

*Project Report*  
*on*  
**SAGE – A CROSS PLATFORM VOICE ASSISTANT**

*Submitted to*  
**Shri Ramdeobaba College of Engineering & Management, Nagpur**  
**(An Autonomous Institute Affiliated to Rashtrasant Tukdoji Maharaj Nagpur University)**

*for partial fulfillment of the degree in*  
**Bachelor of Engineering**  
**(Information Technology)**  
**Eighth Semester**

*by*  
**Gayatri Ladsawangikar**  
**Tanaya Wadibhasme**  
**Ishita Mendhekar**

*Under the Guidance of*  
**Prof. Chetana Thaokar**



**Department of Information Technology**  
**Shri Ramdeobaba College of Engineering & Management,**  
**Nagpur-13**  
**2022-23**

# **CERTIFICATE**

*This is to certify that the Project Report on*

**SAGE –A Cross Platform Voice Assistant**

*is a bonafide work and it is submitted to*

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*during the academic year 2022-23*

*under the guidance of*

**Prof. Chetana Thaokar**

Assistant Professor, Department of Information Technology,  
RCOEM, Nagpur

**Dr. P.D. Adane**

Head, Department of Information Technology  
RCOEM, Nagpur

**Dr. R. S. Pande**

Principal  
RCOEM, Nagpur

**RCOEM**

Shri Ramdeobaba College of  
Engineering and Management, Nagpur

**Department of Information Technology**

**Shri Ramdeobaba College of Engineering & Management,**

**Nagpur-13**

**2022-23**

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**Name of the Projectees :**

**Gayatri Ladsawangikar – 07**

**Ishita Mendhekar - 09**

**Tanaya Wadibhasme – 18**

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## **ABSTRACT**

The report describes the development of a desktop version of a smart voice assistant that is designed to perform various tasks for the user such as sending emails, playing music, opening applications, and doing Wikipedia searches, among other things. Python is used as the programming language, and the SpeechRecognition API is used for speech recognition. The author claims that project demonstrates how AI is decreasing human effort and saving time by performing tasks with the same efficiency as humans. While the project described in the text may not meet the standards of a highly advanced AI system, it can still be considered an AI. The smart voice assistant described in this report performs tasks such as speech recognition, natural language processing, and task automation, which are all examples of AI capabilities.

We aim to create a desktop version of smart voice assistant which would give user a experience to exercise all basic functionalities of assistant, moreover extending its usage to work within the application itself making it complete hands free experience to user. As we know Python is an emerging language so it becomes easy to write a script for Voice Assistant in Python. The instructions for the assistant can be handled as per the requirement of user. Speech recognition is the process of converting speech into text. This is commonly used in voice assistants like Alexa, Siri, etc. In Python there is an API called SpeechRecognition which allows us to convert speech into text. It was an interesting task to make my own assistant. It became easier to send emails without typing any word, Searching on Google without opening the browser, and performing many other daily tasks like playing music, opening your favorite IDE with the help of a single voice command. In the current scenario, advancement in technologies are such that they can perform any task with same effectiveness or can say more effectively than us. By making this project, I realized that the concept of AI in every field is decreasing human effort and saving time.

Functionalities of this project include:

1. It can send emails.
2. It can read PDF.
3. It can send text on WhatsApp.
4. It can open command prompt, your favorite IDE, notepad etc.
5. It can play music.
6. It can do Wikipedia searches for you.
7. It can open websites like Google, YouTube, etc., in a web browser.
8. It can give weather forecast.
9. It can give desktop reminders of your choice.
10. It can have some basic conversation.

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# **CHAPTER-1**

## **INTRODUCTION**

# 1. INTRODUCTION

Artificial Intelligence when used with machines, it shows us the capability of thinking like humans. In this, a computer system is designed in such a way that typically requires interaction from human. As we know Python is an emerging language so it becomes easy to write a script for Voice Assistant in Python. The instructions for the assistant can be handled as per the requirement of user. Speech recognition is the Alexa, Siri, etc. In Python there is an API called Speech Recognition which allows us to convert speech into text. It was an interesting task to make my own assistant. It became easier to send emails without typing any word, Searching on Google without opening the browser, and performing many other daily tasks like playing music, opening your favorite IDE with the help of a single voice command. In the current scenario, advancement in technologies are such that they can perform any task with same effectiveness or can say more effectively than us. By making this project, I realized that the concept of AI in every field is decreasing human effort and saving time.

As the voice assistant is using Artificial Intelligence hence the result that it is providing are highly accurate and efficient. The assistant can help to reduce human effort and consumes time while performing any task, they removed the concept of typing completely and behave as another individual to whom we are talking and asking to perform task. The assistant is no less than a human assistant but we can say that this is more effective and efficient to perform any task. The libraries and packages used to make this assistant focuses on the time complexities and reduces time.

The functionalities include , It can send emails, It can read PDF, It can send text on WhatsApp, It can open command prompt, your favorite IDE, notepad etc., It can play music, It can do Wikipedia searches for you, It can open websites like Google, YouTube, etc., in a web browser, It can give weather forecast, It can give desktop reminders of your choice. It can have some basic conversation.

Tools and technologies used are VS Code IDE for making this project, and I created all py files in VS Code. Along with this I used following modules and libraries in my project. pyttsx3, SpeechRecognition, Datetime, Wikipedia, Smtplib, pywhatkit, pyjokes, etc.

## 1.1 Present System

We are familiar with many existing voice assistants like Alexa, Siri, Google Assistant, Cortana which uses concept of language processing, and voice recognition. They listens the command given by the user as per their requirements and performs that specific function in a very efficient and effective manner. As these voice assistants are using Artificial Intelligence hence the result that they are providing are highly accurate and efficient. These assistants can help to reduce human effort and consumes time while performing any task,

they removed the concept of typing completely and behave as another individual to whom we are talking and asking to perform task. These assistants are no less than a human assistant but we can say that they are more effective and efficient to perform any task. The algorithm used to make these assistant focuses on the time complexities and reduces time.

But for using these assistants one should have an account (like Google account for Google assistant, Microsoft account for Cortana) and can use it with internet connection only because these assistants are going to work with internet connectivity. They are integrated with many devices like, phones, laptops, and speakers etc.

## **1.2 Proposed System**

It was an interesting task to make my own assistant. It became easier to send emails without typing any word, Searching on Google without opening the browser, and performing many other daily tasks like playing music, opening your favorite IDE with the help of a single voice command. SAGE is different from other traditional voice assistants in terms that it is specific to desktop and user does not need to make account to use this, it does not require any internet connection while getting the instructions to perform any specific task.

The IDE used in this project is VS code. All the python files were created in VS code and all the necessary packages were easily installable in this IDE. For this project following modules and libraries were used i.e. pytsx3, SpeechRecognition, Datetime, Wikipedia, Smtplib, pywhatkit, pyjokes, etc.

With the advancement SAGE can perform any task with same effectiveness or can say more effectively than us. By making this project, I realized that the concept of AI in every field is decreasing human effort and saving time. Functionalities of this project include, It can send emails, It can read PDF, It can send text on WhatsApp, It can open command prompt, your favorite IDE, notepad etc., It can play music, It can do Wikipedia searches for you, It can open websites like Google, YouTube, etc., in a web browser, It can give weather forecast, It can give desktop reminders of your choice. It can have some basic conversation.

# **CHAPTER - 2**

## **LITERATURE REVIEW**

## 2. LITERATURE REVIEW

In this section, we have surveyed and compared different types of existing projects as well as models based on voice assistants and has come to a conclusion as to how our project is different than theirs.

### 2.1 Comparison Among Different Existing Models

Sr. No.	Year of Publication	Title of Paper	Objective of Paper
1	2015	The Echo Nest: An Adaptive Music Discovery Platform	Discusses the development of the Echo Nest, a desktop-based voice assistant for music discovery and playback
2	2016	Ok Google Everywhere: Android Speech Commands for Desktop Web	Describes the integration of Google's voice assistant technology into desktop web browsers
3	2017	Evaluation of Voice Assistants in the Desktop Environment	Compares the performance of several popular voice assistants on desktop computers
4	2018	Voice-Based Intelligent Personal Assistant for Desktop Applications	Proposes the development of a voice-based personal assistant specifically for use with desktop applications
5	2019	Designing a Voice-Based Personal Assistant for Desktop and Mobile Environments	Discusses the design and development of a voice-based personal assistant for both desktop and mobile devices
6	2020	Smart Speaker or Voice Assistant: A Study of User Interactions with Google Assistant	Investigates user interactions with Google Assistant on both smart speakers and desktop computers
7	2021	Integrating Voice Assistants with Desktop Environments: Opportunities and Challenges	Examines the potential benefits and challenges of integrating voice assistants into desktop environments
8	2021	Comparative Study of Voice-Enabled Desktop Assistant Technologies	Compares the features and performance of several voice-enabled desktop assistant technologies, including Siri, Alexa, and Cortana
9	2021	Siri and Alexa: A Comparative Analysis of Voice-Enabled Desktop Assistant Technologies	Analyzes the strengths and weaknesses of Siri and Alexa as voice-enabled desktop assistants
10	2022	Building a Voice Assistant for the Desktop Environment Using Deep Learning	Proposes a deep learning-based approach to building a voice assistant for desktop environments
11	2022	Investigating the Effectiveness of Voice Assistants for Workplace Productivity	Studies the effectiveness of voice assistants for workplace productivity tasks, such as scheduling meetings and sending emails
12	2022	Designing an Adaptive Voice Assistant for Personalized Task Management on Desktops	Proposes the development of an adaptive voice assistant for personalized task management on desktop computers
13	2022	A Survey on Voice Assistants: Opportunities, Challenges, and Future Directions	Provides a comprehensive survey of voice assistant technologies and their potential applications

## 2.2 Comparison between our project and the existing projects/models

Sr. No.	Available Assistant	Description	Some drawbacks which are covered by our software
1.	Microsoft's Cortana	Cortana is a Microsoft virtual assistant that uses the Bing search engine to perform tasks like setting reminders and answering questions for the user.	<ul style="list-style-type: none"><li>• It is only available on Windows and Xbox devices.</li><li>• Does not provide a history of commands</li></ul>
2.	Apple's Siri	Siri can be used on Mac computers running macOS Sierra or later. It can be used to make phone calls, send texts, set reminders, and answer questions.	<ul style="list-style-type: none"><li>• For IOS users only.</li><li>• Does not provide a history of commands.</li></ul>
3.	Amazon's Alexa	Alexa, created and owned by Amazon, is a virtual assistant that can be activated via voice commands. It is capable of playing music, setting alarms, controlling smart home devices, and answering questions.	<ul style="list-style-type: none"><li>• It is on the always listening mode, providing no privacy.</li></ul>
4.	Google Assistant	Google Assistant is a virtual assistant software application developed by Google that is primarily available on mobile and home automation devices.	<ul style="list-style-type: none"><li>• There is no official Google Assistant app for Windows, but there is a workaround to access Google Assistant on a Windows 10 computer.</li></ul>

# **CHAPTER - 3**

## **PROPOSED APPROACH**

### **3. PROPOSED APPROACH**

The system is designed using the concept of Artificial Intelligence and with the help of necessary packages of Python. Python provides many libraries and packages to perform the tasks, for example pyPDF2 can be used to read PDF. The details of these packages are mentioned in this report.

