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Rehab 360: Your Intelligent Companion in Addiction Recovery

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Abstract:
To assist people retain good behavioural patterns and lower their risk of relapse, addiction rehabilitation necessitates ongoing observation, emotional support, and direction. Outside of hospital settings, traditional rehabilitation methods frequently lack individualised support and real-time monitoring. This study proposes the development of an AI-based addiction recovery support system that employs AI techniques to assist users in managing the recovery process in order to overcome the aforementioned limitation.

This system will be composed of several intelligent system components, including activity recommendation systems, emotion-aware chatbots, and sleep quality evaluation systems. This will help users input their information through the system's user-friendly interface about their activities, sleep quality, and mental state. It will then analyse the data and provide insightful information to assist users in the recovery process. While the sleep analysis module assesses sleep patterns and presents findings to assist users in improving the quality of their sleep, the chatbot offers conversational assistance and inspirational responses. In order to encourage positive behavioural changes, the activity recommendation system also makes appropriate activity suggestions based on the user's mood and free time. In order to improve user interaction, the system incorporates natural language processing techniques and is constructed utilising a web-based architecture with FastAPI backend services. The outcomes show that the system can successfully offer behavioural insights, emotional support, and tailored guidance to aid in addiction treatment. All things considered, the suggested remedy demonstrates the potential of artificial intelligence to offer ongoing digital assistance to those undertaking rehabilitation and enhancing their general wellbeing.

Keywords —Artificial Intelligence, Addiction Recovery, Emotion-Aware Chatbot, Sleep Quality Analysis, Activity Recommendation System, Natural Language Processing

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I. INTRODUCTION

To assist individuals on their journey to recovery, this research proposes an AI-driven support system for the addiction recovery process that integrates machine learning techniques, behavioral data analysis, and conversational AI. The system is designed to predict relapse probabilities and craving levels by tracking various user inputs such as mood, sleep quality, stress levels, and behavioral trends. Furthermore, it provides tailored recommendations for healthy activities, motivational messages, and emotional support through an AI-enhanced chatbot.

The advancement of artificial intelligence (AI) and conventional machine learning (ML) has made it feasible to develop intelligent technologies that can monitor behavioral trends, assess user data, and provide customized recommendations to improve health outcomes. AI-driven tools can help identify patterns in general stress levels, mood, sleep habits, and behaviors that may indicate an increased risk of relapse. By analyzing these elements, these systems can deliver timely interventions, motivational assistance, and tailored recovery plans specific to each individual.

The proposed system employs a microservice architecture utilizing the FastAPI framework to manage various tasks, including identifying relapse risks, predicting craving intensities, conducting standard sentiment analysis, analyzing crises, and creating recommendations. To detect unusual behavioral patterns that may signify an increased risk of relapse, the system applies anomaly detection techniques alongside other recognized machine learning algorithms.

By integrating behavioral analytics, predictive modeling, and AI-driven engagement, the system aims to provide continuous monitoring, early identification of risks, and tailored recovery support. This approach has the potential to

enhance recovery outcomes for individuals in addiction treatment, reduce relapse rates, and deliver scalable online assistance.

II. LITRATURE SURVEY

A complicated and multi-dimensional process including psychological, social, and behavioral components, addiction recovery is Many studies have looked at several facets of addiction recovery as well as the ways people are helped to maintain long-term abstinence. In qualitative analysis, Dekkers et al. [1] studied the essential requirements for successful recovery from addiction and identified significant requirements for recovery, such as social support, personal motivation, and recovery routes. The results of the study imply that the type of treatment, whether through assistance or independent methods of recovery, could significantly influence the results of the recovery process.

The results of addictive behaviors and recovery are significantly dependent on emotional control and regulation. Emotional regulation difficulties in people with addictive behaviors, as Henden [2] states, can interfere with personal independence and decision-making ability, thus affecting the recovery process. In addition, Giacolini et al. [9] discuss the brain's emotional system and its contribution to addictive behaviors and recovery processes, including emotional attachment, stress, and behavioral dominance.

Furthermore greatly helping addiction recovery are social contact and peer support. Gauthier et al. [3] examined addiction recovery conversations on internet forums thematically and noted that peer groups offer emotional support, responsibility, and shared experiences to help people in recovery. Key elements of recovery support groups that help people sustain long-term sobriety were also found by Rettie et al. [7]: emotional sharing, organized group exercises, and collective motivation.

In addiction recovery studies, therapeutic methods have also been thoroughly investigated. Ogilvie and Carson [4] examined positive addiction rehabilitation therapy and discovered that behavioral change and positive reinforcement-focused psychological therapies might greatly improve recovery results. As an effective treatment strategy, Garland [10] suggested that developing good emotional experiences and self-transcendent significance might help people to stop addicting habits by fostering positive emotional control.

