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D-REHABIA: A Drug Addiction Recovery Through Mobile Based Application

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Abstract—Drug addiction has become a major issue in the world. There are certain governmental and non-governmental organizations which provide various programs to prevent, recover and rehabilitate drug addicts. The patients who are in the recovery process have a higher tendency of relapsing after being released to the society. The objective of this research is to produce a mobile based Drug Recovery Application and prevent patients from relapsing during the recovery process and to involve both family and rehabilitation center to the recovery of the patient. In order to accomplish this objective, the application contains an artificial intelligent assistant which will guide/help the patient regarding issues occurred during the recovery process, a location tracking mechanism to identify the movements of the patient and possible high risk places where drugs can circulate, a voice analysis mechanism to analyze the voice of the patient and identify emotional states which might cause the patient to relapse and treatments to reduce the stress, anxiety and depression level of the patient. The field of drug rehabilitation has been barely addressed via a proper technological solution, hence the system implemented as the result of this research can be effectively used for the recovery of the patient.

I. INTRODUCTION

Drug addiction is a long lasting and a relapsing brain disease which causes indispensable drug seeking and use, regardless of the harmful consequences which can affect the drug addict and the people around them [1].

Drug addiction can be mainly seen as a brain disease because continuous drug usage can lead to structural and functional changes of the brain. This repeating drug usage often affect the self control of the drug addict, potential of making decisions and also continuously increases the cravings to take drugs again and again. With the person taking drugs on a continuous basis, this becomes a habit. The main intention and the goal of drug rehabilitation is to teach the patient the methodology of breaking this habit.

Successful treatment programs typically consists of many components, such as aiding the drug addict to stop using drugs and maintain a sober lifestyle (help to break the habit of taking drugs), strengthen family relationships, guide the patient on facing the problems of day to day life (taking decisions, controlling emotions, managing time/money etc.), provide medication and treatments to patients who suffer from mental disorders during the rehabilitation process [2]. Since

addiction is often a chronic disease, drug addicted patients cannot simply stop using drugs within several days and be cured. Most of the drug addicted patients require long-lasting or repeated episodes of treatment to achieve the final goal of sustained abstinence and recovery of their lives [3]. Behavioral treatments are used as a significant tool to modify the attitudes and behaviors related to drug addiction, and to increase healthy life skills. Mainly there are two mechanisms used which comes under behavioral treatments.

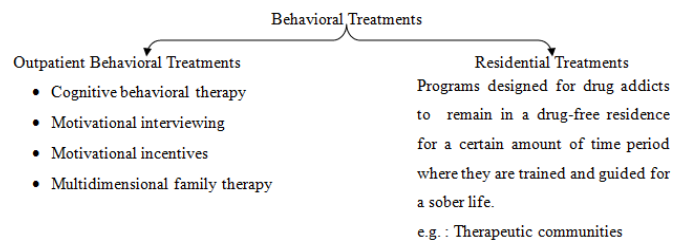


Fig. 1: Common Treatments Used

Among these treatment mechanisms used, cognitive behavioral therapy is considered as a highly effective and a successful approach which helps the drug addicts to identify, abstain, and deal with the conditions where they are most likely to abuse drugs [4-6].

The major issue in drug rehabilitation is when patients are released to the society after the rehabilitation process, there is a higher probability of them using drugs again [7]. This happens due to various reasons such as the patient getting the freedom of doing what they desire, the communication, guidance, monitoring of the rehabilitation center with the patient is getting weak, meeting old drug using friends and visiting the places where they tend to use/buy drugs, having difficulties in acquiring the rightful place in the family etc.

This research addresses the mentioned issues and guide the patient with the help of patient's family, rehabilitation center and also through self-realization.

The system comprises of two applications, a mobile based solution and a web based solution. While the mobile solution guides the patient, the web application keeps the family members and rehabilitation center updated about the patient.

The mobile application acts as an assistant for the patient. The patient is able to talk with the application during the recovery process and discuss basic matters with the application. The application provides suitable responses and guide, advice the patient and provide treatment suggestions

depending on the status of the patient. The assistant mainly covers following areas when it comes to advising and guiding.

