

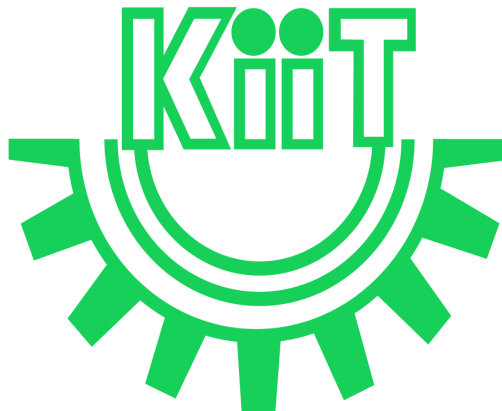
Cognitive Behavioural Therapy Chatbot

Project report submitted in partial fulfilment of the requirement for the degree of **Bachelor of Technology**

By

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Declaration

We declare that this written submission represents our ideas in our own words and where others ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

The expansion of the cyberspace and the enormous process in computing and software applications enabled technology to cover every aspect of our life, therefore, many of our goals are now technology driven. Consequently, the need of intelligent assistance to achieve these goals has increased. However, for this assistance to be beneficial for users, it should be targeted to them based on their needs and preferences. Intelligent software agents have been recognized as a promising approach for the development of user centric, personalized, applications.

In this project, a generic personal smart assistant agent is proposed that provides relevant assistance to the user and provides cognitive behavioral therapy. The main focus of this work is on developing a user behaviour model that captures the deliberative and reactive behaviours of the user using facial recognition, and mood detection. Furthermore, the bot designed initiates human like conversation with the user, thereby aiding in the emotional stability.

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Chapter 1

1.1 Introduction

Benefits from mental health early interventions may not be sustained over time, and longer-term intervention programs may be required to maintain early clinical gains. However, due to the high intensity of face-to-face early intervention treatments, this may not be feasible. Adjunctive internet-based interventions specifically designed for youth may provide a cost-effective and engaging alternative to prevent loss of intervention benefits. However, more sophisticated models responsive to user data are critical to inform tailored online therapy. Thus, integration of user experience with a sophisticated and cutting-edge technology to deliver content is necessary to redefine online interventions in youth mental health.

Cognitive behavioural therapy (CBT) is a talking therapy that can help you manage your problems by changing the way you think and behave. It's most commonly used to treat anxiety and depression, but can be useful for other mental and physical health problems. CBT is based on the concept that your thoughts, feelings, physical sensations and actions are interconnected, and that negative thoughts and feelings can trap you in a vicious cycle. Unlike some other talking treatments, CBT deals with your current problems, rather than focusing on issues from your past. It looks for practical ways to improve your state of mind on a daily basis.



Fig:1.1.1 Overview of Cognitive Behavioural Therapy

1.1.1 Context

The project combines the basic principles from behavioral and cognitive psychology and implements it via a technology platform that uses facial recognition and mood detection algorithms. The main problem faced is to detect the state of mind of user. Similar difficulties exists across all therapeutic attempts. At the end, the main aim is to provide mental well being, positive attitude and solve other disorders.

1.1.2 Personal Assistant Web Based Chatbot

The WebAI platform uses Cognitive behavioural therapy (CBT) methods, via technology, which is a type of talking treatment which focuses on how thoughts, beliefs and attitudes affect feelings and behaviour, and teaches coping skills for dealing with different problems through simple human-computer interaction.

1.1.3 Why Cognitive Behavioral Chatbot?

Artificial intelligence (AI)-powered chatbots provide a new form of mental health support for a tech-savvy generation already comfortable using texting as its dominant form of communication. As the demand for mental health services grows nationwide, there's a shortage of available psychiatric professionals, according to the National Institute of Mental Health. And college campuses are seeing unprecedented rates of anxiety and depression. Chatbots designed to spot indicators of mental health distress may provide emotional support when traditional therapy is out of reach.

1.2 Objective

The main objective of this technology is takes a hands-on, technical and practical approach to problem-solving. Its goal is to change patterns of thinking or behavior that are behind people's difficulties, and so change the way they feel through conversation. The technology implements strong Neural Nets and classifiers to detect the psychological treatment for moderate and severe depression.

1.3 System Requirements

Python3.x was used as the coding language. The computer to be used should have Linux or Windows OS with a minimum RAM requirement of 8 GB. To obtain efficient results, more computational is favourable to implement RAM-heavy Neural Nets and classifiers. High speed internet connection is favourable for quick webhook responses.

