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FUTURE OF PSYCHIATRY: MOBILE HEALTH AND SOCIAL SENSING

PSİKİYATRİNİN GELECEĞİ: MOBİL SAĞLIK VE SOSYAL ALGILAMA

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Abstract

Mobile technologies are transforming our lives. Utilizing the mobile technologies in health care has developed into a new interdisciplinary field called mobile health (mHealth). Data about an individual's moods, cognitions, physical and social activities can be collected and can be used to track mental health of individuals, or make other predictions about their lifestyle such as eating habits and obesity. The smartphone accelerometers and GPS localization systems give information on the overall level of activity. The microphone is used for activity recognition, based on the sound sensed. The social interaction can be tracked by the log of calls, the number of people contacted. Voice analysis is a way of tracking the mood by analyzing the patient's speech during voice calls. The mental health professional must recognize the increasing availability of mobile phones however patient's motivation to use the applications must also be taken into account. Mobile sensors can assist users to monitor their emotions and behaviors. Mobile technology has the potential to transform mental health care.

Keywords: mobile health, m-Health, technology, social sensing, smartphones

Özet

Mobil teknolojiler hayatımızı değiştirmektedir. Sağlık alanında mobil teknolojilerin kullanımı "mobil sağlık" (mHealth) adlı yeni bir disiplinler arası bir alan haline gelmiştir. Bireyin ruh halleri, kognisyonları, fiziksel ve sosyal faaliyetleri hakkında veri toplanabilir ve veriler bireylerin ruh sağlığını izlemek, ya da beslenme alışkanlıkları ve obezite gibi kendi yaşam tarzı ile yakından ilişkili durumları tahmin ve takip etmek için kullanılabilir. Akıllı telefonlarda yerleşik bulunan akselerometre ve GPS gibi sistemler kişinin genel fiziksel aktivite genel düzeyi hakkında bilgi verebilir. Mikrofon sistemi, algılanan sesi analiz ederek kişinin sosyal etkileşimini ve sosyal temas düzeyini takip edebilir. Ses analizi sesli aramalar sırasında kişinin konuşmasını analiz ederek duygulanımı izlemenin bir yolu olarak kullanılabilir. Her ne kadar cep telefonları toplumda yaygın olarak kullanılıyor olsa da bu mobil uygulamaları kullanmak için hastanın motivasyonu da dikkate alınmalıdır. Mobil sensörler duygularını ve davranışlarını izlemek için kullanıcılara yardımcı olabilir. Mobil teknoloji ruh sağlığı hizmetlerini geliştirme potansiyeline sahiptir.

Anahtar Kelimeler: Mobil sağlık, teknoloji, sosyal algılama, akıllı telefonlar

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1. Introduction

The smartphones and other communication technologies have impacted all our lives. We all have a rich set of options for broadcasting information, like Facebook, Twitter, YouTube, Instagram, and Foursquare. Our smartphones are other wearable technologies are equipped with cameras, accelerometers, compasses. All data from various sources are interconnected or interact with each other and form numerous, large-scale, and sophisticated networks, e.g. World Wide Web and social networks. With the aid of technology in almost everyone's pocket, scientists now have the capacity to track self-reported or automatically captured behaviors. Optimal mental health care necessitates early detection of mental health problems. Behavioral factors in severe mental illnesses can also be monitored with mobile sensing. Today, combining the Internet capabilities with the proliferation of sensors is producing a new revolution, called social sensing (Wang et al., 2015).

Mental illness is becoming a challenge in modern societies. With the widespread adoption of social media and mobile devices, a unique opportunity arises for tracking mental health problems. For tracking physical activity, sedentary versus non-sedentary activities can be followed by accelerometers, GPS devices and gyroscopes. This helps to increase physical activity and maintaining body mass index in a healthy level. For tracking social engagement, one can use social encounters, conversational turn-taking, speech volume, speaking rate and intonation via social media channels, microphones and cameras that will increase the frequency of social encounters. Sleep patterns can also be tracked for disrupted versus continuous sleep and time of sleep. Microphones, accelerometers, and even phone usage can be used to detect sleep problems, regulate sleep patterns and synchronize with internal body clock.

Traditional methods of monitoring mental health are expensive and intrusive. More importantly, these methods do not scale to large populations and not sensitive to the symptoms in the early stages of psychiatric problems. Advances in technology and machine learning, combined with the widespread use of the Internet and enactment of social media, now there is an easy way to tracking mental health (Zhou et al., 2015).

2. mHealth

Mobile phones are increasingly being advocated for innovation in psychosocial and behavioral health research and interventions as part of mobile health, "mHealth". mHealth is moving forward rapidly in research and commercial applications (Swendeman et al., 2015). Health apps have the potential to modify healthcare and health promotion. The apps comprise many topics, including smoking cessation, obesity and weight management, personal health records, pain management, fitness and physical activity, medication management and adherence, depression and many others (Nasser et al., 2015). However, although hundreds of health apps exist, very few are evidence-based, and numerous are with low-quality content.

