BeSober: Assisting relapse prevention in Alcohol Addiction using a novel mobile app-based intervention

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Abstract—Chronic alcohol consumption has become one of the major concerns of the society in the sector of public health. The death toll due to excessive consumption of alcohol is increasing exponentially. Face-to-face interaction to create awareness and to stymie the consumption of alcohol is a quixotic solution. Alcohol relapse remains a challenging problem in disorders associated with alcohol addiction which is related to spatial-temporal factors like periods and specific places. In this paper, a new generation of relapse prevention mobile application called "BeSober" is proposed. It assists users to develop abstemious habits in drinking, providing support within the intervention period, tracking risky alcoholic spots, presenting community-based support from alternative users or alcohol addiction therapists, monitoring addict's behaviour and offer personalized recommendations to assist the addict in staying sober.

I. INTRODUCTION

One of the leading factors for mortality and preventable morbidity in the USA and around the world is Alcohol consumption. 2013 has a record of 3.3 million deaths and 6% of deaths worldwide due to alcohol consumption [1]. A large portion of alcohol addiction disorder is because of a problematic pattern of consumption or result in clinically substantive impairment or mental distress. Continuous alcohol usage is categorized as a chronic, lapsing illness, which requires continuous care.

Since the 2010s, smartphones have become an integral part of each individual's lives and has made a significant impact on our society. The new featured smartphones often consist of options like fast internet access, multimedia systems, GPS, video recording and messaging, which enable us to share a large volume of information instantly. The combination of smartphones and the internet has created more opportunities in the healthcare industry and is helping to upgrade the standard services, efficient process and accessibility to the healthcare supplier. Nowadays healthcare treatments have been improvised from a traditional means of caring, which need the manual and physical means of therapy into a more sophisticated controlling mechanism that can handle more complicated or urgent situations within less response time.

In this paper, we proposed and developed a new generation of relapse prevention mobile application called "BeSober", which can assist users in developing abstemious habits in drinking, offering supports within the intervention period by tracking risky alcoholic spots, providing community-based support from alternative users or alcohol addiction therapists. Compared to other traditional prevention and treatment approaches, this platform can bridge the gap between patient and doctor, and provide them with seamless and comprehensive communication for better-personalized recommendations, and therefore might substantially improve prevention effectiveness and reduce treatment costs.

II. SYSTEM DESIGN

BeSober system framework is shown in Figure 1, which has three main integral components. (a) A front-end module comprises of components that will track addicts' interests and spatial-temporal relapse pattern. (b) A back-end module which contains computing algorithms to predict relapse interval, user-customized diversions, and places. This module also stores addict information and interests. (c) A relapse support community that enables users to share recovering experience and ask for recommendation or suggestions. The first-hand datasets used in this paper are collected from the application, which is entered by the user. These data collected is further divided into multiple datasets suitable for various algorithms used in this paper. These multiple datasets include addict's information, addict's alcohol consumption patterns like the amount of alcohol, time at which alcohol is consumed, addict's preferences, geospatial locations, etc. as shown in Figure 2(a).