The data in this project is nothing but user input, whatever the user says, the assistant performs the task accordingly. The user input is nothing specific but the list of tasks which a user wants to get performed in human language i.e. English.

#### **3.1 Visual Studio Code IDE**

It is an IDE i.e. Integrated Development Environment which has many features like it supports scientific tools (like matplotlib, numpy, scipy etc) web frameworks (example Django, web2py and Flask) refactoring in Python, integrated python debugger, code completion, code and project navigation etc. It also provides Data Science when used with Anaconda.

#### **3.2 Python Libraries and Packages**

In SAGE following python libraries were used:

- 3.2.1. pyttsx3: It is a python library which converts text to speech.
- 3.2.2. SpeechRecognition: It is a python module which converts speech to text.
- 3.2.3. pywhatkit: It is python library to send WhatsApp message at a particular time with some additional features.
- 3.2.4. datetime: This library provides us the actual date and time.
- 3.2.5. wikipedia: It is a python module for searching anything on Wikipedia.
- 3.2.6. pyjokes: It is a python libraries which contains lots of interesting jokes in it.
- 3.2.7. webbrowser: It provides interface for displaying web-based documents to users.
- 3.2.8. pyautogui: It is a python libraries for graphical user interface.
- 3.2.9. os: It represents Operating System related functionality.
- 3.2.10. sys: It allows operating on the interpreter as it provides access to the variables and functions that usually interact strongly with the interpreter.
- 3.2.11. sqlite3: It is used to integrate the SQLite database with Python.
- 3.2.12. json: It used as a lightweight data interchange format. json exposes an API familiar to users of the standard library. It is popularly used for representing structured data.
- 3.2.13. pstats : It is a tool that analyzes data collected by the Python profiler.
- 3.2.14. pynput : It allows to control and listen to input devices such as keyboard and mouse.



- 3.2.15. `itertools`: It provides various functions that work on iterators to produce complex iterators.
- 3.2.16. `requests`: for making HTTP requests to a specified URL.
- 3.2.17. `subprocess`: It allows to execute and manage subprocesses directly from Python. That involves working with the standard input `stdin`, standard output `stdout`, and return codes.
- 3.2.18. `beautifulsoup`: It is used for pulling data out of HTML and XML files.
- 3.2.19. `speedtests`: It is used for testing Internet speed
- 3.2.20. `random`: This module implements pseudo-random number generators for various distributions.

### **3.3 Testing**

The system testing is done on fully integrated system to check whether the requirements are matching or not. The system testing for SAGE desktop assistant focuses on the following four parameters:

#### **3.3.1 Functionality**

In this we check the functionality of the system whether the system performs the task which it was intended to do. To check the functionality each function was checked and run, if it is able to execute the required task correctly then the system passes in that particular functionality test. For example to check whether SAGE can search on Google or not, as we can see in the figure 7.1, user said “Open Google”, then SAGE asked, “What should I search on Google?” then user said, “What is Python”, SAGE open Google and searched for the required input.

#### **3.3.2 Usability**

Usability of a system is checked by measuring the easiness of the software and how user friendly it is for the user to use, how it responses to each query that is being asked by the user. It makes it easier to complete any task as it automatically do it by using the essential module or libraries of Python, in a conversational interaction way. Hence any user when instruct any task to it, they feel like giving task to a human assistant because of the conversational interaction for giving input and getting the desired output in the form of task done. The desktop assistant is reactive which means it know human language very well and understand the context that is provided by the user and gives response in the same way, i.e. human understandable language, English. So user finds its reaction in an informed and smart way. The main application of it can be its multitasking ability. It can ask for continuous instruction one after other until the user “QUIT” it. It asks for the instruction and listen the response that is given by user without needing any trigger phase and then only executes the task.

#### **3.3.3. Security**

The security testing mainly focuses on vulnerabilities and risks. As SAGE is a local desktop application, hence there is no risk of data breaching through remote access. The software is dedicated to a specific system so when the user logs in, it will be activated.

#### **3.3.4. Stability**

Stability of a system depends upon the output of the system, if the output is bounded and specific to the bounded input then the system is said to be stable. If the system works on all the poles of functionality, then it is stable.

# **CHAPTER - 4**

## **TECHNOLOGIES USED**

## 4. TECHNOLOGIES USED

“SAGE” model is combination of Automation, Natural Language Processing, Database Management and Data Mining.

### 4.1 Automation

Automation is a term for technology applications where human input is minimized. This includes business process automation (BPA), IT automation, personal applications such as home automation and more. automation, application of machines to tasks once performed by human beings or, increasingly, to tasks that would otherwise be impossible. Automation generally implies the integration of machines into a self-governing system. Automation has revolutionized those areas in which it has been introduced, and there is scarcely an aspect of modern life that has been unaffected by it.

#### 4.1.1 Types of Automation

- Basic automation

Basic automation takes simple, rudimentary tasks and automates them. This level of automation is about digitizing work by using tools to streamline and centralize routine tasks, such as using a shared messaging system instead of having information in disconnected silos. Business process management (BPM) and robotic process automation (RPA) are types of basic automation.

- Process automation

Process automation manages business processes for uniformity and transparency. It is typically handled by dedicated software and business apps. Using process automation can increase productivity and efficiency within your business. It can also deliver new insights into business challenges and suggest solutions. Process mining and workflow automation are types of process automation.

- Integration automation

Integration automation is where machines can mimic human tasks and repeat the actions once humans define the machine rules. One example is the “digital worker”. In recent years, people have defined digital workers as software robots that are trained to work with humans to perform specific tasks.

- Artificial intelligence (AI) automation

The most complex level of automation is artificial intelligence (AI) automation. The addition of AI means that machines can “learn” and make decisions based on past situations they have encountered and analyzed. For example, in customer service, virtual assistants powered can reduce costs while empowering both customers and human agents, creating an optimal customer service experience.

#### **4.1.2 Automation tools**

Engineers can now have numerical control over automated devices. Information technology, together with industrial machinery and processes, can assist in the design, implementation, and monitoring of control systems.

- Different types of automation tools exist:
  1. ANN – Artificial neural network
  2. DCS – Distributed control system
  3. HMI – Human machine interface
  4. RPA – Robotic process automation
  5. SCADA – Supervisory control and data acquisition
  6. PLC – Programmable logic controller
  7. Motion control
  8. Robotics

#### **4.1.3 Automation in daily life**

- Communications

Automation in communications systems include local area networks, communications satellites, and automated mail-sorting machines.
- Transportation

Automation has been applied in various ways in the transportation industries. Applications include airline reservation systems, automatic pilots in aircraft and locomotives, and urban mass-transit systems. For eg. The airlines use computerized reservation systems to continuously monitor the status of all flights.
- Service industries

Automation of service industries includes an assortment of applications as diverse as the services themselves, which include health care, banking and other financial services, government, and retail trade.
- Consumer products

Consumer products ranging from automobiles to small appliances have been automated for the benefit of the user. Microwave ovens, washing machines, dryers, refrigerators, video recorders, and other modern household appliances typically contain a microprocessor that works as the computer controller for the device.

## 4.2 Natural Language Processing

Natural language processing (NLP) refers to the branch of computer science—and more specifically, the branch of artificial intelligence or AI—concerned with giving computers the ability to understand text and spoken words in much the same way human beings can. NLP combines computational linguistics—rule-based modeling of human language—with statistical, machine learning, and deep learning models. Together, these technologies enable computers to process human language in the form of text or voice data and to ‘understand’ its full meaning, complete with the speaker or writer’s intent and sentiment.

### 4.2.1 NLP tasks

Several NLP tasks break down human text and voice data in ways that help the computer make sense of what it's ingesting. Some of these tasks include the following:

Speech recognition, also called speech-to-text, is the task of reliably converting voice data into text data. Speech recognition is required for any application that follows voice commands or answers spoken questions. What makes speech recognition especially challenging is the way people talk—quickly, slurring words together, with varying emphasis and intonation, in different accents, and often using incorrect grammar.

Part of speech tagging, also called grammatical tagging, is the process of determining the part of speech of a particular word or piece of text based on its use and context. Part of speech identifies ‘make’ as a verb in ‘I can make a paper plane,’ and as a noun in ‘What make of car do you own?’

Word sense disambiguation is the selection of the meaning of a word with multiple meanings through a process of semantic analysis that determine the word that makes the most sense in the given context. For example, word sense disambiguation helps distinguish the meaning of the verb 'make' in ‘make the grade’ (achieve) vs. ‘make a bet’ (place).

Sentiment analysis attempts to extract subjective qualities—attitudes, emotions, sarcasm, confusion, suspicion—from text.

Natural language generation is sometimes described as the opposite of speech recognition or speech-to-text; it's the task of putting structured information into human language.

### 4.2.2 Components of NLP

There are the following two components of NLP -

1. Natural Language Understanding (NLU) : helps the machine to understand and analyze human language by extracting the metadata from content such as concepts, entities, keywords, emotion, relations, and semantic roles. NLU mainly used in Business applications to understand the customer's problem in both spoken and written language.
2. Natural Language Generation (NLG) : acts as a translator that converts the computerized data into natural language representation. It mainly involves Text planning, Sentence planning, and Text Realization.