- Problems regarding family relationships
- Controlling emotions (anger, sadness, happiness etc.)
- Time management
- Income (money) management
- Problems regarding sexual life
- Moving with friends

Fig. 2: Areas addressed by the AI Assistant

The human voice is able to transmit information regarding emotions (eroticism, sadness, tenderness, fear, anger, and happiness) of the speaker [8]. The aim of voice analysis mechanism is focused on examining how a drug addict's emotional expressions are encoded in the speech. For an example the fundamental frequency of the voice is closely tied with emotions of the patient [9]. The focus of this study is to analyze the voice of drug addicts and determine whether they have taken drugs by considering emotional expressions [10]. By analyzing the voice of the patient, a report is generated regarding the emotional state and it is sent to the web application so that the rehabilitation center and family members can analyze and identify the state of the patient.

The location tracking mechanism gathers location specific data by using GPS (Global Positioning System) such as latitude, longitude, time spent etc. From those data the application identifies the places visited by the patient. Upon receiving sufficient amount of location specific data, the mobile application sends them to the server side. The server clusters the data and from that, deviations of the user from the normal travelling pattern are identified. Then all the deviations of all the users who use the application are clustered and the clusters with a higher density are considered as the possible high risk places where drugs can possibly circulate. Based on these high risk places a report is generated and it is sent to the web application so that the rehabilitation center can take necessary actions. Additionally there is the option provided for the patients to view the places that they have visited and the time spent on each of those locations, so that they can gain self understanding about the places they have visited and how they have spent time on each of those locations.

The patient might come across mental issues during the recovery process, such as increase of stress, anxiety, depression. The application provides mechanisms to calm down the nerves of the patient and help them to stay sober. Those treatments includes breathing exercises [11] and relaxation games implemented by mapping cognitive behavioral therapy [12] characteristics.

The web based solution is used by the family members of the patient and the rehabilitation center. The family members can login to the system and view certain reports generated by the mobile application about the patient, report any unusual behavior, symptoms, problems regarding the patient to the rehabilitation center.

Personals at the rehabilitation center are also capable of accessing all the records sent regarding the patients, analyze them, so that they can guide, advice the patients in a better manner.

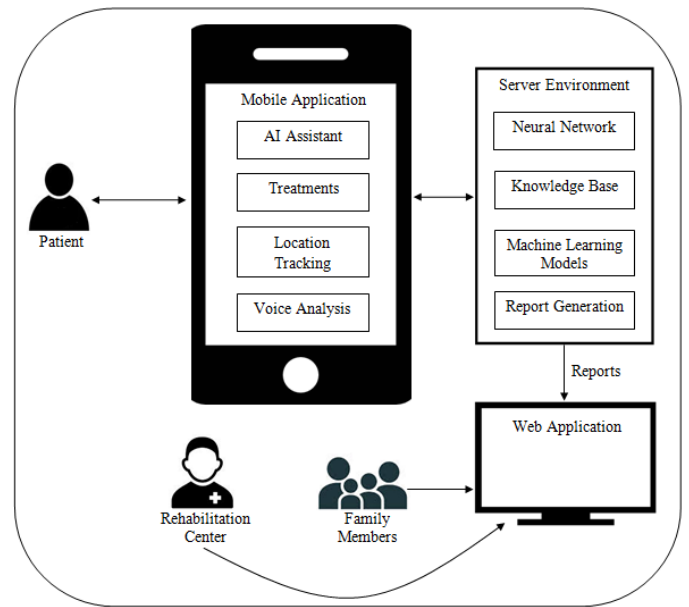


Fig. 3: Overview of the System

II. ARTIFICIAL INTELLIGENT ASSISTANT

The patients can chat or speak with the AI assistant regarding their issues during the recovery process. The assistant contains the knowledge regarding six areas as mentioned in Fig 2. It is mainly used to solve the basic issues of the patients by providing solutions for them. Also it is effectively used as a companion to reduce loneliness and feelings of isolation of the patient.

The assistant was implemented by using the bot libre open source android sdk [13]. For the purpose of representing the knowledge of the assistant AIML (Artificial Intelligence Markup Language) was used.

A. Operations of the assistant

The user can either use text messages or voice messages to chat with the assistant. The assistant processes the user input by setting a semantic interpretation to the user request. Then this semantic interpretation is sent to the knowledge base and it is mapped against the AIML scripts deployed in the server. Through this mapping a proper response is identified and that identified response is sent back to the mobile application.

The knowledge base of the AI assistant is comprised with scripts written in AIML. By using AIML, knowledge regarding the six areas mentioned in Fig 2 is represented. These scripts contain proper responses for the semantic interpretations sent by the mobile application.

