INVESTIGATION OF SMARTPHONE USAGE AS PROBATIONARY TOOL WITH A PRELIMINARY DESIGN

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1. INTRODUCTION

The advance of technology has helped the societies a great deal in various ways. From access to required information for even simplest tasks to communicating with others, technology is utilized in abundance in our daily lives. Therefore, this shift from analog to digital world has changed the way people do things. For example, the education system has adapted itself to this new era by adopting the tools, devices and techniques brought forth by these new technological advancements [2, 3]. For most of us, seeing someone reading a hard copy book or paper in public places has become an unusual event, something that looks like it is from an old movie; instead, devices with electronic reading capabilities are preferred. Of course these kind of technological advances bring ease with it. We can now carry thousands of books with us everywhere and read whichever we want on the go, which was probably some sort of a dream only a couple decades ago.

Technology has changed the way we interact too. It is more common these days to meet new people on social media platforms than it is in real social places such as libraries and coffee shops. Recent surveys indicate that people prefer digital platforms even to find their romantic partners over traditional in-person meetings. More than one third of recent marriages started in digital world [1]. Moreover, when we compare the number of friends people have on these platforms with the actual number of friends that they interact in real life; we realize that the latter is a lot smaller.

Today, mobile devices and smartphones are probably the most widespread technological gadgets. The point we reached in terms of mobile device technology is fascinating considering what we can do with these small, lightweight, in other words, easy-to-carry personal gadgets. We can execute almost all of our daily tasks or sometimes even work-related tasks on our mobile devices. All of the educational activities, social interactions as well as entertainment can easily be realized through our smartphones.

Technology has been used by some outside of its useful intent for humanity and new challenges and problems have emerged that need to be handled. The advance in technology, smartphones and mobile devices in particular, has provided those ill-intentioned with an opportunity to carry out malicious activities. For example, it is relatively more common place to see identity thefts and bank account robberies compared to a decade ago [4,5]. In turn, technology has progressed to enable the discovery of criminal activities in society and to monitor criminals anytime or during their probation period as well.

Although there are several commercial products to help monitor offenders during probation period, smartphones still remain somewhat under-utilized in this domain with the great technological potential that they retain. With variety of benefits they offer, we think smartphones can be a substitute for current monitoring devices. We lay out a system...
design with smartphones at its core that can be used standalone or in parallel with other monitoring devices. To our knowledge there is not a smartphone application or a smartphone based probationary control system. Smartphones with their built-in hardware and software capabilities can easily be an industry standard for probation period. In this paper, we also analyze the Smartphone applications to see the main use cases of these devices. Providing some statistical data about the smartphone usage, we analyze how feasible this smartphone-centric approach would be in probation. Finally, we discuss the detailed features of this system and its design.

2. STATISTICS ON SMARTPHONE USAGE AND APPLICATIONS

It is quite easy to see how widespread the use of smartphones has become from the increase in smartphone sales day by day globally. According to a report on USA TODAY, smartphone sales increased by 28% from 2013 to 2014, reaching to 1.2 billion sales worldwide [7]. This number indicates that smartphones can serve a great connection point between people.

In fact, the growth of social networks signals the significant influence of the smartphone usage in countries such as Turkey, Indonesia, Nigeria and Brazil etc. According to a study conducted in Indonesia, people in this country have the idea that Facebook is a platform or an entity which is totally separated from internet. 11% of these people who use Facebook actively said that they do not use internet [8]. We conclude from this point that daily smartphone usage in these countries is much higher than that of the notebooks and personal computers to such an extent that it makes them think that the mobile applications like Facebook are not associated to internet.

Another study that points out the place of smartphones in general internet usage shows that an estimated 3 billion people of the world’s population are connected to internet as of 2014 [12]. 1.55 billion of these people are on Facebook and 1.31 billion are accessing Facebook via a mobile device [13].

People of Turkey are becoming more connected to internet and social networks according to recent statistics. A survey entitled “Information and Communication Technology (ICT) Usage Survey on Households and Individuals, 2014” shows that 53.8% of people are connected to internet. This number exhibits an increase of 4.9% compared to the previous year. The survey also discovers that 60.2% of households have internet access [9].

The growth in the ad revenues also indicates the spread of mobile devices in Turkey. According to data from the Interactive Advertising Bureau Turkey (IAB Turkey), digital advertisers, compared to the year before, increased their profit by 20.5% in 2014, which is a number equal to nearly $644.1 million. The share of mobile advertising in this number is dramatic. In 2014, digital ad revenue through mobile advertising increased by 58.5% compared to the year before, a number that is roughly equal to $11.9 million [10].

