Intelligent Counselling System using Artificial Neural Networks

Authors:

Md.Tahmidur Rahman

Anamika Ahmed

Mariyam Begum

Raihan Sultana

Abstract

Adolescence is considered as a critical and crucial stage in human life that requires most parental care, direction, and compassion. This is a transitional stage in physical and mental improvement and most younger ones, especially female, face a lot of problems due to these sudden changes which they find difficult to share with others. The best way to manage requirements and issues at this age is to know about them and be prepared to confront them, and thus, a cross platform application is developed that helps them to talk about their problems and gain knowledge about the remedies. The proposed model is an artificial intelligent (AI) bot that takes in the user input as audio or text depending on how the user wants to share her experience or problem.The human interaction system uses a conversational interface that is nice and smooth to use and uses natural language processing to understand sentences to understand the emotional

content of the speech before suggesting the most effective remedies and initial counselling to cope up with the situation. A data set consisting of fifty cases (conversations between professional counselors and patients) is collected for training and testing the model.Twenty-five attributes are taken in from the user in order to diagnose the specific mental disorders.The three classifiers viz., Multilayer Perceptron, Multiclass Classifier and LAD Tree are used on the set of these attributes in order to produce an accurate diagnosis of the result.The system then analysis the context of the problem it is given, and produces responses accordingly.

Literature Review

In this chapter we would discuss the theoretical and methodological approaches that were established related to voice controlled robotics system. Basavappa S.R. et al. [1] used depth first search method with backward search strategy to diagnose depression or dementia. They developed an expert system using the patient's behavioral, cognitive, emotional symptoms and results of neuropsychological assessments. Pirooznia Mehdi et al. [2] used data mining techniques to find Genome wide Association in Mood Disorders. Six classifiers Support Vector Machine, Bayesian Network, Logistic Regression, Radial-Basis Function, Random Forest and Polygenic Scoring method were being compared. It was found that a simple polygenic score classifier performed much better than others.In [3], Kipli, Kuryati, Abbas Z. Kouzani, and Matthew Joordens detected depression from structural MRI scans to diagnose the mental health of patients. They investigated performances of four Feature Selection algorithms, namely, OneR, SVM, Information Gain (IG) and ReliefF. Finally, they concluded that the SVM Evaluator in combination with Expectation Maximization (EM) classifier and the IG evaluator in combination with Random Tree Classifier have achieved the highest accuracy. It had also been found that the small sample sizes limit the ability to draw firm conclusions.Masri R.Y. and Jani H.M. in [4] proposed a Mental health Diagnostic Expert System to assist the psychologists in diagnosing and treating their mental patients. Three artificial intelligence techniques viz., Rule-Based Reasoning, Fuzzy Logic and Fuzzy-Genetic Algorithm were used for diagnosis and suggestion of treatment plans.Veera Boonjing in [5] used Multi-Layer Perceptron (MLP) with Back Propagation Learning to diagnose Parkinson's disease effectively with reduced number of attributes. Information Gain of all attributes is used as a measure to reduce the number of attributes.Dabek et al. [6] build a Neural Network Model with accuracy of 82.35% to predict the likeness of developing psychological conditions like anxiety, behavioral disorders, post-traumatic stress, and depression disorders.Besides, there are several chatbots designed to help the user overcome depression.Joy is a chatbot which takes care of one's mental health. Joy sends daily check-ins, asking "How you feel?" and "What you did that day?". Joy then uses the response to interpret the mood and respond appropriately. Joy uses a generic corpus provided by IBM Watson and Microsoft LUIS to understand the intent and give responses.[7] -Brisbot is a chat bot that gives answers and advice to many of the questions and problems that children face today. Brisbot is loaded with hundreds of questions from kids, with answers written by counselors. Brisbot does not respond to open questions, instead the user will navigate through pre-programmed professional advice.[8]

Comparing all these mentioned cases, we see that there are several efforts made in computerizing the diagnosis of mental health disorders, but not many, to perform efficient counselling for the user.That is why, we have proposed an user-friendly system that is feasible and intelligent enough to both diagnose and counsel the patient regarding some specific mental disorders, and

we believe our approach would bridge the gap between computerized and live therapy from any professional psychiatrist.