B. Finding a semantic interpretation

The process of finding a semantic interpretation is done via the local storage of the mobile device. First the application breaks the user input into words separated by spaces and these words are matched with a pool of words available in the local storage. With those pre-defined words there is an integer value which defines the number of matches which needs to be satisfied in order to provide a semantic interpretation. If the words match and the number of matches are greater than or equal to the declared integer value, the mechanism picks the semantic interpretation associated with those data.

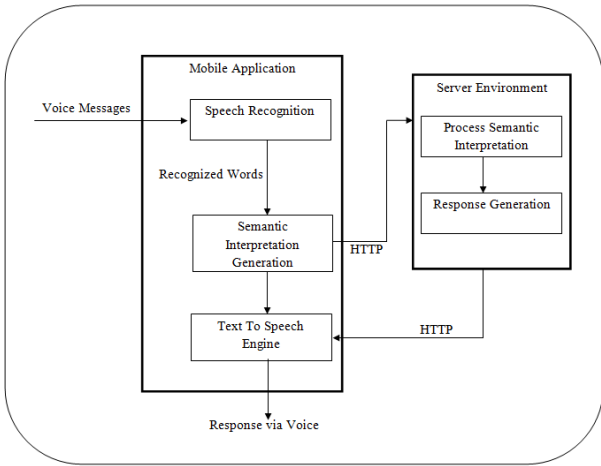


Fig. 4: Basic Flow of AI Assistant

III. LOCATION TRACKING MECHANISM

Location tracking mechanism gathers GPS data in every 5 seconds and calculates the time spent on each location the user visits. This mechanism uses Google map API for its operations. This process gathers the location specific data and those data are being added to the local storage. Upon reaching the level of 500 records, all the records in the local storage are written to a file and it is transferred to the server. Upon successfully sending the data, records in the local storage are erased so that the memory utilization is optimized.

Upon gathering sufficient amount of location specific data the application clusters the data and deviations of the user from the normal travelling pattern are identified. To identify these deviations, the application uses SPMF, java open source data mining library [14] and DBScan clustering algorithm [15]. Then all the deviations of all the users who use the application are clustered and the clusters with a higher density are considered as the possible high risk places where drugs can possibly circulate. Apart from identifying high risk places the application supports to identify whether there is any significant deviation of the user from their normal travelling pattern [16].

The generic pattern for the movements is updated every week. These generic patterns of all the patients are matched against each other to identify high risk places (possible places where drugs can circulate) as well.

Upon completing these operations a report is generated with the information generated and it is sent to the web application for the use of rehabilitation center and family members of the patient.

Additionally there is an option provided for the patients to check the places visited by them within a day. Patients can view the places visited and the time spent on each of those locations which can effectively be used as a self learning/self realization [17] technique.

IV. VOICE ANALYSIS MECHANISM

The voice analysis mechanism was developed using freely available source code which is developed by Na Yang, Jianbo Yuan, and Yun Zhou, University of Rochester [19]. This component runs as a background process of the patient's mobile device and it extracts patient's voice features time to time when the patient is speaking with the application. Those

features are sent to the server and fed into the neural network to identify the emotional state of the patient. The system generates a report regarding the emotional state of the patient and it is sent to the web application.

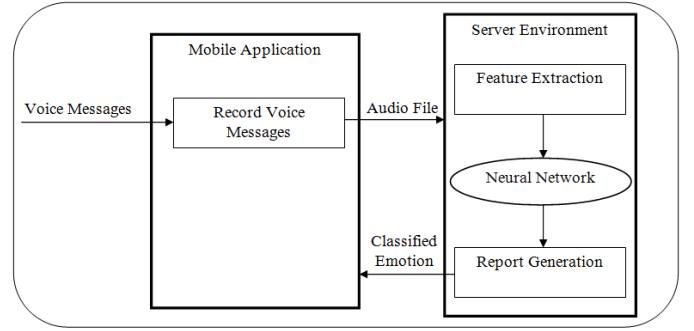


Fig. 5: Basic Flow of Voice Analysis Mechanism

A. Feature extraction

Feature extraction focuses on extracting the statistics of speech features from audio files which are sent through the mobile device. Data with and without speaker normalization are both generated. Each individual speech file contains extracted speech features and de-normalize features the audio file. The speech features include energy, energy difference, formant frequency and bandwidth, pith, pitch difference, 12 MFCCs, and speaking rate. In this feature extraction phase, pitch is calculate by using the BaNa algorithm [20].

