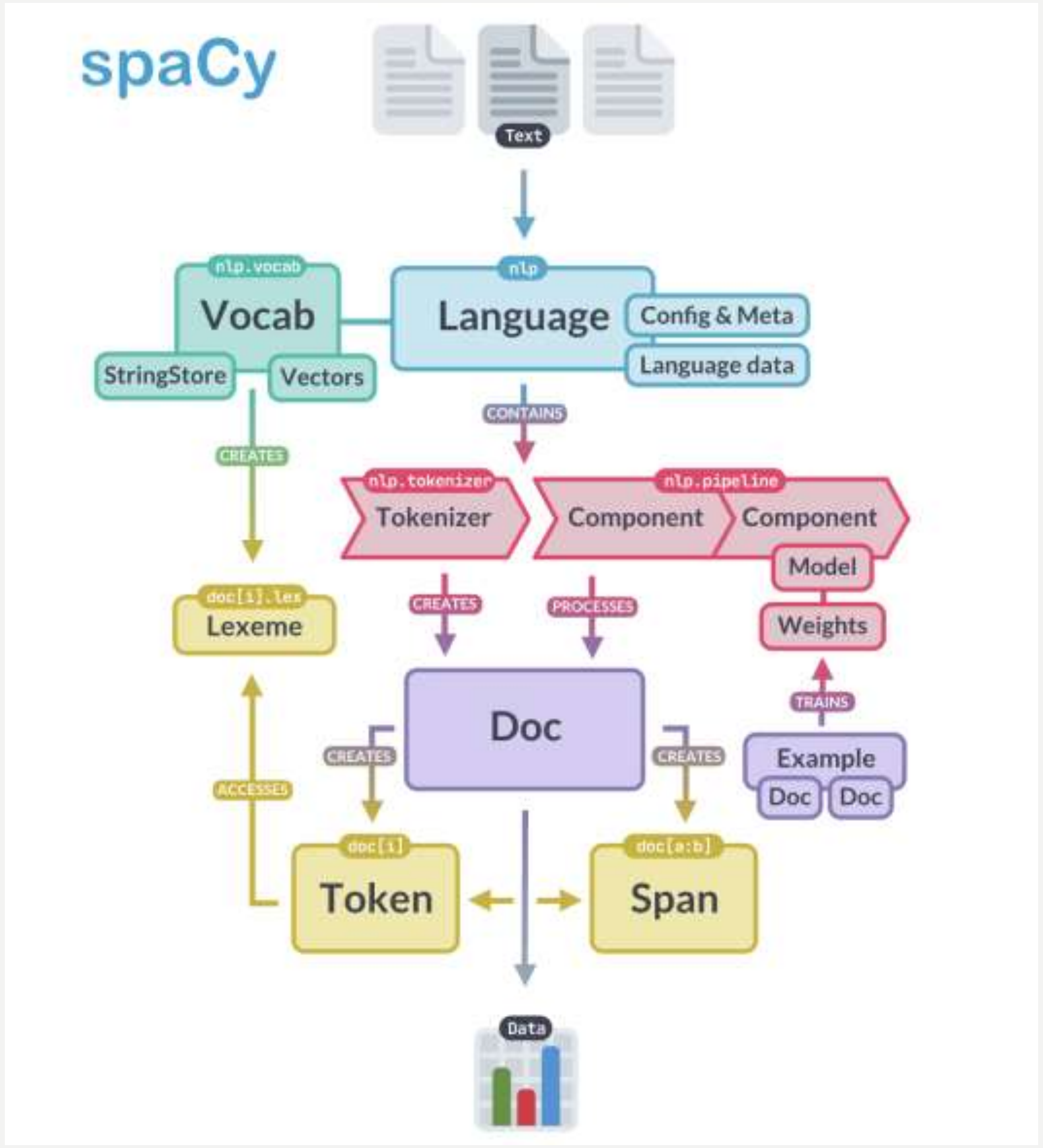