System Implementation

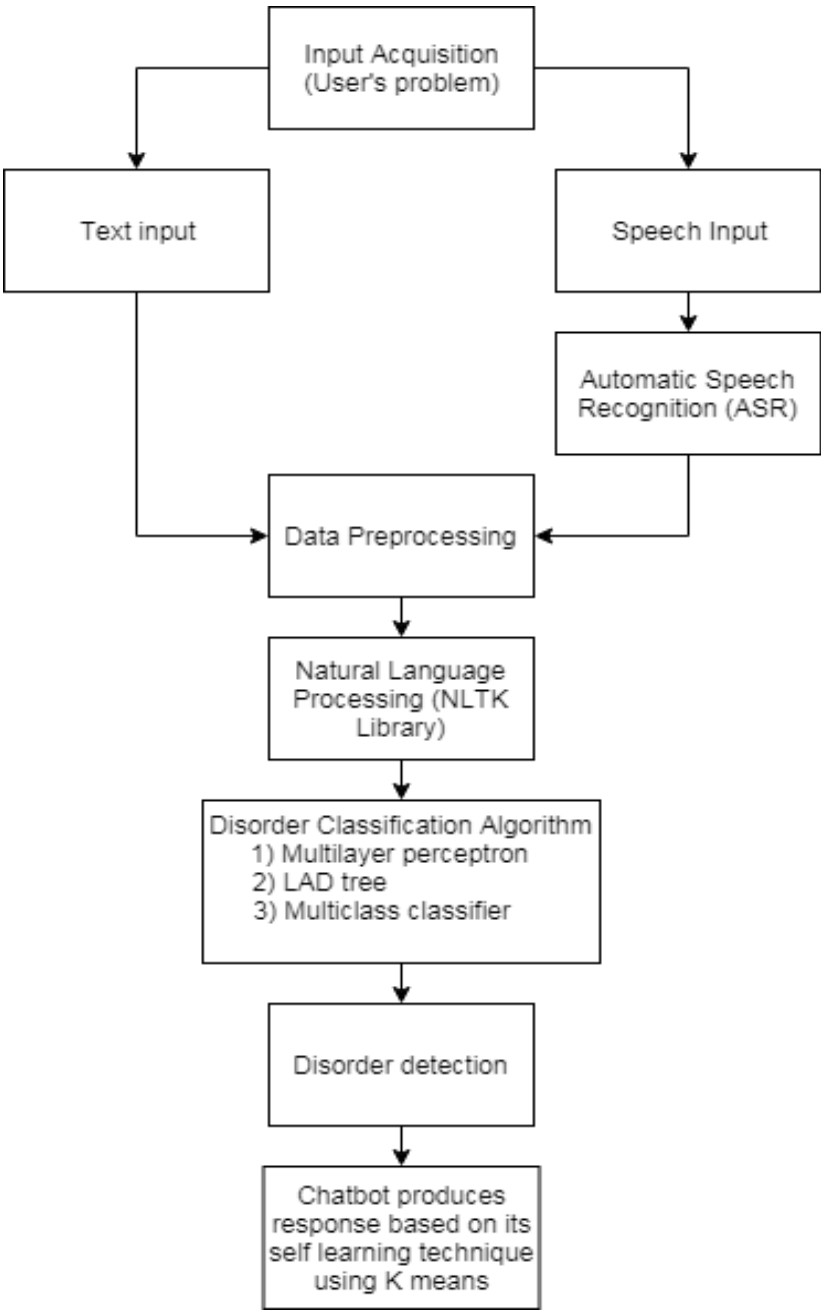


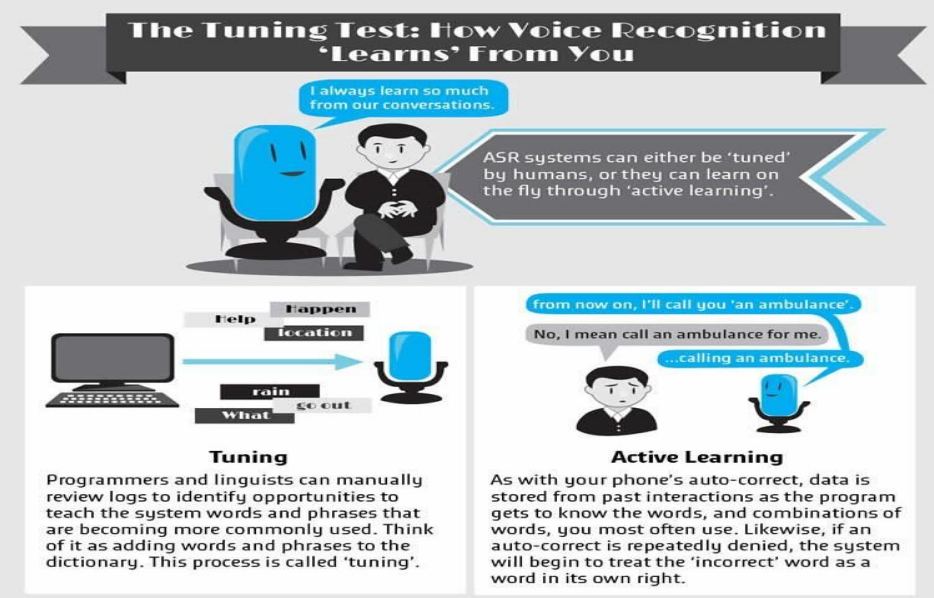
Figure: Proposed Model of our Counselling System