A. Tracking and Monitoring

To identify the high-risk situations among the addicts, the best possible approach is to track the addict's drinking patterns, i.e., the amount of alcohol consumed, the time and locations at which addicts usually consume alcohol and so on. Some other mobile applications track daily intake educates the user about when they are exceeding their limits in addition to how much they spent on drinks and calories consumed from alcohol[2]. But these applications lack continuous monitoring,
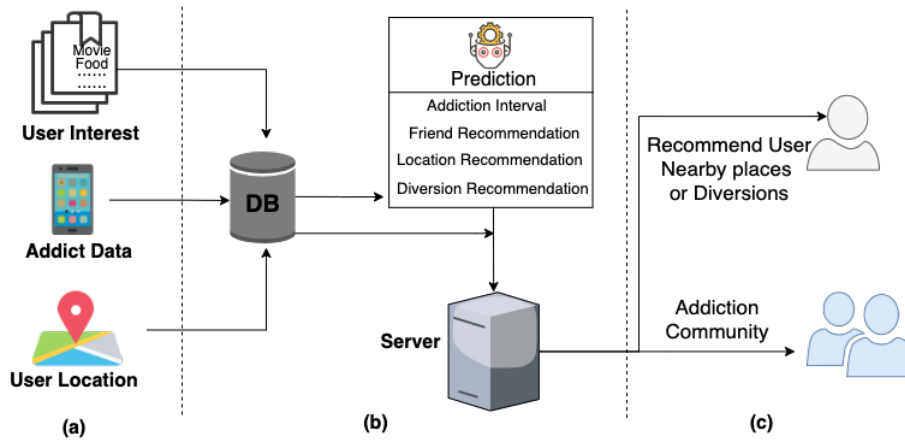
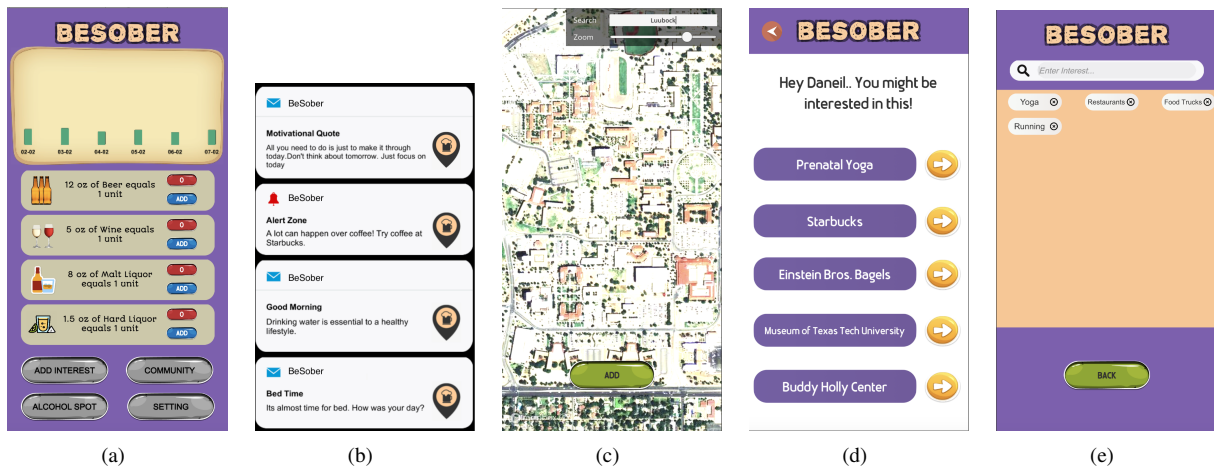Fig. 1. Framework of the BeSober mobile application.

Fig. 2. (a) BeSober Home Screen; (b) BeSober Notification; (c) BeSober Map Screen; (d) BeSober Location Remocommendation Screen; (e) BeSober Interest Screen.
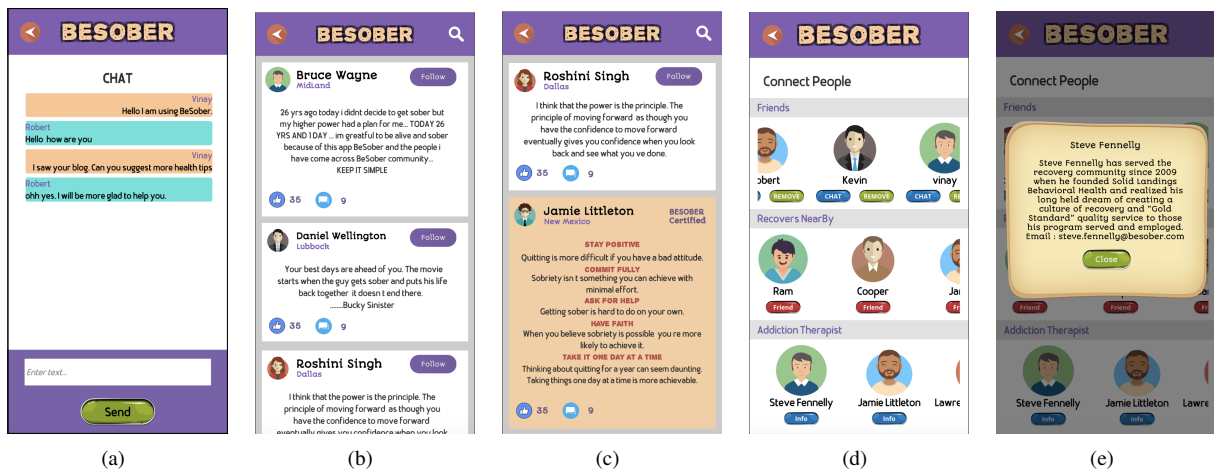

Fig. 3. (a) BeSober Chat Screen; (b) BeSober Blog Screen; (c) BeSober Blog Screen; (d) BeSober Connect Screen; (e) BeSober Therapist Info Popup.

measurement of accurate alcohol units consumed. Instead, BeSober aims at maintaining the tracking at accurate measurements by converting user's alcohol consumption quantities, such as cans, bottles, mugs or glasses, into the standard units of alcohol which particularly allows the user to be aware of his progress to quit the addiction. BeSober also visualizes addict's current alcohol consumption, to better monitor their activities and the gap between their present situation and their target.