### 4.2.3 Applications of NLP

1. Question Answering : Question Answering focuses on building systems that automatically answer the questions asked by humans in a natural language.
2. Spam Detection :Spam detection is used to detect unwanted e-mails getting to a user's inbox.
3. Sentiment Analysis : It is used on the web to analyse the attitude, behaviour, and emotional state of the sender. This application is implemented through a combination of NLP (Natural Language Processing) and statistics by assigning the values to the text (positive, negative, or natural), identify the mood of the context (happy, sad, angry, etc.)
4. Machine Translation :Machine translation is used to translate text or speech from one natural language to another natural language. Example: Google Translator
5. Spelling correction : Microsoft Corporation provides word processor software like MS-word, PowerPoint for the spelling correction.
6. Speech Recognition : Speech recognition is used for converting spoken words into text. It is used in applications, such as mobile, home automation, video recovery, dictating to Microsoft Word, voice biometrics, voice user interface, and so on.
7. Chatbot : Implementing the Chatbot is one of the important applications of NLP. It is used by many companies to provide the customer's chat services.

In project, we use NLP for Question Answering, Speech recognition and Chatbot. Our project model answers some of the basic questions asked by user and do conversation with them. User can interact with the SAGE using speech only. User voice command is converted into text and given as text input to our project model. Then project model performs the operations and return the output to the user in voice form. Thus Text-to-Speech and Speech-to-Text functionality of NLP is used here. Apart from this, it performs all the functions done by an ideal chatbot.

### 4.2.4 Libraries used in Project

Libraries we used in Our project for Speech recognition (Speech-to-text and Text-to-speech):

- Python Speech Recognition module:
  - › Speech to text translation
  - › Allow Adjusting for Ambient Noise
- pyttsx3 :
  - › Text-to-speech conversion library in Python.
  - › Unlike alternative libraries, it works offline and is compatible with both Python 2 and 3.

## 4.3 Database Management System

Database management system is a software which is used to manage the database. For example: MySQL, Oracle, etc. are a very popular commercial database which is used in different applications. DBMS provides an interface to perform various operations like database creation, storing data in it, updating data, creating a table in the database and a lot more. It provides protection and security to the database. In the case of multiple users, it also maintains data consistency.

DBMS allows users the following tasks:

**Data Definition:** It is used for creation, modification, and removal of definition that defines the organization of data in the database.

**Data Update:** It is used for the insertion, modification, and deletion of the actual data in the database.

**Data Retrieval:** It is used to retrieve the data from the database which can be used by applications for various purposes.

**User Administration:** It is used for registering and monitoring users, maintain data integrity, enforcing data security, dealing with concurrency control, monitoring performance and recovering information corrupted by unexpected failure.

### 4.3.1 SQLite

SQLite is embedded relational database management system. It is self-contained, serverless, zero configuration and transactional SQL database engine. SQLite is free to use for any purpose commercial or private. In other words, "SQLite is an open source, zero-configuration, self-contained, stand alone, transaction relational database engine designed to be embedded into an application".

SQLite is different from other SQL databases because unlike most other SQL databases, SQLite does not have a separate server process. It reads and writes directly to ordinary disk files. A complete SQL database with multiple tables, indices, triggers, and views, is contained in a single disk file.

### 4.3.2 Applications of SQLite

Due to its small code print and efficient usage of memory, it is the popular choice for the database engine in cell phones, PDAs, MP3 players, set-top boxes, and other electronic gadgets. It is used as an alternative for open to writing XML, JSON, CSV, or some proprietary format into disk files used by the application. As it has no complication for configuration and easily stores file in an ordinary disk file, so it can be used as a database for small to medium sized websites. It is faster and accessible through a wide variety of third-party tools, so it has great applications in different software platforms.



### 4.3.3 Advantages

1. The configuration process is very easy, no setup or administration is needed.
2. All the features of SQL is implemented with some additional features like partial indexes, indexes on expressions, JSON, and common table expressions.
3. Sometimes it is faster than the direct file system I/O.
4. It supports terabyte-sized databases and gigabyte-sized strings and blobs.
5. Almost all OS supports SQLite like Android, BSD, iOS, Linux, Mac, Solaris, VxWorks, and Windows (Win32, WinCE, etc. It is very much easy to port to other systems.
6. A complete database can be stored in a single cross-platform disk file.

### 4.3.4 Limitations

1. Limited concurrency: SQLite uses file-based locking to control access to the database, which can lead to performance issues when multiple clients are trying to read and write to the database simultaneously. This makes it less suitable for use in highly concurrent systems.
2. Limited support for data types: SQLite has a relatively small set of data types compared to other database engines. It does not support many of the more advanced data types, such as arrays and JSON, that are available in other databases.
3. Limited scalability: SQLite is not designed to be a high-concurrency, high-transaction-rate database engine. It is more suited for use in smaller-scale, low-concurrency systems, and may not be able to scale to handle very large amounts of data or very high levels of concurrency.

## 4.4 Data Mining

Data mining, also known as knowledge discovery in data (KDD), is the process of uncovering patterns and other valuable information from large data sets. Given the evolution of data warehousing technology and the growth of big data, adoption of data mining techniques has rapidly accelerated over the last couple of decades, assisting companies by transforming their raw data into useful knowledge. However, despite the fact that that technology continuously evolves to handle data at a large-scale, leaders still face challenges with scalability and automation.

Data mining has improved organizational decision-making through insightful data analyses. The data mining techniques that underpin these analyses can be divided into two main purposes; they can either describe the target dataset or they can predict outcomes through the use of machine learning algorithms. These methods are used to organize and filter data, surfacing the most interesting information, from fraud detection to user behaviors, bottlenecks, and even security breaches.

#### 4.4.1 Data mining techniques

Data mining works by using various algorithms and techniques to turn large volumes of data into useful information. Here are some of the most common ones:

**Association rules:** An association rule is a rule-based method for finding relationships between variables in a given dataset. These methods are frequently used for market basket analysis, allowing companies to better understand relationships between different products. Understanding consumption habits of customers enables businesses to develop better cross-selling strategies and recommendation engines.

**Neural networks:** Primarily leveraged for deep learning algorithms, neural networks process training data by mimicking the interconnectivity of the human brain through layers of nodes. Each node is made up of inputs, weights, a bias (or threshold), and an output. If that output value exceeds a given threshold, it “fires” or activates the node, passing data to the next layer in the network. Neural networks learn this mapping function through supervised learning, adjusting based on the loss function through the process of gradient descent. When the cost function is at or near zero, we can be confident in the model’s accuracy to yield the correct answer.

**Decision tree:** This data mining technique uses classification or regression methods to classify or predict potential outcomes based on a set of decisions. As the name suggests, it uses a tree-like visualization to represent the potential outcomes of these decisions.

**K-nearest neighbor (KNN):** K-nearest neighbor, also known as the KNN algorithm, is a non-parametric algorithm that classifies data points based on their proximity and association to other available data. This algorithm assumes that similar data points can be found near each other. As a result, it seeks to calculate the distance between data points, usually through Euclidean distance, and then it assigns a category based on the most frequent category or average.

#### 4.4.2 Application of Data mining in SAGE

In this voice assistant, we include the feature of recommended commands by tracing activity logs of users. This voice assistant will store the commands given by user and give the recommendation based on frequent input. This technique is similar to market basket analysis.

Market basket analysis is a data mining technique used by retailers to increase sales by better understanding customer purchasing patterns. It involves analyzing large data sets, such as purchase history, to reveal product groupings, as well as products that are likely to be purchased together. Thus it help us in analyzing behavior of user and giving them recommendation of commands.

In market basket analysis, association rules are used to predict the likelihood of products being purchased together. Association rules count the frequency of items that occur together, seeking to find associations that occur far more often than expected.

The **Apriori** algorithm is a well-known Machine Learning algorithm used for association rule learning. The primary objective of the apriori algorithm is to create the association rule between different objects. The association rule describes how two or more objects are related to one another. Apriori algorithm is also called frequent pattern mining.

#### **4.4.3 Data mining applications**

Data mining techniques are widely adopted among business intelligence and data analytics teams, helping them extract knowledge for their organization and industry. Some data mining use cases include:

**Sales and marketing :** Companies collect a massive amount of data about their customers and prospects. By observing consumer demographics and online user behavior, companies can use data to optimize their marketing campaigns, improving segmentation, cross-sell offers, and customer loyalty programs, yielding higher ROI on marketing efforts. Predictive analyses can also help teams to set expectations with their stakeholders, providing yield estimates from any increases or decreases in marketing investment.

**Education :** Educational institutions have started to collect data to understand their student populations as well as which environments are conducive to success. As courses continue to transfer to online platforms, they can use a variety of dimensions and metrics to observe and evaluate performance, such as keystroke, student profiles, classes, universities, time spent, etc.