Beside emotional elements, sociological and psychological influences are also rather significant in addiction rehabilitation. Investigating the development of emotional intelligence in people with substance addiction, Smokova et al. [5] discovered that better emotional awareness and emotional control may help to enhance recovery results. Further investigating addiction recovery among women receiving opioid treatment, Martin et al. [6] emphasized the need of social, familial, and medical support networks in keeping stability.

From a neurological standpoint, Wiers and Verschure [8] advocated a systems-based strategy to addiction recovery emphasizing neurorehabilitation of brain processes impacted by addiction. Their study indicates that successfully recovering cognitive control and decision-making skills depends on treating both neurological and behavioral elements.

III. SYSTEM ARCHITECTURE

All In order to help people recover from addiction, the suggested AI-based addiction recovery support system combines machine learning models, natural language processing, and a recommendation engine in a modular and scalable architecture. Data gathering, processing, prediction, and response generation are all handled by the system architecture's many interconnected levels.

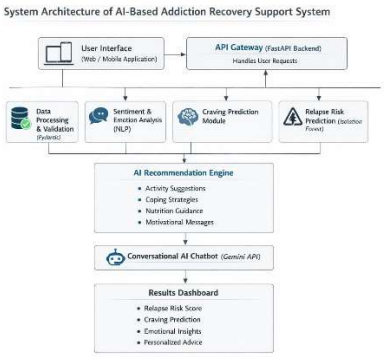

Fig. 1 System Architecture

A. User Interface Layer

The user interface layer, which facilitates the communication between the users and the system, is the first layer in the architecture. An online/mobile application through which the users can input their states of emotional and behavioral states can be used in the development of the user interface layer. States of information such as the mood of the user, stress, sleep quality, cravings, and recovery can be inputted into the system. Additionally, the system's output such as the risk forecast of the relapse, the forecast of the cravings, the emotional states, and the recovery can be shown in the user interface layer.

B. Backend Layer and API

FastAPI is used in the development of the system's backend, which is also an API gateway that handles the interaction between the AI modules and the interface. This part handles the requests from the users, and the actual processing is done using the appropriate APIs, after which the results are sent to the interface. FastAPI was chosen because it is very efficient, asynchronous, and can be used in deploying machine learning services.

C. Layer of Data Processing and Validation

Data collected from the users goes through a process of pre-processing as well as validation before the prediction models are used. This process helps in ensuring consistency as well as organization of the data provided for the purpose of analysis. Pydantic models are used during the validation of the data, ensuring consistency in the data provided. Normalisation, as well as the extraction of features, are part of the pre-processing

of the data.

D. Prediction Layer for Machine Learning

The analysis of behavioural patterns and forecasting of the risk of relapse is performed by the machine learning layer of the system. To detect unusual behavioural patterns that may indicate a higher risk of relapse, the system utilizes the Isolation Forest algorithm. An anomaly detection system known as the Isolation Forest utilizes decision trees to spot anomalous data items in the dataset. To calculate the risk of relapse and classify it, the system examines parameters such as mood score, stress level, sleeping habits, social support, and therapy sessions.
The system also contains a forecasting module for craving strength in addition to forecasting for the risk of relapse. To forecast the likelihood of craving in the future, this module analyzes parameters such as stress, mood swings, sleeping habits, and craving patterns.

E. Layer of Natural Language Processing

Additionally, the system utilizes natural language processing methods to analyze the user's text input. The system utilizes sentiment analysis and emotion detection to identify emotional states such as tension, anxiety, and melancholy when the user interacts with the system or writes comments. The system can recognize possible crisis scenarios and react accordingly.

F. AI-Powered Suggestion Engine

The AI recommendation engine generates personalized recommendations for recovery assistance based on the predictions generated by the machine learning models and the emotional states identified through the natural language processing analysis methods. The recommendations could be coping strategies, healthy hobbies, stress management strategies, dietary recommendations, and inspirational quotes that can aid the user in maintaining a constant state of healing..

G. Conversational AI Assistance System

Furthermore, there is also a conversational AI chatbot that provides interactive emotional support, which is also part of the design. The chatbot may be able to answer questions from users, provide support, and also assist in explaining coping mechanisms in trying circumstances. This adds to user engagement.

H. Layer of Output and Visualisation

The key findings from the study are also presented in a dashboard that displays the final outputs of the system. These include risk of relapse, craving intensity, emotional analysis, and suggestions, which are all displayed in the dashboard. Users are able to understand their recovery process and take preventative measures with the help of these displays.