Chapter 2

2.1 Review of Literature

Cognitive behavioural therapy (CBT) is one of the widely researched topic in the field of psychological therapy. In today's world, with the introduction of modern methods to predict user behaviour and mood, a lot of work is underway to come up with an efficient technological solution.

One of the most well-known personal therapy chatbot is WoeBot [1]. Woebot is an automated conversational agent (chatbot) who helps user to monitor mood and learn about himself. Drawing from a therapeutic framework known as Cognitive Behaviour Therapy, Woebot asks people how they're feeling and what is going on in their lives in the format of brief daily conversations. Woebot also talks to the user about mental health and wellness and sends videos and other useful tools depending on the user's mood and needs at that moment. Woebot can be thought of as a choose-one's-own-adventure self-help book that is capable of storing all of your entries, and gets more specific to your needs over time.

Jo Aggarwal, Ramakant Vempati and team [2] developed a chatbot which is now used by more than 300,000 people across 30 countries. The bot, Wysa creates user's personal toolkit drawn from over 70 AI tools drawn from evidence based self-help techniques from CBT, mindfulness and life coaching, Wysa is a great way to work through issues and break patterns that are holding one back. Nothing can match the privacy of an anonymous conversation with an AI bot. It acts like an interactive journal and life coach. Wysa is good at asking the right probing questions, and helping one untangle and unwind after a hard day.

2.2 Technical Specifications

Technical Specifications

The technical tools used in making this project include the following:

- **Python3** : Python is an interpreted high-level programming language for general-purpose programming. Created by Guido van Rossum and first released in 1991, Python has a design philosophy that emphasizes code readability, notably using significant whitespace. It provides constructs that enable clear programming on both small and large scales.
- **PyCharm** : Developed by JetBrains, PyCharm is an Integrated Development Environment used in computer programming, specifically for the Python language.
- **Jupyter Notebook** : The Jupyter Notebook is an open-source web application that allows you to create and share documents that contain live code, equations, visualizations and narrative text. Uses include: data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning, and much more.
- **Spyder** : Spyder is an open source cross-platform integrated development environment for scientific programming in the Python language. Spyder integrates NumPy, SciPy, Matplotlib and IPython, as well as other open source software.
- **NGROK** : ngrok provides a real-time web UI where you can introspect all HTTP traffic running over your tunnels. Replay any request against your tunnel with one click.

2.3 Libraries used

- **Matplotlib:** Matplotlib is a Python 2D plotting library which produces publication quality figures in a variety of hard copy formats and interactive environments across platforms. Matplotlib can be used in Python scripts, the Python and IPython shells, the Jupyter notebook, web application servers, and four graphical user interface toolkits.
- **Pandas:** In computer programming, pandas is a software library written for the Python programming language for data manipulation and analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series.
- **Numpy:** NumPy is the fundamental package for scientific computing with Python. It contains among other things: a powerful N-dimensional array object; sophisticated (broadcasting) functions; tools for integrating C/C++ and Fortran code; useful linear algebra, Fourier transform, and random number capabilities.
- **Scikit learn:** Scikit-learn (formerly scikits.learn) is a free software machine learning library for the Python programming language. It features various classification, regression and clustering algorithms including support vector machines, random forests, gradient boosting, *k*-means and DBSCAN, and is designed to interoperate with the Python numerical and scientific libraries NumPy and SciPy.
- **NLTK:** NLTK is a leading platform for building Python programs to work with human language data. It provides easy-to-use interfaces to over 50 corpora and lexical resources such as WordNet, along with a suite of text processing libraries for classification, tokenization, stemming, tagging, parsing, and semantic reasoning, wrappers for industrial-strength NLP libraries, and an active discussion forum.