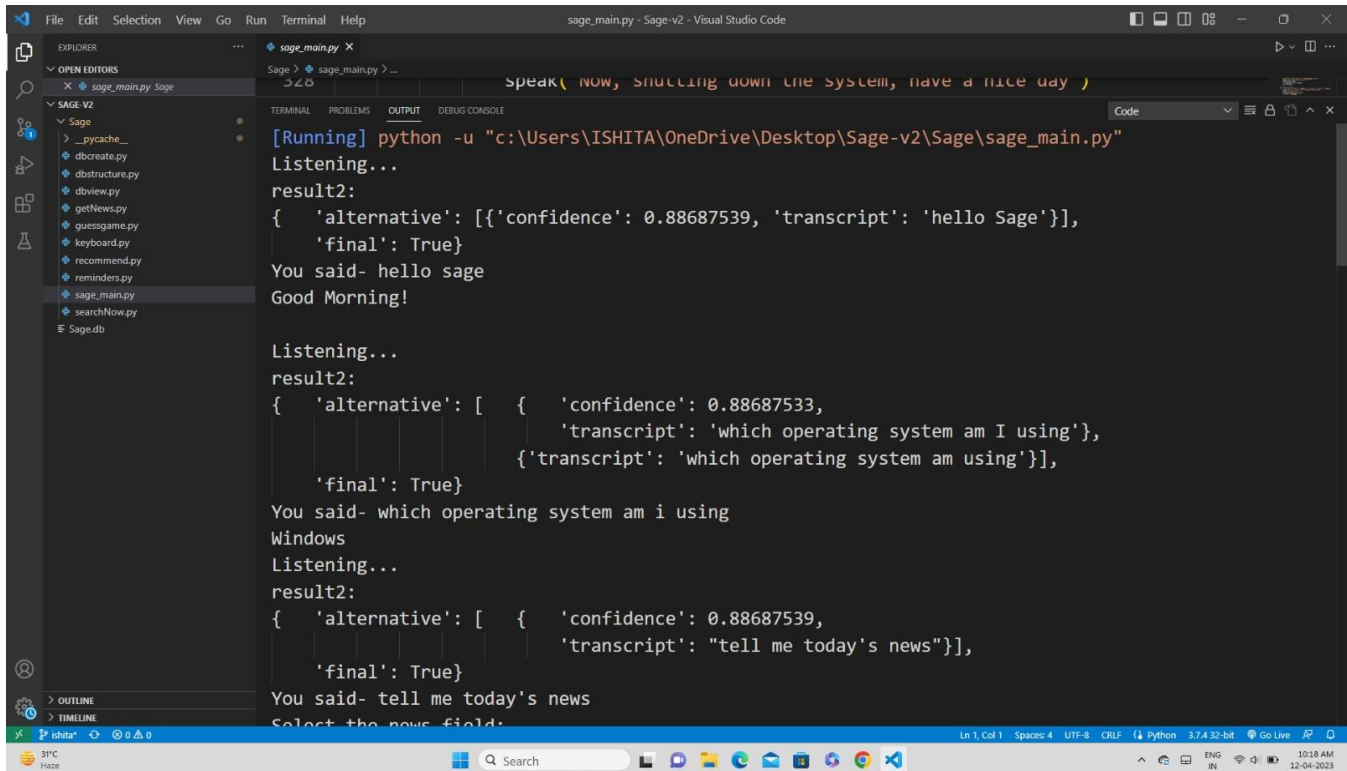
**Fraud detection :** While frequently occurring patterns in data can provide teams with valuable insight, observing data anomalies is also beneficial, assisting companies in detecting fraud. While this is a well-known use case within banking and other financial institutions, SaaS-based companies have also started to adopt these practices to eliminate fake user accounts from their datasets.

# **CHAPTER-5**

## **RESULTS**

## 5. RESULTS

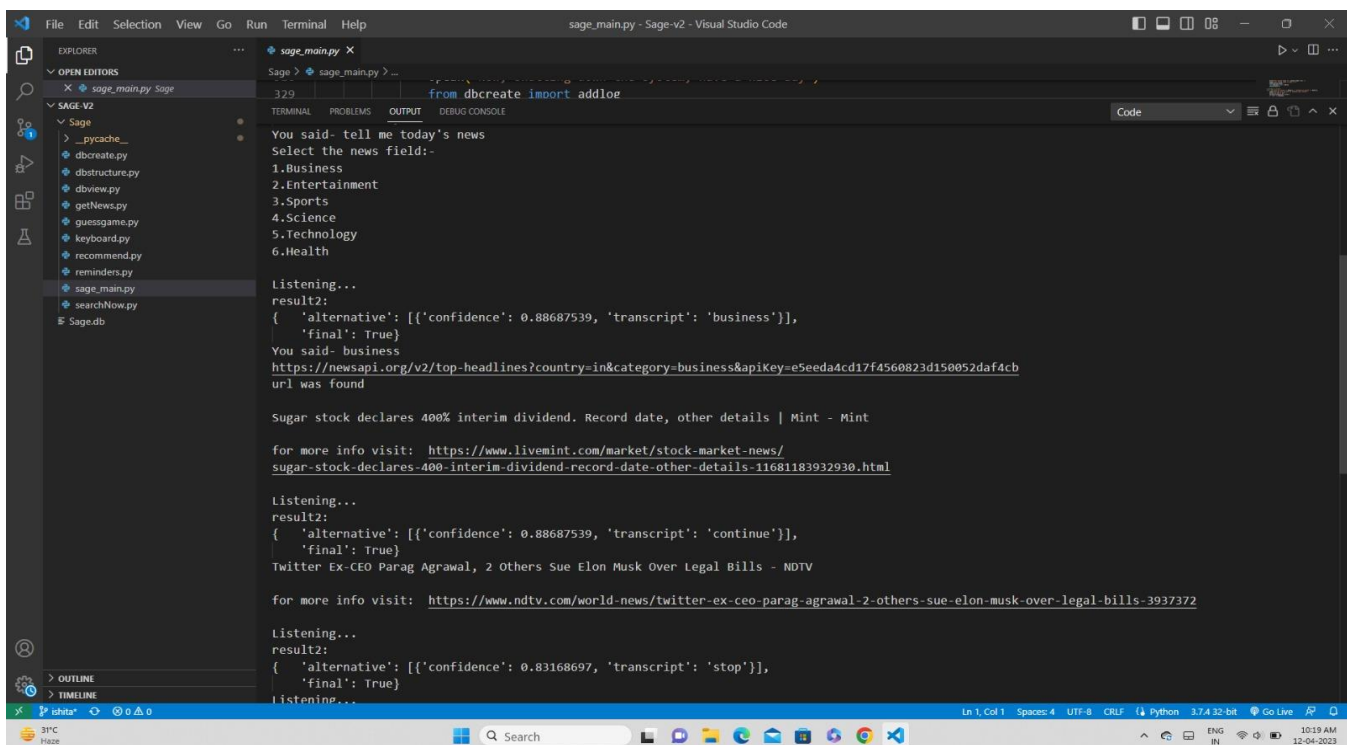
The efficiency of the project is determined by the results achieved through it. The more successful results we obtained, the higher the efficiency of the project. Hence results are a very important aspect in a particular project. Here are some of the results we achieved in our project.



```
sage_main.py - Sage-v2 - Visual Studio Code
sage_main.py X
Sage > sage_main.py > ...
speak( NOW, shutting down the system, have a nice day )
[Running] python -u "c:\Users\ISHITA\OneDrive\Desktop\Sage-v2\Sage\sage_main.py"
Listening...
result2:
{ 'alternative': [{ 'confidence': 0.88687539, 'transcript': 'hello Sage' }],
  'final': True }
You said- hello sage
Good Morning!

Listening...
result2:
{ 'alternative': [ { 'confidence': 0.88687533,
                    'transcript': 'which operating system am I using'},
                  { 'confidence': 0.88687533,
                    'transcript': 'which operating system am using' } ],
  'final': True }
You said- which operating system am i using
Windows
Listening...
result2:
{ 'alternative': [ { 'confidence': 0.88687539,
                    'transcript': "tell me today's news" } ],
  'final': True }
You said- tell me today's news
Select the news field:
```

Figure 5.1 Basic Commands performed on Sage



```
sage_main.py - Sage-v2 - Visual Studio Code
sage_main.py X
Sage > sage_main.py > ...
from dbcreate import addlooe
329
You said- tell me today's news
Select the news field:-
1.Business
2.Entertainment
3.Sports
4.Science
5.Technology
6.Health

Listening...
result2:
{ 'alternative': [{ 'confidence': 0.88687539, 'transcript': 'business' }],
  'final': True }
You said- business
https://newsapi.org/v2/top-headlines?country=in&category=business&apiKey=eSeeda4cd17f4560823d150052daf4cb
url was found

Sugar stock declares 400% interim dividend. Record date, other details | Mint - Mint

for more info visit: https://www.livemint.com/market/stock-market-news/
sugar-stock-declares-400-interim-dividend-record-date-other-details-11681183932930.html

Listening...
result2:
{ 'alternative': [{ 'confidence': 0.88687539, 'transcript': 'continue' }],
  'final': True }
Twitter Ex-CEO Parag Agrawal, 2 Others Sue Elon Musk Over Legal Bills - NDTV

for more info visit: https://www.ndtv.com/world-news/twitter-ex-ceo-parag-agrawal-2-others-sue-elon-musk-over-legal-bills-3937372

Listening...
result2:
{ 'alternative': [{ 'confidence': 0.83168697, 'transcript': 'stop' }],
  'final': True }
Listening...
```

Figure 5.2 Getting input and output of News

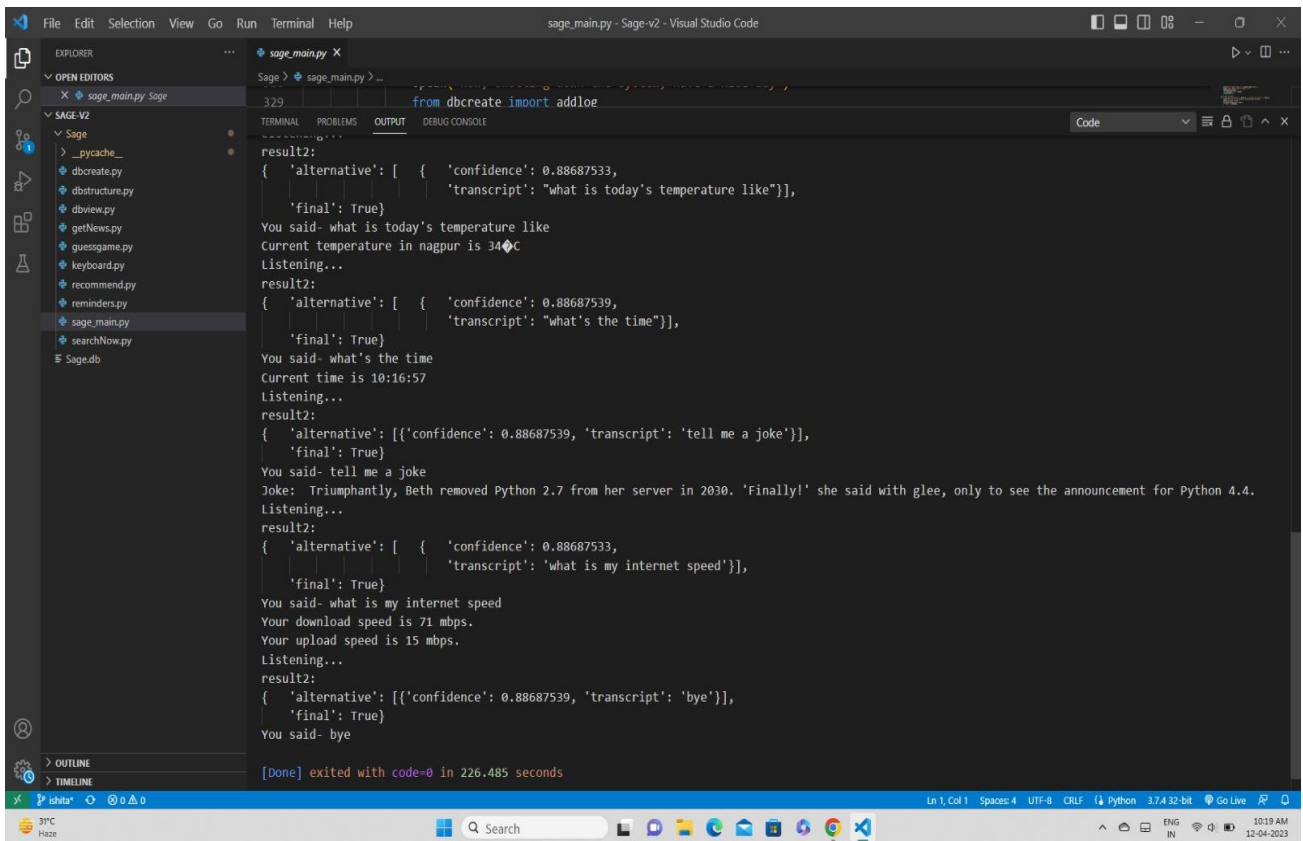


Figure 5.3 Other basic commands like time, internet speed etc.