IV. METHODOLOGY

The proposed method is an AI-based method for assisting in the recovery from addiction by monitoring the behavior, predicting the risk of relapse, and providing customized recovery assistance. The process followed by the system includes data collection, initial processing, machine learning-based prediction, and the generation of recommendations based on the AI model. All the steps in the system's workflow are implemented as microservices using the FastAPI framework. The microservices are for specific purposes such as providing activity suggestions, sentiment analysis, and risk prediction.

A. Data Collection

The system collects data from the user in the form of behavioral and psychological characteristics. The data collected includes several factors that are necessary for predicting the chance of relapse and the success of the rehabilitation program for the addict.
The characteristics collected by the system are as follows:
1) Weekly therapy sessions
2) Rate of task completion
3) Days of sobriety
4) Number of previous relapses
5) Check-in frequency
6) Social support score
Predictive analysis and behavioral therapy monitoring use such characteristics as input variables

B. Preprocessing of Data

The collected data is then assessed and processed in order to ensure accuracy, consistency, and transparency before the application of the machine learning algorithm. This step is required in order to make the raw data useful for analysis.

The following are the actions taken as part of the preprocessing phase:
1) Input Validation: The user's input data is validated using Python-based models.
2) Data Transformation: In order for the machine learning algorithm to be able to process the data, the textual or categorical data needs to be transformed into numerical data.
3) Behavioural Score Normalisation: To ensure consistency in the data range, the user behavioural ratings are normalised.
4) Managing Missing or Unreliable Data: The data is assessed in order to identify the presence of any incomplete data and ensure its proper handling.
This stage in the preparation phase ensures the accuracy and consistency of the data collected.

C. Feature Evaluation

Feature evaluation is the process of identifying key behavioral characteristics from the data that has been processed to identify behavioral characteristics related to the risk of relapse. In the machine learning domain, features refer to measurable characteristics that can be used to help machines differentiate and make predictions.

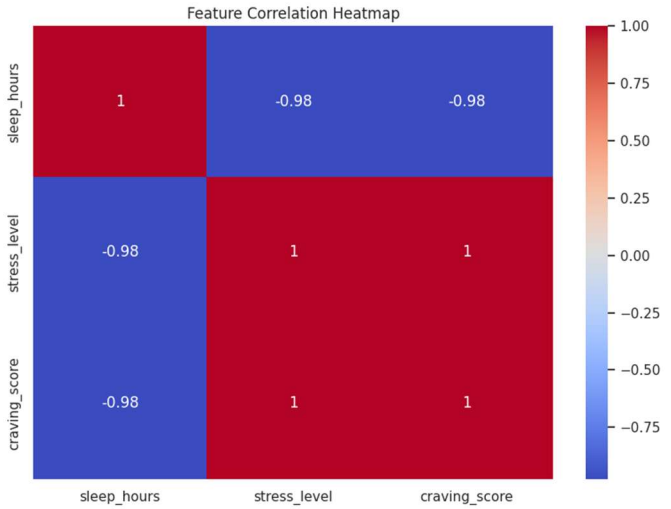

Fig. 2 Correlation Heatmap of Behavioral Features

Under the above framework, the features will be the user's lifestyle, habits, and state of mind. By analyzing these features, the system can monitor the changes in the user's behavior and the state of recovery. Key features will include the user's emotional stability, sleeping habits, social interactions, involvement in recovery activities, and the user's relapse history. Emotional stability will be used to measure the level of stress and mood swings. Sleeping habits will be used to monitor the user's sleep quality and the number of hours slept. Social interactions will be used to measure the user's interactions with family and friends. Involvement in recovery activities will be used to monitor the user's involvement in recovery activities and the user's relapse history.

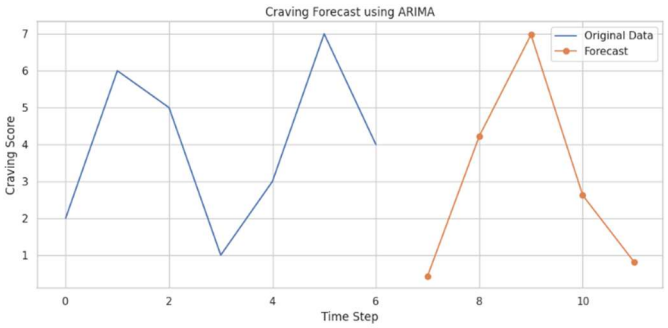

Fig. 3 Graph showing Stress Level against Craving Intensity

The above features give insight into the progress of the user's recovery and assist in recognizing abnormal patterns.

D. Model of Machine Learning

In order to identify abnormal behavioural trends which could possibly indicate a higher relapse risk, the system utilizes the Isolation Forest algorithm.