- **Seaborn** : Seaborn is a library for making attractive and informative statistical graphics in Python. It is built on top of matplotlib and tightly integrated with the PyData stack, including support for numpy and pandas data structures and statistical routines from scipy and statsmodels.
- **OpenCV(cv2)** : **OpenCV** (*Open Source Computer Vision*) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license. OpenCV supports the deep learning frameworks TensorFlow, Torch/PyTorch and Caffe.
- **Pillow** : **Python Imaging Library** (abbreviated as **PIL**) (in newer versions known as Pillow) is a free library for the Python programming language that adds support for opening, manipulating, and saving many different image file formats. It is available for Windows, Mac OS X and Linux. The latest version of PIL is 1.1.7, was released in September 2009 and supports Python 1.5.2–2.7, with Python 3 support to be released "later".
- **Os** : This module provides a portable way of using operating system dependent functionality.
- **Urllib** : The urllib module in Python 3 allows you access websites via your program. This opens up as many doors for your programs as the internet opens up for you. urllib in Python 3 is slightly different than urllib2 in Python 2, but they are mostly the same. Through urllib, you can access websites, download data, parse data, modify your headers, and do any GET and POST requests you might need to do.
- **Flask** : Flask is a micro web framework written in Python and based on the Werkzeug toolkit and Jinja2 template engine. It is BSD licensed.

- **Json** : In Python, the json module provides an API similar to convert in-memory Python objects to a serialized representation known as JavaScript Object Notation (JSON) and vice-a-versa.
- **TensorFlow** : TensorFlow is an open-source software library for dataflow programming across a range of tasks. It is a symbolic math library, and is also used for machine learning applications such as neural networks. It is used for both research and production at Google, often replacing its closed-source predecessor.
- **Theano** : Theano is a numerical computation library for Python. In Theano, computations are expressed using a NumPy-esque syntax and compiled to run efficiently on either CPU or GPU architectures.
- **Keras** : Keras is a high-level neural networks API, written in Python and capable of running on top of TensorFlow, CNTK, or Theano. It was developed with a focus on enabling fast experimentation.

Chapter 3

The following steps were taken during execution of program.

3.1 Starting up the sign up process

At first, speech recognition and Text- to-speech will boot up and then speech recognition will recognize the voice of the user and convert it to text and then text to speech will guide user through the process. Speech recognition and Text-to-speech enhances the user experience. Text-to-speech and Speech recognition is implemented using google speech APIs.

User should provide their details like hobbies, name, username and password through speech API and also user must provide their image for facial recognition to sign in.

We are storing all the information of the user in SQLite 3 database and the images are stored in media root directory of Django. Facial detection is trained on the user image at this stage.

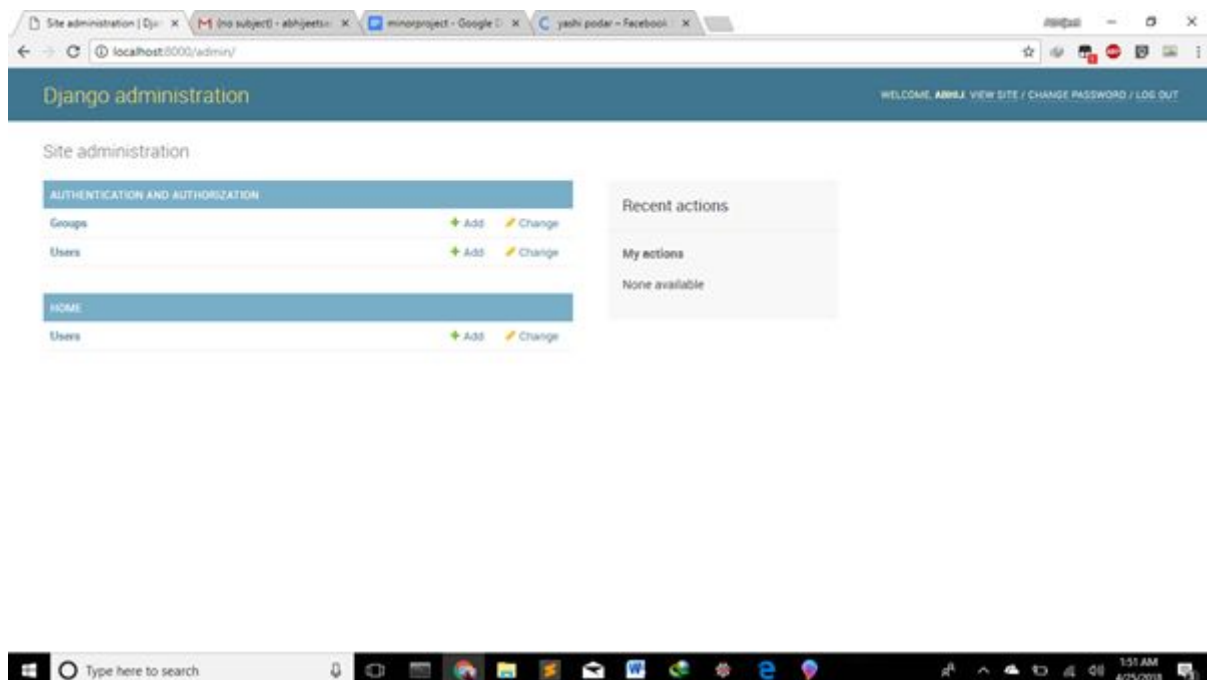


Figure 3.1.1: Django administrator

3.2 Sign-in process

For the login process, the system will capture the user's image through face recognition system which uses Haar-cascading to extract the face from the image and pass it to the classifier to identify the user.