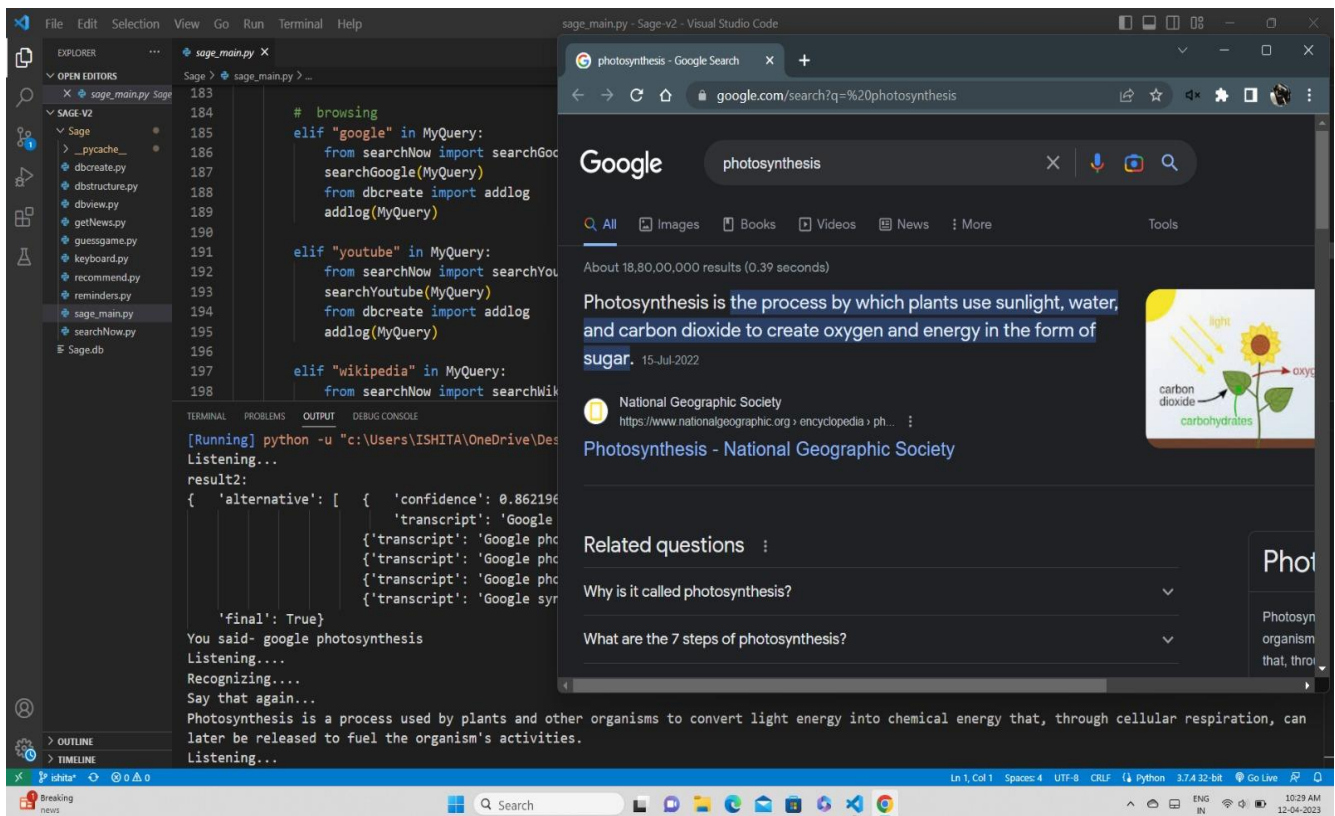


Figure 5.4 Input and Output of Google Search

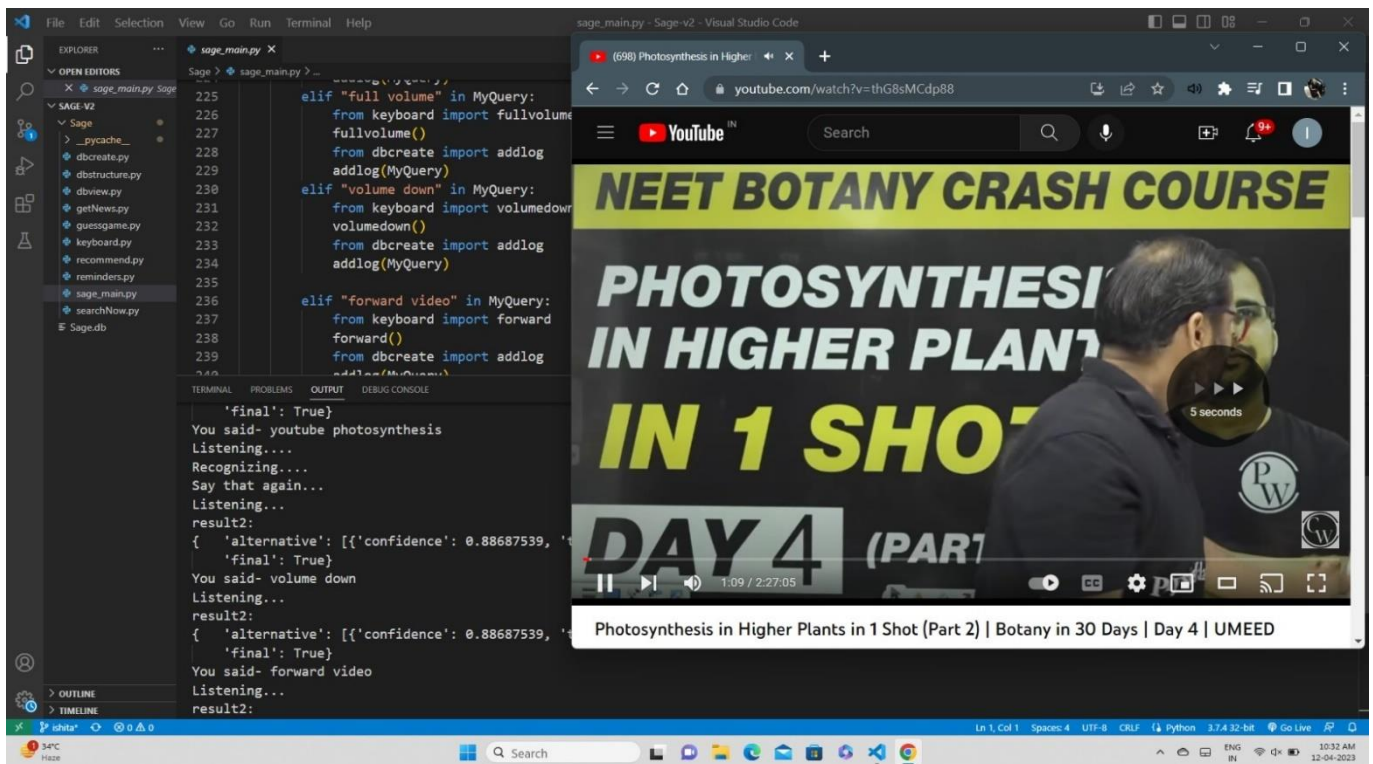


Figure 5.5 Input and Output of YouTube Playback Controls

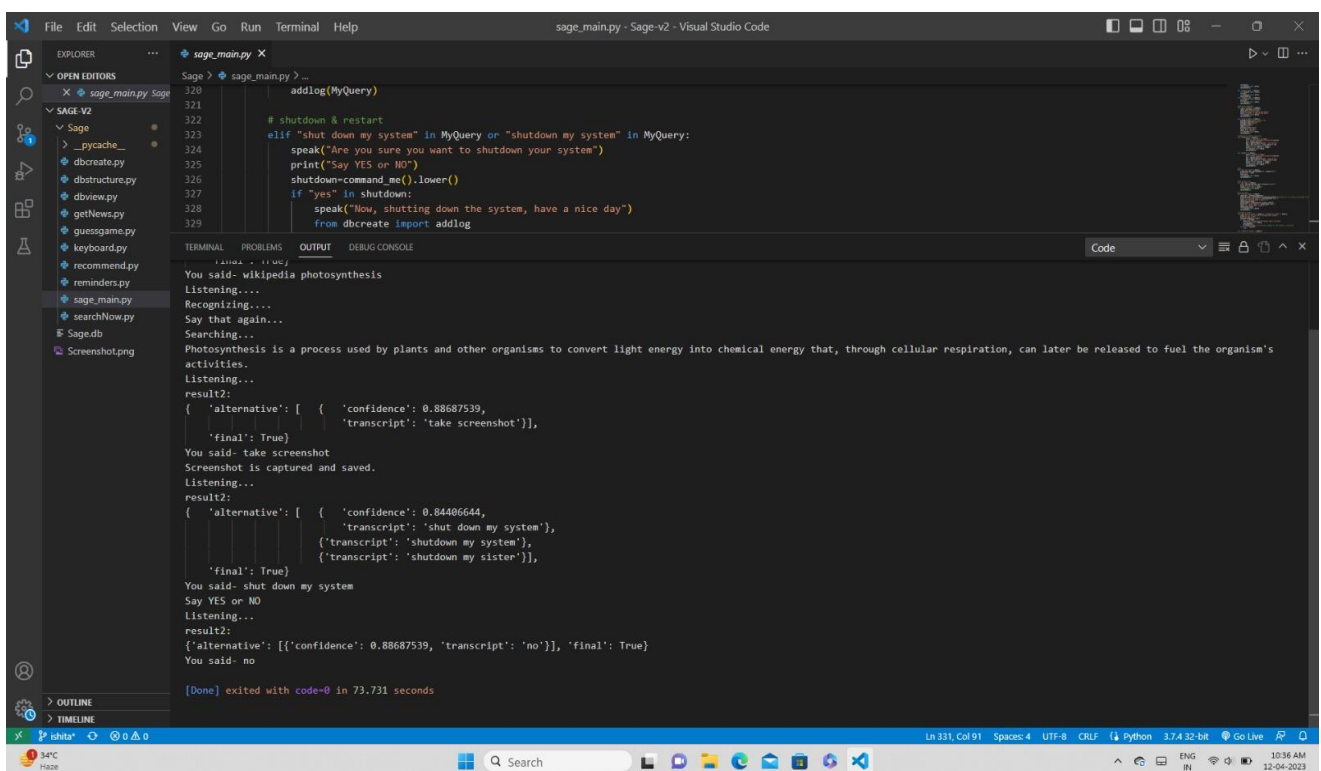


Figure 5.6 Wikipedia Search



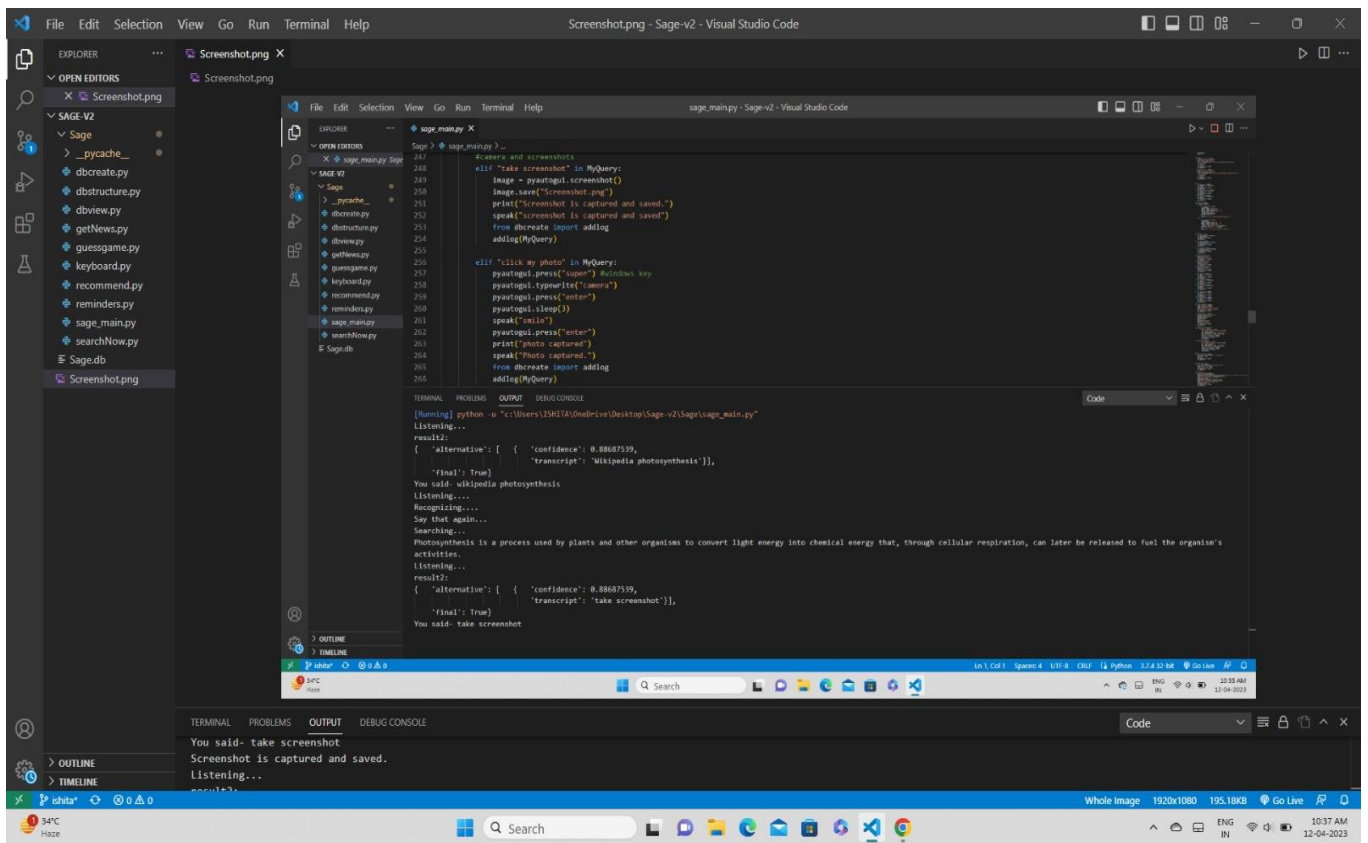


Figure 5.7 Taking Screenshot