B. Alcoholic Spot identification

Alcoholic spots are the locations at which the addict is more prone to addictions. These alcoholic spots are identified using a technique called Geo-fencing. To track the users' present location, Geo-fence stores information like latitude, longitude and the radius of those harmful alcoholic spots. Geo-fence empowers remote checking of geographic zones encompassed by a virtual fence. The locations like bars, liquor stores, pubs are marked as default alcoholic spots and BeSober also allows the user to add his/her alcohol influencing areas as shown in Figure 2(c). Geo-fence also supports smart notifications when the user enters or leaves those alcoholic spots which have a high association with the relapse. BeSober also considers the time constraint(i.e., the time in which the user stays inside the Geo-fences created), and a notification is popped-up when the mobile device enters or leaves those alcoholic spots as shown in Figure 2(d).

C. User Notification

When individuals focus on alcohol, then their cravings will seem more intense, and this is the fundamental idea behind the diversion techniques. If the user is distracted at that moment, then they will probably be able to trick their mind into forgetting the craving and eventually they lose the craving intensity. This behavioural observation can be utilized for stopping drinking because cravings rarely last for longer than a couple of minutes. A personalized user diversion based on the user's interests is popped-up as a notification to the user. As shown in Figure 2(b) notifications will be popped up a few minutes before the predicted time when the relapse is most likely to occur. It is crucial always to keep the addicts motivated towards their quitting goals, and they should be reminded every now and then why they are on this journey. One way to provide that inspiration to the addicts is by providing inspirational quotes that can help them to stay on track. BeSober provides motivational notifications that inspire the addicts and help them to stay motivated towards their goal of quitting alcohol a shown in Figure 2(b).

D. BeSober Community

The social network has been used in different aspects such as water management [3], disaster management [4], [5], or healthcare [6], [7]. In our solution, the relationships in BeSober social network are divided into three classes. A relationship is between a group referred to as "Members", and the other two relationships are between two users and referred to as "Follower" and "Friend". The bi-directional confirmation is essential if two users wish to become friends. There's no need for confirmation bidirectionally if user A wishes to become user B's follower. The connection between two users is either uni-directional or bi-directional, but cannot be both. Users are removed from each other's follower list if they become friends.

It is important for addicts to use every resource at their disposal. Blogs can be an excellent resource for anyone struggling with addiction. BeSober blog provides a window
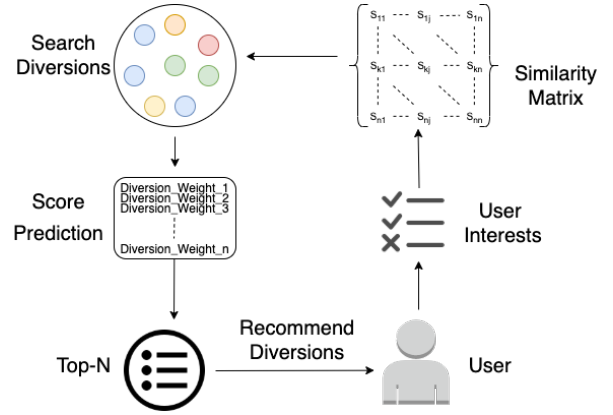

Fig. 4. **Overview of Collaborative Filtering**

into someone else's experience and can help other addicts to overcome their feelings of isolation, as shown in Figure 3(b). It also provides suggestions of what strategies worked and what did not work during other's experience with addiction and thereby helps the user to cope up with issues faced in his/her recovery process.

The process of giving and receiving nonprofessional, non-clinical assistance from individuals with similar conditions or circumstances to achieve long-term recovery from alcohol problems plays a prominent role in the addiction recovery process [8]. BeSober Connect is a platform that enables the user to connect with other users of the application and receive assistance in several stages. In BeSober Connect as shown in Figure 3(d) , users can connect to other addicts nearby or their friends. The nearby addicts can also be added to the users' friend list. It also provides an unfriend option. The hope of BeSober Chat is that alcoholics who are in the recovery process and need support from others in the same direction will find the online support they require by utilizing the chat room of BeSober as shown in Figure 3(a).