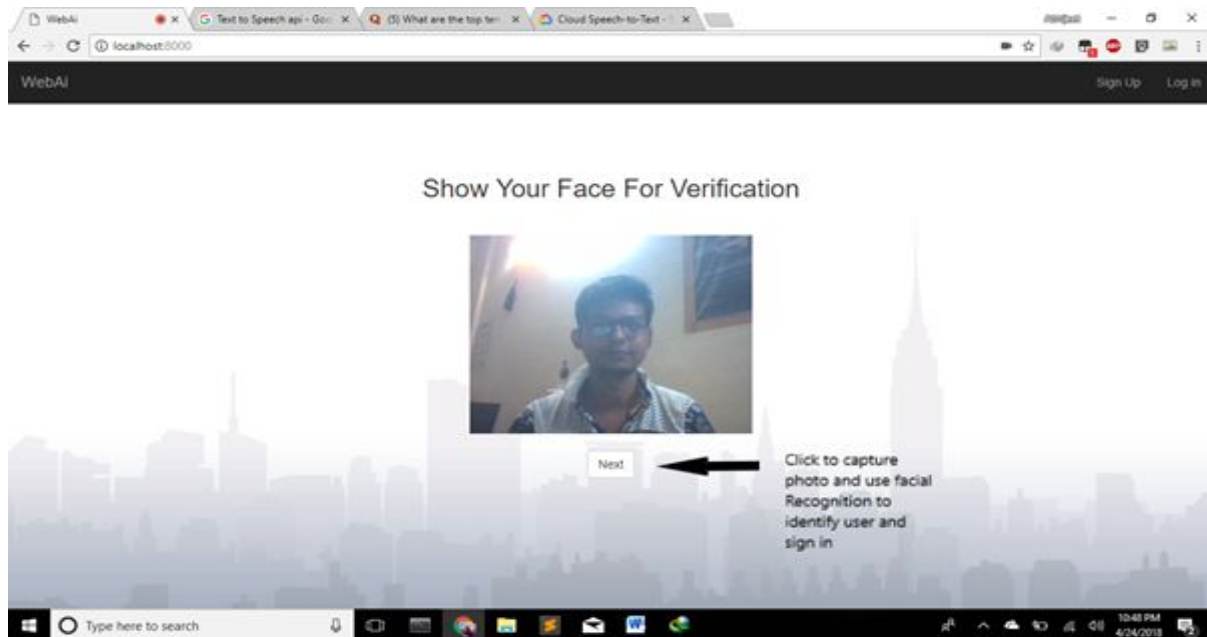


Figure 3.2.1: Face verification interface

3.3 Mood Detection of the user

The system will first capture the image and then pass it for preprocessing. In the pre-processing step, the image goes through pooling process where the image is passed through different filters to enhance different features then it goes to flattening process where the result of previous stage(image) is normalized, then it is passed to Fully connected Convolutional Neural Network. Depending of the emotion of the person. It gives the probability of being happy or sad.


```

22 classifier = Sequential()
23
24 # Step 1 - Convolution
25 classifier.add(Convolution2D(32, 3, 3, input_shape = (64, 64, 3), activation = 'relu'))
26
27 # Step 2 - Pooling
28 classifier.add(MaxPooling2D(pool_size = (2, 2)))
29
30 # Adding a second convolutional layer
31 classifier.add(Convolution2D(32, 3, 3, activation = 'relu'))
32 classifier.add(MaxPooling2D(pool_size = (2, 2)))
33
34 # Step 3 - Flattening
35 classifier.add(Flatten())
36
37 # Step 4 - Full connection
38 classifier.add(Dense(output_dim = 128, activation = 'relu'))
39 classifier.add(Dense(output_dim = 1, activation = 'sigmoid'))
40
41 # Compiling the CNN
42 classifier.compile(optimizer = 'adam', loss = 'binary_crossentropy', metrics = ['accuracy'])
43
44 # Part 2 - Fitting the CNN to the images
45
46 from keras.preprocessing.image import ImageDataGenerator
47
48 train_datagen = ImageDataGenerator(rescale = 1./255,
49                                   shear_range = 0.2,
50                                   zoom_range = 0.2,
51                                   horizontal_flip = True)
52
53 test_datagen = ImageDataGenerator(rescale = 1./255)
54
55 training_set = train_datagen.flow_from_directory('dataset/training_set',
56                                                  target_size = (64, 64),
57                                                  batch_size = 32,
58                                                  class_mode = 'binary')
59
60 test_set = test_datagen.flow_from_directory('dataset/test_set',
61                                             target_size = (64, 64),
62                                             batch_size = 32,
63                                             class_mode = 'binary')