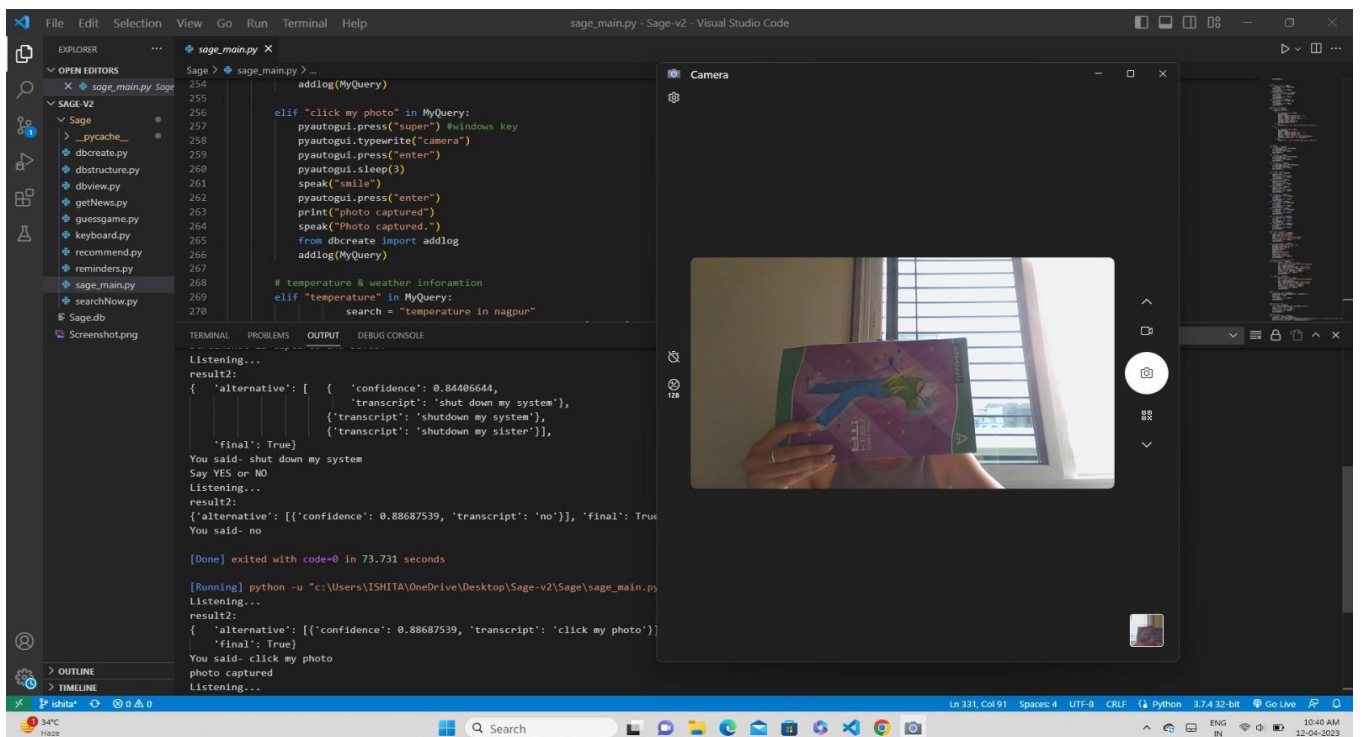


Figure 5.8 Capturing an Image



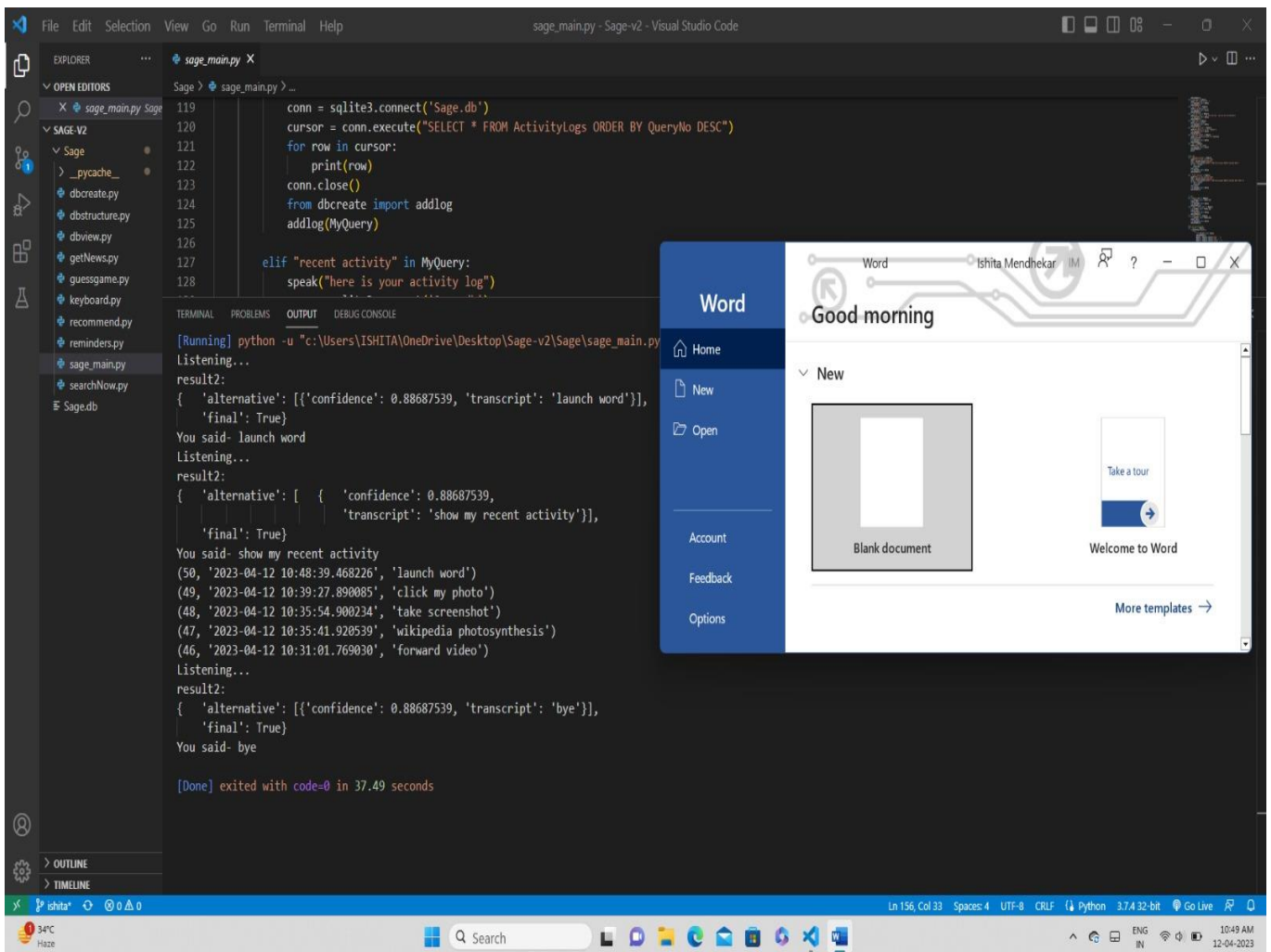


Figure 5.9 Opening Microsoft Word

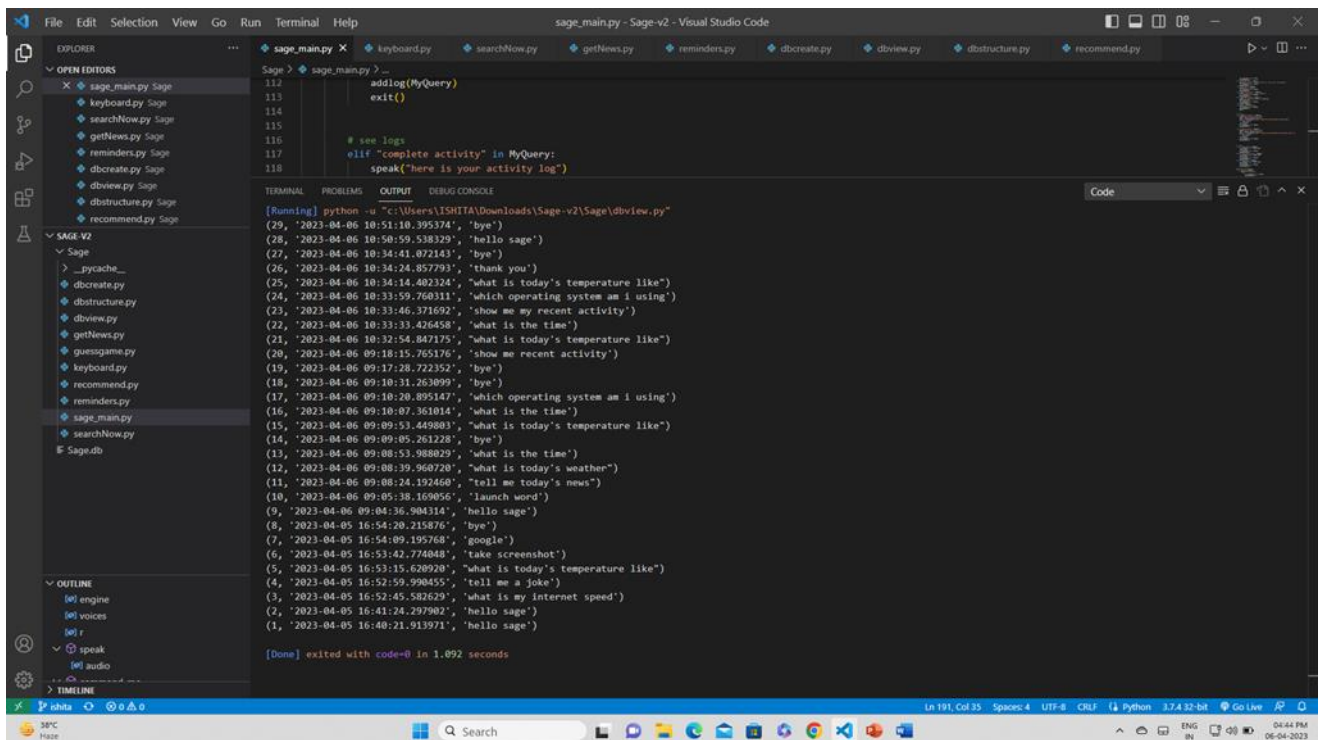


Figure 5.10 Activity Logs of the Executed Queries

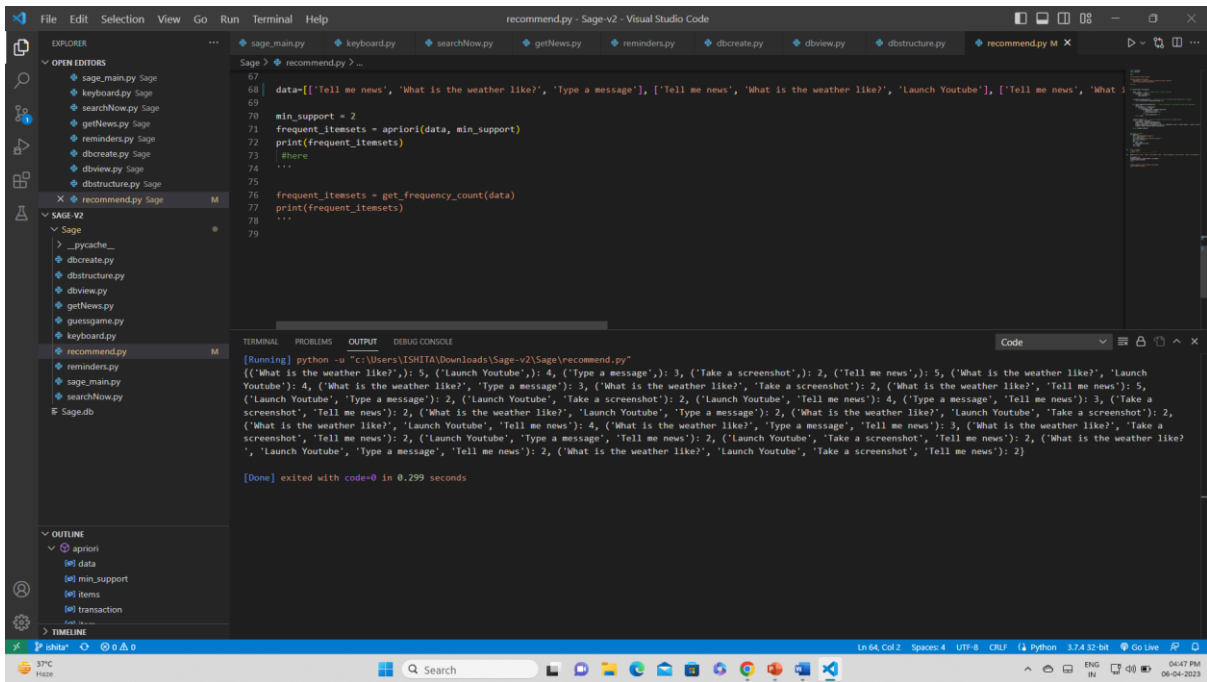


Figure 5.11 Analysis of the user data logs

Column Name	Data Type	Allow NULL	Primary Key	Autoincrement
QueryNo	INTEGER	NO	YES	YES
Time	TEXT	YES	NO	NO
Query	TEXT	YES	NO	NO

```

[Done] exited with code=0 in 1.557 seconds

```

Figure 5.12 Database Schema

```

({'bye': 6, ('which operating system am i using': 2, ('what is the time': 3, ('hello sage': 4, ('what is today's
temperature like': 4)

[Done] exited with code=0 in 1.358 seconds