Recently, mHealth technologies present the opportunity for scientists to collect information about the individual's biology, cognitions, emotions, behavior and social life in the real-world via wearable sensors (Wiederhold et al., 2015). mHealth technologies produce continuous streams of data, however, ethical, and security issues remain as a source of a problem, especially in areas involving sensitive behavior or treatment (e.g., alcohol use) (Arora et al., 2014).

Several internet-based self-help and treatments were developed as an attempt to give information, assessment, support, or adjunctive treatment for people with substance use disorders or behavioral addictions. A cross-sectional online survey was administered to users of an application, namely "Stop-cannabis". Users were encouraged to participate in the survey via a message sent to the app. The app was used daily by 348 of the participants (around 70%) and almost 80% of the users regarded the app to have helped them to stop or reduce cannabis consumption (Monney et al., 2015).

There is also currently growing interest in using mobile phones to support the treatment of psychotic disorders, such as schizophrenia. Firth et al recently conducted a systematic review and meta-analysis to assess mobile phone ownership and interest in mHealth among patients with psychosis (Firth et al., 2015). Their literature search yielded data from 12 samples of psychiatric patients ($n = 3227$). The overall mobile phone ownership percentage was 66.4%. The authors reported that having a mobile has been significantly increasing since 2007. Moreover, in studies of mHealth acceptability, the majority of patients acknowledged that they use mobile phones to contact with services and support self-management.

In another study feasibility and validity of a mHealth system for tracking mood-related symptoms after traumatic brain injury (TBI) is assessed (Juengst et al., 2015). A mobile system was developed specifically for individuals with TBI. The authors also developed a clinical patient safety management mechanism for the individuals with risk of suicidality. Participants completed 73% of all assessments which took daily less than 2 minutes to perform. Subjects described high satisfaction with applications (6.3 of 7) and found them simple to use (6.2 of 7).

Controlled breathing is vital as a behavioral intervention for panic disorder. A randomized controlled research assessed the feasibility and clinical efficacy of a mobile game called "Flowy" that digitally delivered breathing exercises for anxiety and panic management. Patients perceived "Flowy" acceptable as an anxiety control intervention. Intent-to-treat analyses exhibited a decline in anxiety and self-report hyperventilation scores. Participants perceived "Flowy" as an entertaining and beneficial intervention (Pham et al., 2015).

Wang et al reported that the smartphone intervention was a completely or at least partially effective tool to assist in managing several chronic diseases. With the help of health-related smartphone apps, patients with chronic conditions felt secure in the knowledge that their illnesses were closely monitored, participated in their own health

management more effectively, and perceived that they had not been neglected by their doctors and were taken good care of even they are outside the hospital (Wang et al., 2014).

3. Social Sensing

Social sensing has arisen as a new paradigm for collecting sensory measurements from the human population. Humans can serve as sensor carriers (e.g., carrying GPS devices that share location data), sensor operators (e.g., taking pictures with smartphones), or as sensors themselves (e.g., sharing their observations on Twitter). We can obtain real-world data via wearable sensing technology that give clues related to interaction patterns, speaking patterns, motion, and location. The phone camera can provide measures related to body orientations. The accelerometer can be used to detect chest wall vibrations and speech activity. Wi-Fi can be used for distance calculation (Macias et al., 2013).

A recent study investigated the impact that social interactions in the real world have on weight changes in student communities (Madan et al., 2010). The researchers tried to understand the role of exposure to different types of peers—those that are obese, overweight, have unhealthy dietary habits, and inactive lifestyles. They used the measures of Bluetooth proximity to peers that are overweight or that have unhealthy dietary practices or inactive lifestyles to examine the impact of social acquaintances on weight changes. The greatest correlations noted are with social exposure to peers with weight gains during the same period. These results suggest that subjects affected by the behaviors of the peers that they interact.

A recent study examines whether the information captured with multi-modal smartphone sensors can serve as behavioral markers for one's mental health (Ben-Zeev et al., 2015). The researchers hypothesized that smartphone sensor data would be associated with individuals' daily levels of stress, changes in depression, and personal loneliness over time. Participants used smartphones with sensors and software that facilitated continuous tracking of their geospatial activity (using GPS and Wi-Fi), kinesthetic activity (using accelerometers), sleep duration (using device use data, accelerometer, sound features, and light levels), and time spent proximal to human speech (i.e., microphone and speech detection algorithms). Participants performed daily ratings of stress. Results suggest that sensor-derived geospatial activity and sleep duration were associated with daily stress levels. Changes in loneliness were associated with the sensor-derived physical activity. They suggested that smartphones could be used as instruments for tracking several behavioral indicators of mental health.