```

Figure3.3.1:Code snippet of mood detector algorithm

3.4 Suggesting songs based on user's mood

Preprocessing is done first by stop-word removal, Porter Stemming and Lemmatization of Lyrics. Label Encoding is done to the 'Mood' field of the song dataset. Then the model is trained. Countvectorizer and Multinomial Naive-Bayes Classifier are used in a pipeline for feature extraction and classifying the songs according to user's mood.

	ACC (%)	PRE (%)	REC (%)	F1 (%)	ROC AUC (%)
Training	94.0	93.47	93.05	93.26	93.91
Validation	68.0	75.95	57.14	65.22	68.57

Figure 3.4.1: Result of music recommender system

3.5 Interaction of user with the chatbot

In addition to the face recognition for signup and mood detection for song recommendation the web application also provides a platform for chatting. Here, the user can interact with the bot for smart talks. The bot can also share jokes. It even provides the facility to query about the weather of any place. These features are achieved using the intents created on the DialogFlow where it trains on the sample input provided by the developer. This model has a huge scope for development. The model can provide more features which can be more accurate and efficient provided the training data is large.

Chapter 4

4.1 How to use

To use the personal assistant, the following steps should be followed:

1. Open the WebAi, for the user interface

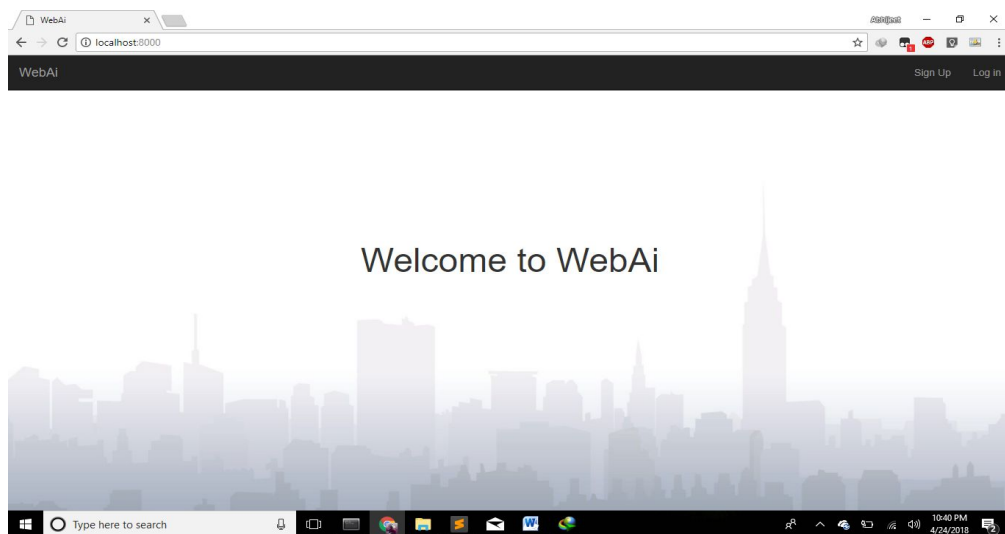


Figure 4.1.1: The interface of web application