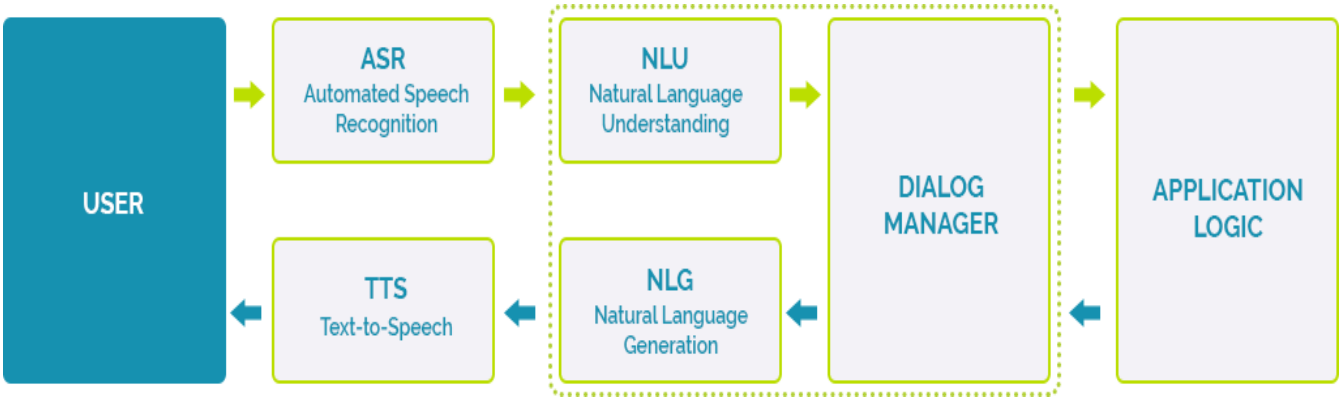
Processing the user's input accurately:

In order to convert an input speech to text, we would be using Natural Language Processing (NLP) and Actual Speech Recognition (ASR). When an audio input is taken, audio sampling takes place and it further undergoes feature extraction. Feature extraction uses Artificial Neural Networks and hidden Markov models algorithms. Later, the actual speech recognition is done to convert it to text and this is carried out by the technology known as Automatic Speech Recognition or ASR, as it's known in short. It helps humans to carry out a conversation using their voice, in it's most sophisticated variations, which resembles like normal human conversations. ASR takes the acoustic signal as an input and tries to determine which words were actually spoken. After receiving the output from the speech recognizer (ASR – automated speech recognition), it is then responded through the speech synthesizer (TTS – text-to-speech) which makes use of Natural Language Processing or NLP techniques.

Firstly, ASR software take audio inputs and create wave files to of the words. The wave files are then normalised by removing the background noises. These resulting filtered wave files are then broken down into phonemes. Phonemes are the basic building block sounds of language and words. English has 44 of them, consisting of sound blocks such as "wh", "th", "ka" and "t". Each phoneme is like a chain and they are analyzed in a sequence , starting from the first phoneme to the next. ASR software uses statistical probability to derive whole words and then derive complete sentences from there. Now the ASR has the "understood" words which results in meaningful sentences.
There are two types of variant softwares, one is directed dialogue conversations and the other is natural language conversations (the same thing as NLP). Directed dialogue conversation consists of machine with interfaces where the user is provided with limited number of choices and the users have to respond with a specific word thus , narrowing down the user's narrowly defined request. Automated telephone banking is one of the examples of these systems. Whereas, natural language conversation are the most sophisticated variants of ASR as they focus on carrying out a real conversation with the users by providing them an open chat instead of heavily limited menus of words the users may use. Siri , used in the ios devices is one of the best examples of these systems.

In NLP, the system is designed to act to a much smaller list of selected "tagged" keywords that give context to longer requests. Contextual clues help in narrowing down what exactly the user is telling and respond to it adequately. Active learning is tried with NLP versions of speech learning. Here the system is trained by exposing the system to new words and vocabularies , resulting in unlimited growing knowledge of the advance languages. It gets adapted very well compared to other systems.
There are various libraries that provide the algorithmic building blocks of NLP in real-world applications. The one we are using for our thesis project is Natural Language Toolkit (NLTK). It is a Python library that provides modules for processing text, classifying, tokenizing, stemming, tagging, parsing, and more.