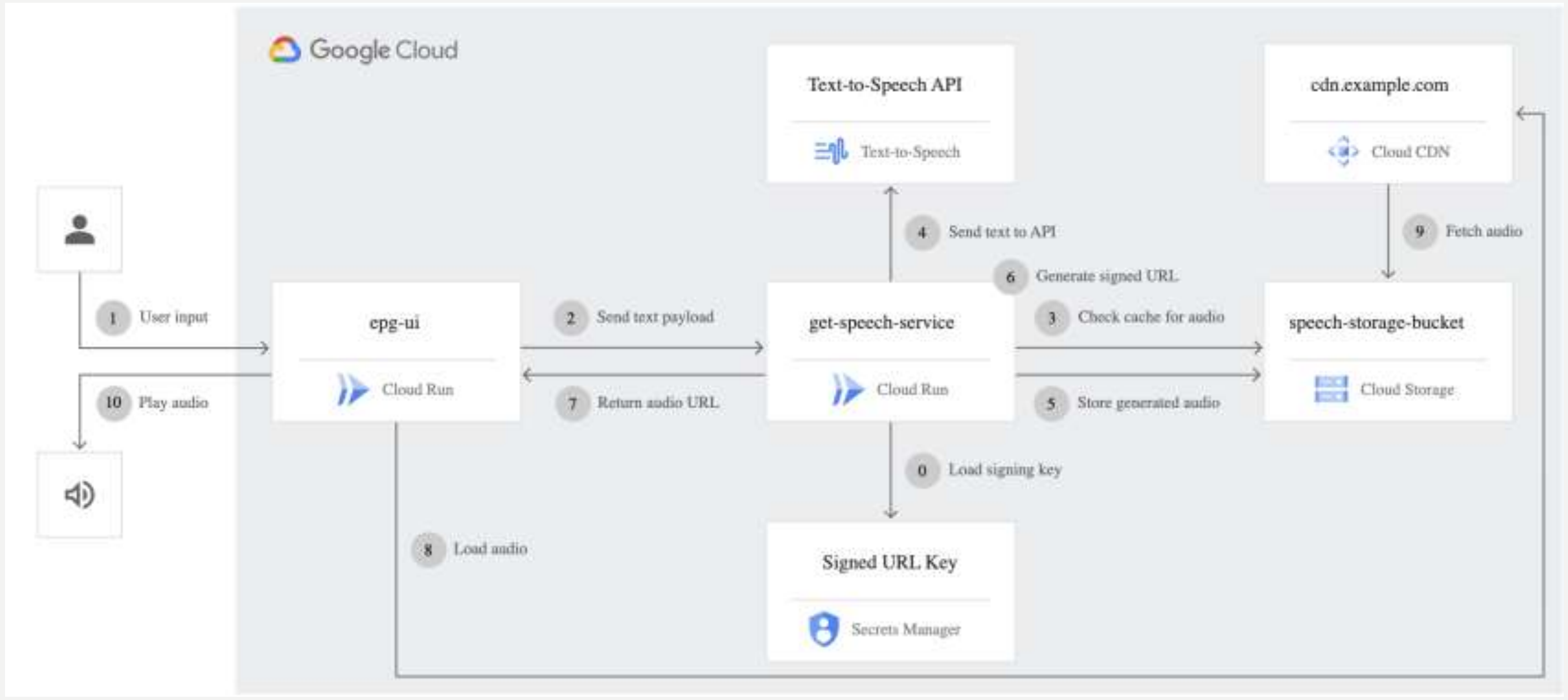
CODING AUDIO EXPLANATIONS