2. The web application will prompt "Enter the name" on which you should provide your name for speech to text conversion

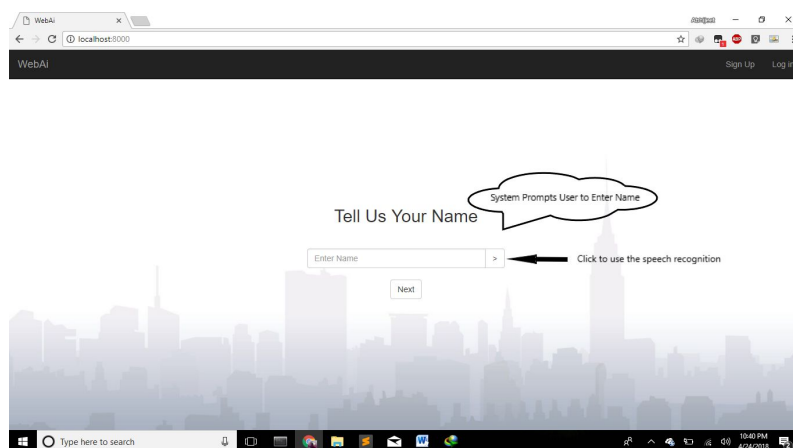


Figure 4.1.2: Interface to provide your name

3. For verification the user's face must be identified and checked.

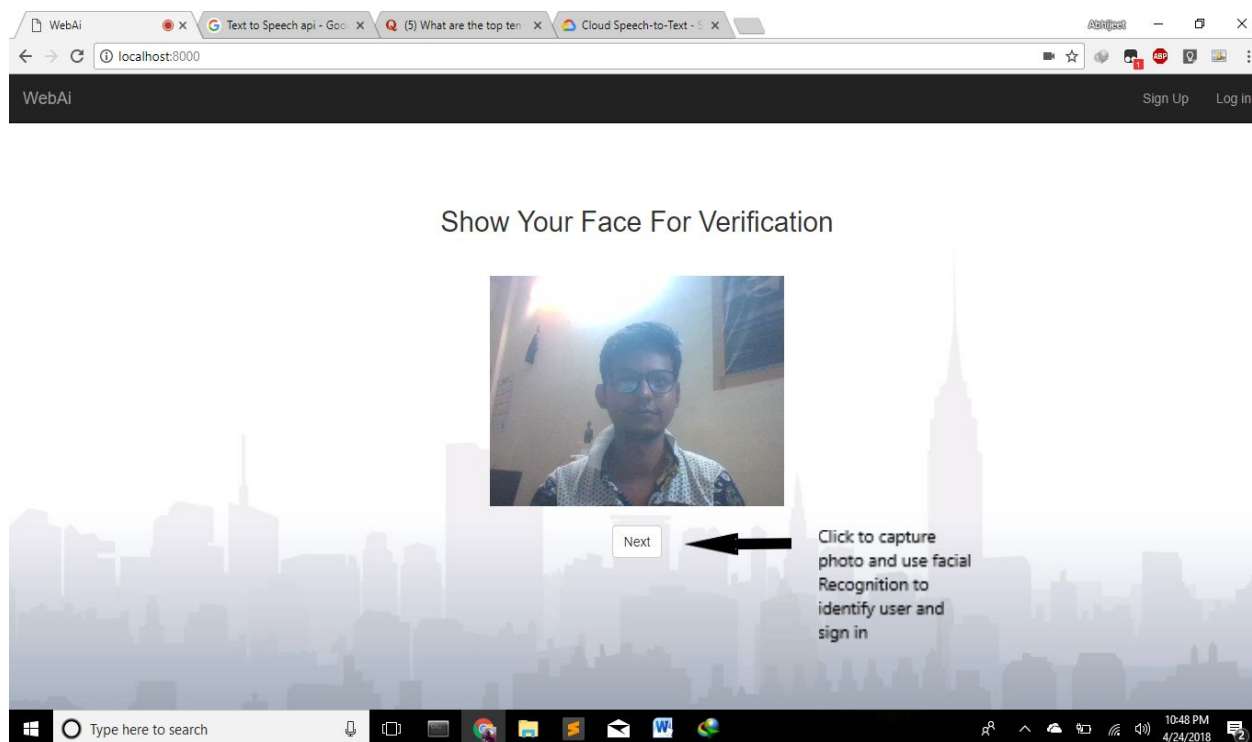


Figure 4.1.3: Using facial recognition to identify the user for sign in

4. For taking the snapshot press the “next” button.

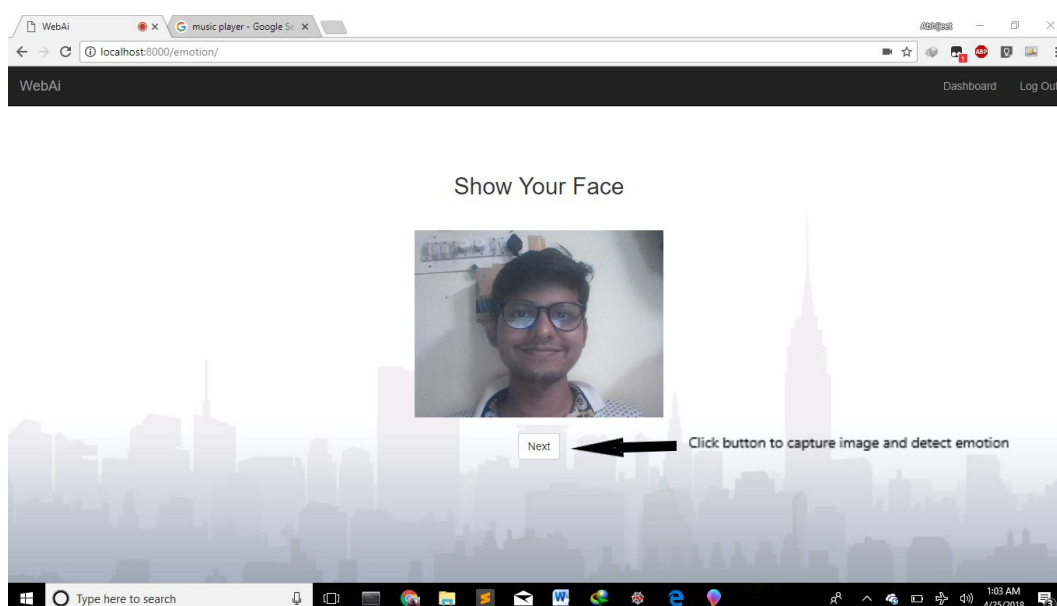


Figure 4.1.4: Snapshot of your face

5. After the snapshot is taken the image is processed and your mood will be identified.

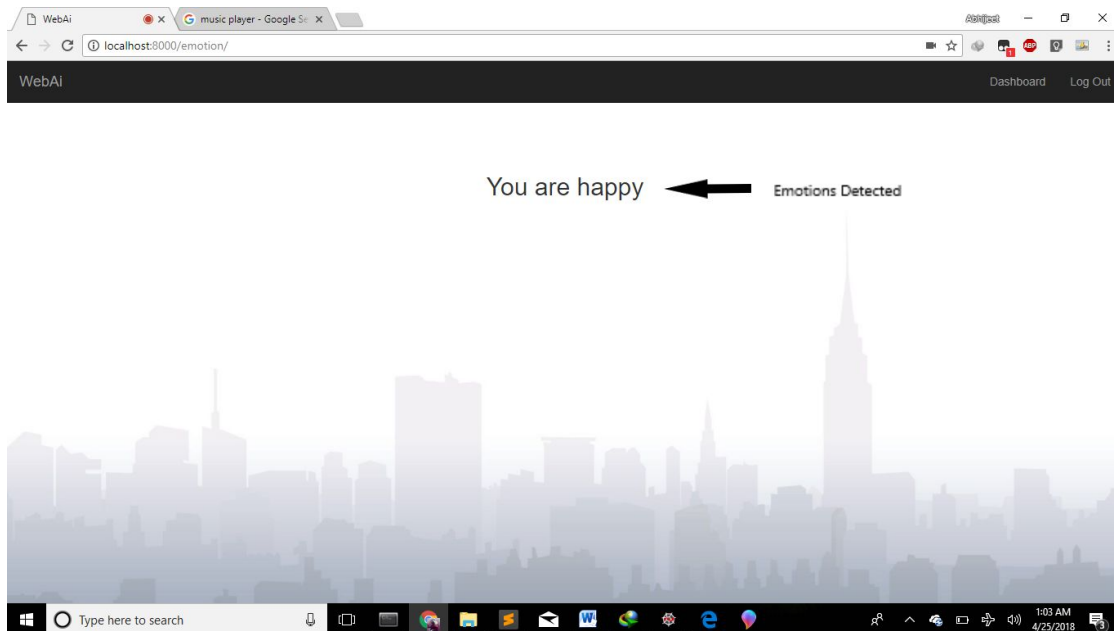


Figure 4.1.5:The mood is detected and shown

6.The Personal Assistant chatbot will appear which will be used to interact with the bot for casual chatting and weather report.