Isolation Forest is an unsupervised machine learning technique often utilized for anomaly detection. It functions through isolating anomalous data from regular trends. The possible risk of relapse in the system is indicated through abnormal behavioural trends of the user, such as high stress levels, lack of sleep, and low participation in recovery activities. After recognizing the demographic characteristics of the user, the following are determined:

Score for relapse risk

Category of risk (Low, Medium, High).

E. Predicting Craving Intensity

Furthermore, it also incorporates a seeking intensity projection module, which predicts the likelihood of increased craving intensities. Anxiety levels, sleep quality, routine moods, and triggering situations are some of the parameters that are taken into account for making this prediction.

Based on the impact of these behavioural, characteristics, desire frequency is estimated using a weighted scoring method.

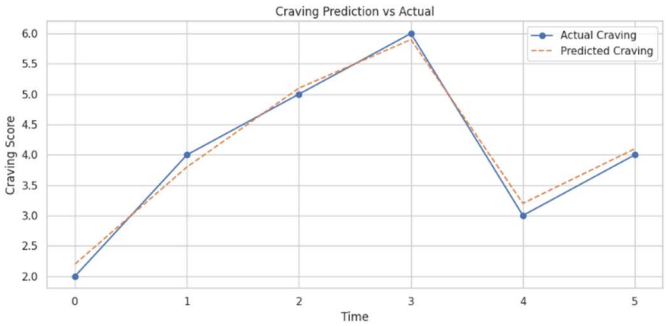

Fig. 4 Craving Prediction using ARIMA Model

F. Natural Language Interpretation

The system uses natural language processing (NLP) methods for analysing user text inputs in order to facilitate emotional monitoring. Sentiment levels and emotional states can be determined by analysing user messages.

This module does out:

1) Analysis of sentiment

2) Identification of emotions

3) Understanding context

The findings aid in identifying whether the person using the app is under stress, experiencing unpleasant emotions, or going through a crisis.

G. AI-powered Assistance System

A conversational AI module which offers recovery assistance and emotional support is implemented into the system. AI language models are used by the system to produce:

1) Motivational messages

2) Personalised coping techniques

3) Responses to emotional support

These answers are customised based on the user's emotional condition and level of rehabilitation.

H. Framework of Recommendations

The system generates specific recommendations based on the emotional assessment and forecasting results, including the following:

1) Activities which encourages health
2) Strategies for minimising stress
3) Rehabilitation-focused activities
4) Food recommendations
These suggestions are aimed at reducing the possibility of relapse and assist users in maintaining healthy practices.

I. Integration of APIs
The FastAPI endpoints are employed for the integration of all the modules, thus facilitating communication among different entities of the system. The scalable deployment and integration of the system with online platforms or mobile applications are achieved through the API framework.

V. RESULT & ANALYSIS

The proposed AI-based support system for addiction recovery support has been designed to provide a digital platform for the clients to track their progress and maintain their mental health. For this purpose, the system has been designed to incorporate different cognitive modules, such as an activity recommendation system, emotion-aware chatbot, and sleep quality assessment system.

The users can interact with the system through the web interface and provide information regarding their free time, sleep quality, and emotional states. After obtaining this information, the system can provide insightful results in the form of emotional states, sleep quality, and activities for reducing stress and maintaining health.

Fig. 5 A visualization dashboard of the Rehab360 system showing real-time recovery metrics such as sobriety progress, sleep quality score, stress level, craving intensity, as well as a trend analysis of week-long cravings.

With the ability to share feelings and receive encouraging feedback, the emotion-aware chatbot helps in creating a joyful and motivating work environment. By analyzing the sleep-related data and displaying the results, the sleep quality assessment tool helps the user understand the results, thus creating a better understanding of the need to make any required changes. Additionally, the activity suggestion tool promotes good behavioural changes through the suggestion of suitable activities based on the user's mood and available time.

Overall, all aspects of the technology show the potential of incorporating artificial intelligence and behavioural analysis to provide support to people undergoing treatment for addiction.

The website aims at providing support to users in creating a better routine, thus enhancing their health status.

VI. CONCLUSIONS

Our study developed an artificial intelligence-based support system for addiction rehabilitation, which helps users track their progress while enhancing their level of well-being. Features of the system include an emotion-aware chatbot, a sleep quality evaluation, and activity suggestions to offer customized support.

The system offers helpful counsel and suggestions based on user data about mood, sleep, and daily activities to promote positive behavioral changes and good habits. The platform shows how artificial intelligence might offer ongoing emotional support and direction for recovery.

The system shows in general how artificial intelligence-driven solutions may assist in the treatment of addictions and mental illness, and it has the potential to be enhanced by modern machine learning techniques and mobile apps.

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