- The Audio generation had to be able to explain user code and not explain user code, so trial and error of Natural Language processing models took place.
- The Natural Language processing model used was Spacy, as it breaks down the code lines into tokens, which provides an understanding of each line.
- Within the spacy model, a text file will be returned in terms of the explanations from the spacy module which are taken in by the Google-text-to-speech python library.
- The Google-text-to-speech python library provided a human nature voice, which allows for more understanding.
- The audio in the frontend, also allowed students to have ability to control the speed of the audio.

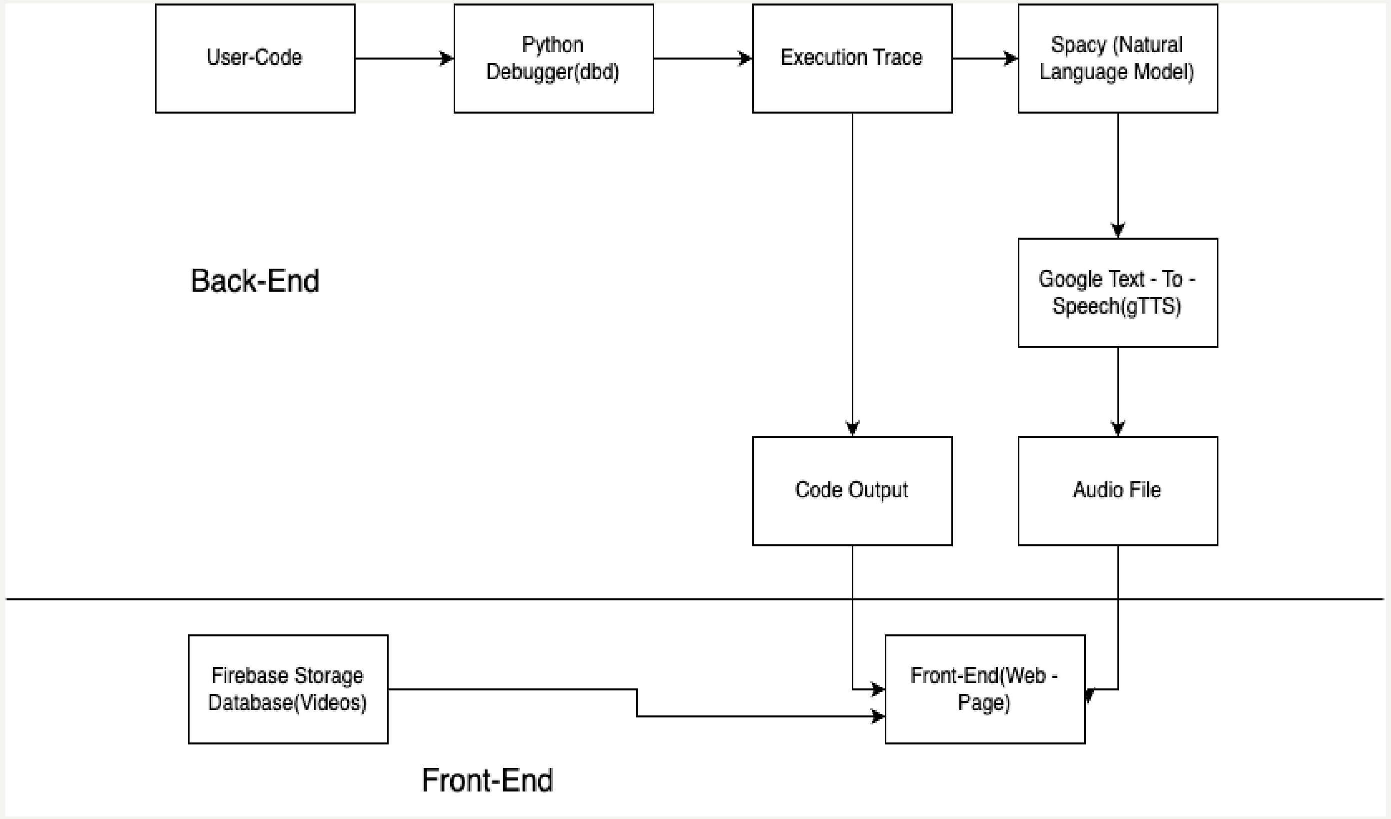
- Spacy Architecture



GOOGLE ARCHITECTURE DIAGRAM



SYSTEM ARCHITECTURE DIAGRAM



USER TESTING

- Participants – 10 participants studying at University of Cape Town , enrolled in CSC1010H and CSC1011H
- Students had the ability to use questions from W3schools, as they pasted the code and received the output of the code, as well as the audio.
- Students were given a set of questions so they can have a feedback on the web application and rate the web application.

FINDINGS

- Audible – in terms of audible, students showed that the audio had great sound quality and didn’t have low volume.
- Understanding – in terms of understating the scale of understanding wasn’t great.
- Realistic - In terms of realistic the audio showed that it didn’t have a robotic accent when it comes to other words.
- Usability - Students were expecting the web application to help them with their assignement questions.

LIMITATIONS

- We had 10 participants instead of 20 participants , so research lacks more results.
- Some error messages not clearly understable by other students.
- The compiling time of the user's code took long at some parts as it gets affected by the speed of the internet.
- With regards to internet speed it sometimes takes time for the audio explanations to be returned.

CONCLUSION

- This research has made significant advancements in addressing the challenge of student engagement in introductory programming courses. By exploring the integration of audio and video lesson features, coupled with reduced context switching, into a web application, we sought to understand their impact on user engagement.