B. Dataset Generation

This generates data sets for training and testing purposes. Extracted features are scaled and written to different data files. Entire data set which was obtained from the feature extraction phase was divided into training and testing data sets for further use.

C. Emotion Classification Using Multiclass SVM

Using the generated data sets, multiclass classifiers were trained and by applying One-Against-All (OAA) approach [21], the classifiers were combined together as a single classifier. The classifier calculates results for the six emotions, anger, disgust, fear, happy, neutral and sadness. Then depending on the largest confidence value among the SVM classes it predicts the correct emotion.

V. TREATMENTS

The application focuses on three mentalities of the user, stress, depression and anxiety. Once the patient is in either of the these three conditions, they might not be able understand/judge what is best for them. Hence the application analyses the patient's condition by requesting the patient to answer a simple questionnaire [23-24] provided by the system and decide the most suitable solution for the patient to reduce or overcome the negative mentality which is causing problems. The user needs to state 'Yes' or 'No' as the answers for the questions.

The application provides three games to reduce the three negative mentalities, stress, anxiety and depression. The 'Word Game' is focused on reducing the depression level of the patient. The user is provided with a description and asked to guess the word that suits best for the description provided. Six attempts are given to the patient and the patient is

provided with facilities to check whether the word leads to a correct one. If the entered word is correct patient can proceed. In this manner the patients are made to think of positive words (e.g. : love, warmth, affection) [25-27] so that their brain tends to look in to positivity thus reduces the depression of the user. This game is implemented based on the psychological principle called 'Activation' [28-31].

The 'Smile Game' focuses on reducing level of anxiety of the patient while following the psychological principle, 'Inhibition' [32] which is defined as 'a feeling that makes one self-conscious and unable to act in a relaxed and natural way' [33]. In this game the patient is provided with an avatar. In order to score, the avatar should be moved so that it could catch smiling faces. Here there are some angry faces appearing which the patient should avoid. If the angry faces are being collected, the score will be reduced. The users are made to focus on happy feelings by making them to concentrate on smiling faces. This approach gradually develops positivity and reduces anxiousness since the mentality of a person can be changed depending on the things that they see [34].

The 'Shape Game' is focused on reducing the level of stress of the patient. The patient is encouraged to focus on one task so that the facts that causes stress to the patient are forgotten. The application provides different shapes with different sizes in a way as they are falling down from the top of the mobile device, which allows the user to have enough time to think and move the shapes and arrange them in an orderly manner. More the user arranges the shapes more the score is increased.

The games are implemented in a way that would attract the users. The interfaces are designed with cheerful colors and thus looking at these interfaces could implant positive/cheerful feelings within the patient [35-36]. These games helps the patients to transform their negative mentalities into positive ones even without knowing that they are actually being treated.

Apart from the above three games, the application also provides a mechanism for the patients to practice meditation. Meditation is a very effective way of reducing negative mentalities [38] of patients and it helps them to control their feelings. The application helps the patients to practice a breathing exercise which is one of the basic meditation technique. In order to help the patients, the application provides very calm music which is played in the background where the they can first focus in to the music and then gradually practice the breathing exercise [37], [39], [40].

VI. CONCLUSION

The field of drug rehabilitation and recovery has not been addressed with a proper, complete solution using novel technology similar the research conducted. In this research the conventional recovery treatments have been combined with technology to produce a mobile based solution. This could effectively be used for the recovery of drug addicted patients. The application introduced is expected to achieve a higher rate of recovery of the patient from drug addiction and also to identify possible high risk places where drugs can circulate.

The patients will have the access to use the application and the services provided when they need them at most. With AI assistant there is the option of solving the basic issues of the patients regarding the six areas mentioned in Fig 2. The

treatment mechanisms provided is used to reduce the level of stress, anxiety and depression level of the patients. In order to provide effective monitoring of the patients, the location tracking mechanism identifies the places visited and high risk places while the voice analysis mechanism analyzes the voice of the patients to identify their emotional states. Using these mechanisms the probability of patients being relapsed is reduced effectively. The web based system is used by the rehabilitation center and family members, so they could monitor/guide the patients towards complete recovery.

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