4. Tracking Sleep

To explain the interaction between sleep, depressive symptoms, and electronic media use at night, a study investigated changes in adolescents' electronic media use at night and sleep associated with smartphone ownership

(Lemola et al., 2015). Owning a smartphone was found to be related to more electronic media use in bed, later sleep times and more sleep problems compared to youngsters owning standard mobile phones. Given the high usage of smartphones, mobile phone usage data may give clues on several behavioral signals of mental health problems, for example, an increased frequency of searching for information using the phone's browser might correspond to a manic episode of bipolar disorder (Matthews et al., 2014).

5. Tracking Diet

Rich user interfaces make manual logging of users' behaviors easier and more pleasant, and sensors make tracking effortless. To date, several applications use machine-learning models to create personalized recommendations based on the individual's physical activity and dietary intake. "MyBehavior" is one of them. It was created to process data related to physical activity and eating behavior and provides personalized suggestions to the user. It uses automatic and manually recorded data related to physical activity, location, and food consumption. A recent study investigated the impact of the suggestions on user physical activity and eating behavior (Rabbi et al., 2015). Users described MyBehavior suggestions to be extremely feasible and stated that they appointed to follow the advice of the application. MyBehavior users exercised significantly more than the control group over the three weeks of the study. Users considered MyBehavior's personalized recommendations more positively than the non-personalized, generic suggestions built by professionals.

6. Tracking Mood and Cognition

E-health includes multiple tools to assess and document mood symptoms, particularly mood charts. Although these approaches are popular, many of them lack the studies to evaluate validity and efficacy (Parikh & Huniewicz, 2015). Massey et al. recently described a mobile health system for mood disorders where they introduce different possible sensors for mood detection with optimal coverage and optimal placement of on-body sensors (Massey et al., 2010).

Early identifying the social media users with depressive symptoms is an aim of several research groups. In a study, authors focused used on Facebook to discern any correlations between the platform's features and users' depressive symptoms (Park et al., 2013). Facebook features found to held predictive power in identifying depressed individuals. Participants' number of viewed app tips and app points had a positive correlation with depression scales. The number of friends and location tags held a negative correlation with the depression scales. The results also suggested that depressed individuals had less intercommunication with others. Current prospective studies are examining the possibility of detecting manic episodes in bipolar disorder using changes in Facebook use.

The effectiveness of treatment in bipolar disorder

the strongly depends on the timing. Thus, therapeutic measures can be very effective if administered at the beginning of a patient's transition into a different mood episode. Education patients about early warning signs are vital. Grunebl et al. introduce a system, which, based on smartphone-sensing can recognize mood state changes of patients with bipolar disorder. They reported that the system could recognize the episodes with 76% accuracy and state change detection precision was 97% (Grunerbl et al., 2015).

Daily tracking of mood and physical activities helps bipolar disorder patients notice how changes in their routines affect how they feel. Smartphone sensing capabilities are uniquely adapted to monitor key bipolar disorder parameters: the nature and frequency of social interaction, and sleep/wake activity (Matthews et al., 2014). The current literature reports several studies that explored how the social activity affects the mood states during the day. It was shown that different types of social encounters provoke diverse emotional effects while there is also an association between the overall amount of social interactions and responses in positive affect. A study demonstrates the use of low-cost sensing technologies for monitoring speech activity as one aspect of social behavior, which according to the previous studies, has an impact on the emotional response of individuals. The researchers used the accelerometer based speech detection method to investigate the correlation between the amount of speech and mood changes (Mukhopadhyay & Postolache, 2013).

Patients encountering a manic episode usually talk very fast, sleep very little, and are hyperactive. On the contrary, depressive people tend to move and speak slowly, sleep a lot, and gain weight. The smartphone accelerometer and GPS provide information on the overall level of activity. The microphone is used for fine activity recognition, based on the sound sensed. The social interaction is also an important factor in determining the patient's state. When in a manic phase, people tend to spend much of the day outside, moving from place to place. The type of places visited and their relative distance from the patient's home changes. In the manic phase, the patients are much engaged in making calls and sending SMS and e-mails, however, the social activity decreases significantly during the depressive episode. A log of calls, SMS and e-mails provide information related to the social activity. Voice analysis may give clue related to the mood, and this is possible by acquiring and consequently analyzes the patient speeches during voice calls. A research evaluated a wearable system, "Monarca", had the aim of recognizing early warning signs and predicting manic or depressive episodes. The system is a smartphone centered and minimally invasive wearable sensors network. The system recognizes both physical activity and social activity (Puiatti et al., 2011).

7. Conclusion

Mobile technologies are reconstructing the way in which people interact with each other. It also changes the way mental health professionals track behavior, cognition and

mood changes of the patients. Mental health professional must consider the increasing availability of mobile phones however patient's motivation to use the applications must be taken into account. Mobile sensors can assist users to monitor their emotions and behaviors. Mobile technology has the potential to revolutionize mental health care.

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