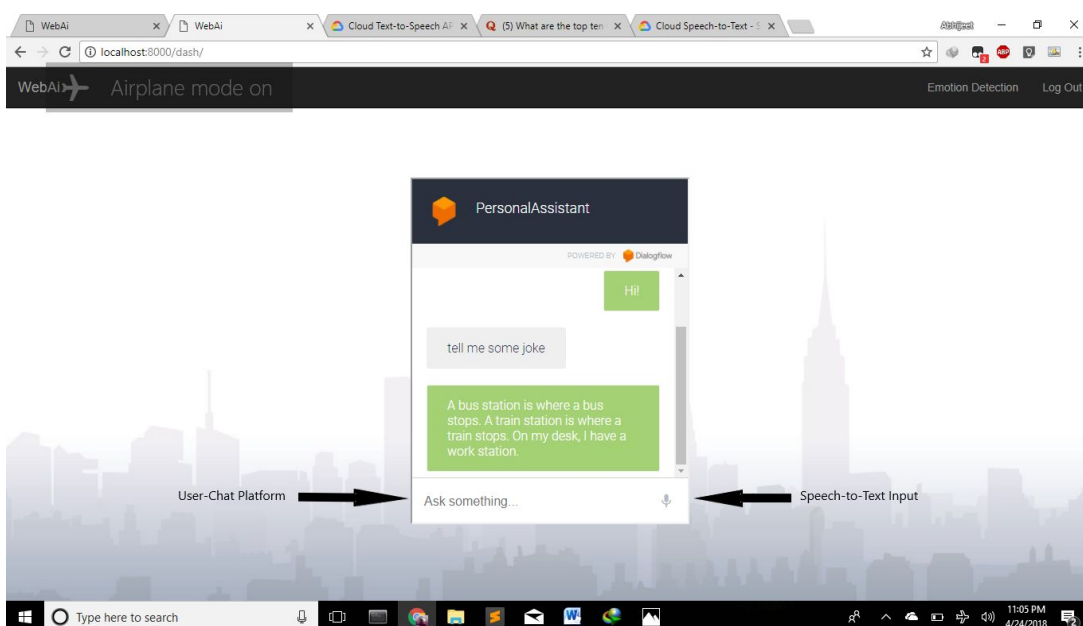


Figure 4.1.6.: The chat box to interact with the Personal Assistant

4.2 Future Developments

- Large facial data, better feature selection and cleaning of data can give more accurate results.
- More emotions including happy and sad can be identified like surprise, worry etc.
- More features like movie recommendation, genre recommendation can be added on the basis of the mood identified.
- More features in the chatbot can be added to make it more realistic and the intents regarding news, food ordering, traffic details etc can be added.

Chapter 5

5.1 Use Cases

1. Cognitive-behavioral therapy: applications for the management of bipolar disorder.

Preliminary data on CBT for BD are promising but more rigorous randomized clinical trials are needed to confirm the efficacy of CBT for BD. An other area of research should be to pursue the understanding of cognitive processes in BD which would allow us to refine and develop CBT interventions unique to this disorder.

2. Applying Cognitive Behavioral Therapy to Promote Positive Change term benefits for various conditions.

A common form of psychotherapy for depression and anxiety, CBT has also become a popular component of programs that seek to address antisocial thoughts and actions, including violence and criminality, substance abuse, and other risky behaviors. Its power stems from the idea that troubled behavior can be traced back to patterns of thought and distorted perceptions that are learned rather than inherent, and therefore have the potential to change.

3. The application of cognitive-behavioral therapy for psychosis in clinical and research settings.

CBT for psychosis conducted in clinical settings was more strongly characterized by assessment of symptoms and work on coping strategies and less so by relapse prevention and schema-level work. Relapse prevention interventions and schema work could be considered more challenging for therapists to undertake. The findings suggest that therapists working in routine clinical settings are able to establish good therapeutic relationships with people with psychosis and to work on assessing and coping with their psychotic symptoms. However, some therapeutic approaches may be more challenging in this context.

5.2 Conclusion

The project was successfully compiled and the mood of respective users were predicted successfully. The music recommender system was successfully able to suggest songs based on classification. The chatbot was able to hold friendly and human-like conversation with the user, predicting the intents and offering various services. Overall, the system was able to provide a user friendly platform for a user and fulfill it's ultimate goal: provide CBT based solutions to users and generate a positive backdrop in the user.

5.3 References

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