```

Figure 5.13 Recommendation Analysis of user data by Sage

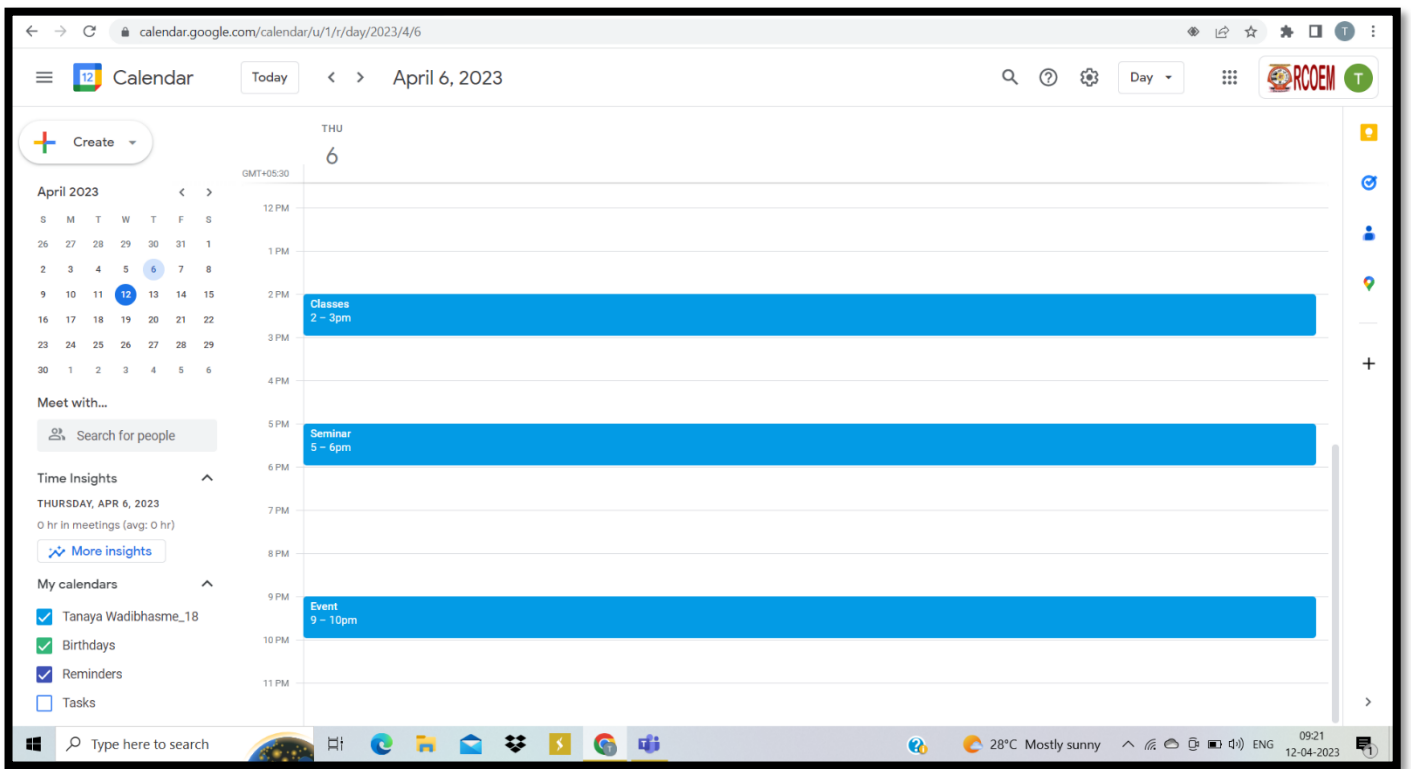


Figure 5.14 Input for getting Reminders by Sage

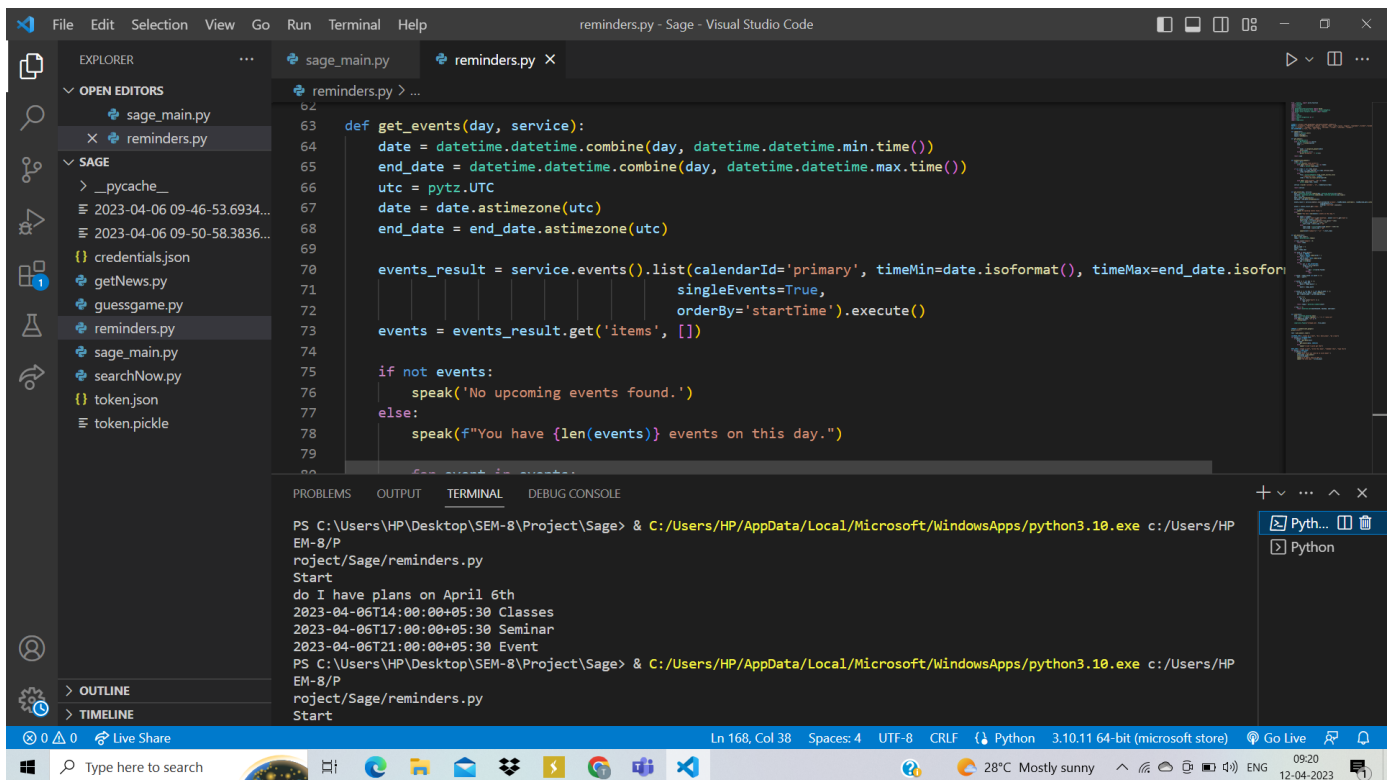


Figure 5.15 Reminder given by Sage

# CONCLUSION

# CONCLUSION

SAGE is a very helpful voice assistant without any doubt as it saves time of the user by conversational interactions, its effectiveness and efficiency. The development of a cross-platform desktop version voice assistant has been a challenging but rewarding project. The implementation of natural language processing, machine learning, and speech recognition technologies has enabled the voice assistant to perform a wide range of tasks, including scheduling appointments, sending emails, playing music, and providing information on various topics.

The voice assistant has been designed to be compatible with multiple operating systems, making it accessible to a broad range of users. Its user-friendly interface and customizable features make it easy for users to personalize their experience and tailor the voice assistant's functionality to their specific needs.

Moving forward, there is still room for improvement in terms of the voice assistant's accuracy and responsiveness. However, the progress made in this project represents a significant milestone in the development of voice assistants and the potential they hold for improving productivity and enhancing user experience. But while working on this project, there were some limitations encountered and also realized some scope of enhancement in the future which are mentioned below:

## 1) LIMITATIONS

- Security is somewhere an issue, there is no voice command encryption in this project.
- Background voice can interfere.
- Misinterpretation because of accents and may cause inaccurate results.
- SAGE cannot be called externally anytime like other traditional assistants like Google Assistant can be called just by saying, “Ok Google!”

## 2) SCOPE FOR FUTURE WORK

- Make SAGE to learn more on its own and develop a new skill in it.
- SAGE android app can also be developed.
- Make more SAGE voice terminals.
- Voice commands can be encrypted to maintain security.

# **BIBLIOGRAPHY**

## **BIBLIOGRAPHY**

- 1] The Echo Nest: An Adaptive Music Discovery Platform. (2015). In Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (pp. 2105-2105). ACM.
- 2] McMillan, A. (2016). Ok Google Everywhere: Android Speech Commands for the Desktop Web. In Proceedings of the 25th International Conference Companion on World Wide Web (pp. 1487-1488). ACM.
- 3] Bhatia, S., Chetan, K. N., & Khanna, N. (2017). Evaluation of Voice Assistants in the Desktop Environment. In Proceedings of the 2017 International Conference on Advances in Computing, Communications and Informatics (pp. 1566-1570). ACM.
- 4] Sahoo, S. K., & Rath, S. K. (2018). Voice-Based Intelligent Personal Assistant for Desktop Applications. In Proceedings of the 2018 2nd International Conference on Advances in Electronics, Computers and Communications (pp. 247-252). IEEE.
- 5] Alam, M. N., Akter, T., & Roy, K. (2019). Designing a Voice-Based Personal Assistant for Desktop and Mobile Environments. In Proceedings of the 2019 IEEE International Conference on Systems, Man and Cybernetics (SMC) (pp. 3035-3040). IEEE.
- 6] Feijóo, C. E., & Fernández, P. L. (2020). Smart Speaker or Voice Assistant: A Study of User Interactions with Google Assistant. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (pp. 1-12). ACM.
- 7] Bonomi, A., & Mazzon, J. A. (2021). Integrating Voice Assistants with Desktop Environments: Opportunities and Challenges. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (pp. 1-14). ACM.
- 8] Kaur, P., Singh, P., & Singh, K. (2021). Comparative Study of Voice-Enabled Desktop Assistant Technologies. In Proceedings of the 2021 International Conference on Advances in Computing, Communication and Automation (pp. 1-5). IEEE.
- 9] Arora, T., & Gupta, S. (2021). Siri and Alexa: A Comparative Analysis of Voice-Enabled Desktop Assistant Technologies. In Proceedings of the 2021 International Conference on Computer Communication and Informatics (pp. 1-5). IEEE.

- 10] Ionescu, A. E., & Popescu, A. T. (2022). Building a Voice Assistant for the Desktop Environment Using Deep Learning. In Proceedings of the 2022 International Conference on Innovative Research and Development (pp. 17-20). IEEE.
- 11] Bandyopadhyay, D., & Saranya, M. (2022). Investigating the Effectiveness of Voice Assistants for Workplace Productivity. In Proceedings of the 2022 International Conference on Engineering, Applied Sciences and Technology (pp. 1-5). IEEE.
- 12] Hossain, M. S., Rony, M. S., & Arefin, A. S. (2022). Designing an Adaptive Voice Assistant for Personalized Task Management on Desktops. In Proceedings of the 2022 5th International Conference on Computing, Communication and Security (pp. 1-5). IEEE.
- 13] Nambiar, M., & Shaikh, N. A. (2022). A Survey on Voice Assistants: Opportunities, Challenges, and Future Directions. In Proceedings of the 2022 International Conference on Computational Intelligence and Knowledge Economy (pp. 1-6). IEEE.