III. METHODS

A. Diversion Recommendation System

We use model-based collaborative filtering algorithms that contribute to diversion recommendation by first developing a model of user preference/interest. Given the preference of the addict on other interests, the collaborative filtering process computes the expected diversion for a prediction of a user of the application [9]. The collaborative algorithm classifies the users as follows, the probability of a particular user is in a particular class C is estimated and similar users in the same class are clustered in the clustering model [10] [11]. The association between the user preferred interests and association rule discovery algorithms are applied in the rule-based approach to generate the diversion recommendation based on the association strength between the items [11] [9].

B. Location Based Recommendation System

A location-based recommendation algorithm is proposed in this paper to integrate the mobile services for positioning
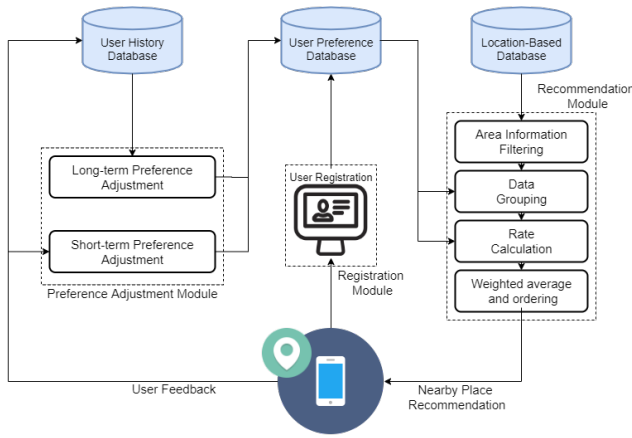
Fig. 5. **Overview of Location-Based Recommendation Method.**

of alcohol consumed is considered as the risky- situations and with the help diversion recommendation algorithm, the best diversions for a particular user is predicted and recommended to users in such time intervals.

IV. CONCLUSIONS

We developed BeSober, an interactive mobile application and a relapse intervention assistant to help users to stymie their urge for alcohol consumption. Initially, it allows users to build abstemious habits in drinking and gradually make them clean from alcohol addiction. The platform incorporates a variety of data to obtain insight into the individual's trend of drinking. The most likely relapse locations and periods are predicted by considering the spatial and temporal factors. Also, the Geo-fence methodology has been adapted to monitor the user's location progressively. The user's on creating an account on BeSober application has to provide essential information about their interests. These inputs are treated as valuable assets in understanding the user's mentality and recreational activities. Based on the user's alcohol consumption trend, the application recommends diversion activities in a timely fashion to reduce the urge for alcohol consumption. Besides, this application builds a healthy and interactive environment where the user could personally interact with the doctors to keep track of their progress.

and personalization. As shown in Figure 5, it mainly contains the user preference change module, recommendation module and the registration module. User preference is established by the registration module. Using the location-based information, the user location is used to retrieve data in that area once the location-based data is searched by the user after the registration. To calculate the recommendation score, history and user preference information is collected. To attain a customized recommendation method, the long-term and short-term preference adjustment is integrated with user preference and history information to record the recommendation result. The interface style is added with the degree of every preference as the preference attribute of the individual user is acquired with clearer importance [12].

C. Friend Recommendation System

Based on Friend-Of-a-Friend (FOF) totally, a friend recommendation algorithm in the BeSober social network system is designed. The number of customaries joined teams of two users, their common followers and the number of common followed users are taken into consideration along with the number of common friends of two users. Rather than the whole relationship information, we tend to use progressive relationship information, to form the new friend recommendation list. This reduces the requirement for process power and reaches a speedy situation from the deletion of the existing connections of the friend recommendation and establishment of recent connections.

D. Relapse Prediction

To predict the possible relapse of an addict, we use Recurrent Neural Network(RNN), which is suitable to the sequences of varying lengths. To enhance the performance of the model and to predict the time at which the addict consumes the highest amount of alcohol in a day more accurately, BeSober groups the consumption amount within an hour and reduces the dataset into hourly data within a day for each user. BeSober predicts the amount of alcohol consumed for each hour for the next 24 hours, and the time interval at which highest amount

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