Diagnosing the psychological disorder:

We will be training our system with large set of data, that will contain a huge number of attributes for instance age, family history, delayed speech, academic performance, behavioral problems, concentration, restlessness, learning difficulties etc. At first we need to preprocess the data, since there might be redundant and irrelevant attributes in our dataset that might not be useful for us in predicting the disorder. Preprocessing will remove the unwanted attributes and keep the best attributes only. We will use best first search technique in order to do this. Once the data is prepared, we will use classification algorithms that will help our system to learn from the given data and hence identify which category of psychological disorder a particular feature belongs to. There are plenty of classification techniques available in machine learning. However we will use the three most accurate techniques that are multilayer perceptron (MLP), LAD (Logical analysis of data) tree and multiclass classifier.
Multilayer perceptron: This technique is a class of feed forward artificial neural network. It consist of at least three layers of nodes. It uses supervised technique called back propagation for training a system. It can also distinguish data that is not linearly separable.

LAD tree technique: This technique applies logistic strategy and creates multiclass alternating decision tree. Every observation consists of vector of attribute values and its outcome.
Multiclass classifier: In this technique each training point belongs to one of X different classes. The aim is to construct a function, so that when a new data point is given, it can predict to which class it will belong.
After implementing the three methods separately, we will find out which approach gives higher accuracy. In order to measure the accuracy of prediction, we will use three methods that are Kappa statistic, ROC area and accuracy technique. [9]

Counselling the patient:

The chatbots is fed with a training dataset and after learning on its own for a while it will be able to generate its own answers and interpret what the user is trying to say more accurately. The bot will respond appropriately to get to know more about the user by asking several questions like "What is the problem from your viewpoint?" and after analysing data from the user, it will give the responses based on the pre-trained data from the training dataset.

Psychiatrist: Yes, we can talk about anything you want
Patient: I hear voices you know
Psychiatrist: Really? What are they saying?
Patient: That I should hijack a plane and fly into Atlantic Ocean. I am tired of my life.

Training Dataset Example: Conversation between a professional psychiatrist and a patient.

Conclusion and Future Implementation

Nowadays, several models are being made to diagnose psychological problems using machine learning techniques, and we believe. As a number of machine learning techniques are available to construct expert systems, it is necessary to compare them and identify the best that suits the domain of interest. Our model is an expert counsellor system that has been developed for predicting the mental health problems at an early stage and providing efficient solutions (using machine learning techniques) like professional psychiatrists. In future we are planning to implement machine translation in order to translate languages to "target language". Our second motive is applying accent recognition algorithms while taking user input. We would also expand our database to train our model to produce more accurate responses to the patient regardless of their age, gender or trauma.

References

[1] SR Basavappa, SL Rao, et al. Expert system for dementia or depression diagnosis. NIMHANS Journal 1996; 14: 99-106.

[2] 14. P Mehdi, F Seifuddin, et al. Data mining approaches for genome-wide association of mood disorders. Psychiatric genetics 2012; 22: 55-61.

[3] Kipli, Kuryati, Abbas Z. Kouzani, and Isredza Rahmi A. Hamid. "Investigating machine learning techniques for detection of depression using structural MRI volumetric features." International journal of bioscience, biochemistry and bioinformatics 3.5 (2013): 444-448.

[4] Rahman, Rashedur M., and Farhana Afroz. "Comparison of various classification techniques using different data mining tools for diabetes diagnosis." Journal of Software Engineering and Applications 6.03 (2013): 85.

[5] Gil, David, and M. A. G. N. U. S. Johnson. "Diagnosing parkinson by using artificial neural networks and support vector machines." Global Journal of Computer Science and Technology 9.4 (2009): 63-71.

[6] Gomuła, Jerzy, Krzysztof Pancerz, and Jarosław Szkoła. "Classification of MMPI profiles of patients with mental disorders–experiments with attribute reduction and extension." Rough Set and Knowledge Technology. Springer Berlin Heidelberg, 2010. 411-418.

[7] Seixas, Flávio Luiz, et al. "A Bayesian network decision model for supporting the diagnosis of dementia, Alzheimer′ s disease and mild cognitive impairment." Computers in biology and medicine 51 (2014): 140-158.

[8] D Razzouk, JJ Mari, et al. Decision support system for the diagnosis of schizophrenia disorders. Brazilian Journal of Medical and Biological Research 2006; 39: 119-128.

[9] M.R, S., & Poorna, B. (2016). Prediction of Mental Health Problems Among. (IJACSA) International Journal of Advanced Computer Science and Applications, No.1.