According to the survey conducted by Neomobile, a leading Mobile Commerce Group, the penetration of smartphone usage in Turkey is very high and its people are very active on Social Media. Current state of the smartphone penetration (at the time of this survey) reaches a very high number like 92.5% and this renders these mobile devices as one of the most widely used handheld device. This survey also shows that Social Media penetration is rising with 34 Million Facebook users active in 2015 and 11.5 Million users on Twitter. This number conforms to the general smartphone usage and internet connectivity rates in Turkey [11].

3. SMARTPHONE APPLICATIONS CATEGORIES

We can say that the development of Android Operating System by Google gave a momentum to the spread of smartphone usage. Today, many leading electronics companies including Sony, Samsung, LG and many others, are using Android OS for the mobile devices they manufacture. The reason behind this may be seen as the fact that Android OS is open source and thanks to Google Play, a digital market for Android applications, it addresses a wider audience. As such, as of July 2013 this digital market has had millions of apps published and billions of apps downloaded [15]. Moreover, surveys show that 71% of developers create Android Apps and for 40% of developers, Android is the target platform [18].
Despite this very large number of developers and apps for Android platform, when we analyze the applications we realize that apps for certain domains and purposes exist abundantly and new ones emerge on daily basis. Yet, to the best of our knowledge, none exists to support the justice system in our country.

Android apps on Google Play have been categorized by AppBrain, the leading source for information about Android apps, and the number of apps in each category is shown in Figure 1 [14]. The kinds of apps that some of these categories include are briefly discussed below.

The high rate of Education apps may seem like we are utilizing these devices or apps in our formal education system. Yet, when we look at the top downloaded apps, we realize that they are electronic versions of religious texts like Bible and Qur’an, e-reading or language learning apps. We can still say that we are yet to fully incorporate or exploit these mobile devices in our education system.

The diversity of apps in lifestyle category also takes attention. Apps for ordering food, for recipe of foods, calendars and prayer reminders are all placed under this category. Entertainment category includes game-related apps, apps to watch movies and various others such as file sharing apps. In business category we see apps like office programs and file format converters as well as file managers.

This picture shows us the lack of apps that can enhance our justice and education systems. In this paper, we propose a design for such an app that can be used to track the offenders during their probation period. We also discuss pros and cons of our design and how some of the critical issues can be overcome.

4. STATE-OF-THE-ART PROBATION MONITORING TECHNOLOGY

Although probation has been practiced in some countries like US and England for a long time, technological devices to monitor an offender while on parole have emerged fairly recently, only within the last decade. As we mentioned before, rapid advances in technology has made things easier for us in almost all aspects of our lives. By offering new monitoring products with differing capabilities, these technological advances have helped probation period to progress and become more effective and less expensive. We have explored the commercially available devices in use today to monitor an offender while on parole. Continuous Alcohol Monitoring, GPS Location Monitoring and House Arrest System are some of the most widely used electronic monitoring devices.

4.1 Continuous Alcohol Monitoring

The point we came in technological development allows us to test alcohol consumption continuously from practically anywhere. Continuous Alcohol Monitoring Devices are placed around the alcohol offender’s ankle and alcohol consumption level is tested through the offender’s perspiration. With these devices the offenders no longer need to transport to a testing center to have their alcohol level tested. Moreover, the device usually repeats the alcohol test at regular
intervals like every 30 minutes and reports the results instantaneously. With this device, probation officer does not have to participate in alcohol testing and will automatically be notified if alcohol consumption is detected from the offender’s perspiration. These bracelets also come with built-in sensors to detect any tampers, obstructions, and removals. These devices can be good option to assess offenders’ alcohol dependence or addiction while on parole.

Another alcohol consumption monitoring device that can be used especially with lower-risk offenders is Remote Alcohol Breath Testing devices. This kind of device validates the identity of the offender with face recognition using their built-in camera. With every single test this face recognition algorithm is run to ensure the identity of the user.

4.2 GPS Location Monitoring

GPS location monitoring devices are used widely as a commercial product in probation. The idea behind this is to keep track of physical location of an offender. Some of these devices may support an alerting mechanism based on the inclusion-exclusion zones. Once the offender gets out of the zone that he is allowed, an automatic alert is sent to the probation officers. Today, some of these devices are designed to work in extreme environmental conditions such as high temperature and they are also resistant to water and outside impact. They are also designed to detect removal instantaneously and to support a 2-way offender communication.

4.3 House Arrest System

This kind of device is used when the offender is confined by the authorities to a certain resident and restricted to travel. They usually report the offender’s movements inside the resident and whether the offender has gone outside of the zone he is restricted to. Sometimes they come with a display to support offender communication and sometimes random verifications. They are also designed to detect removal and tampers.

5. AN ALL-IN-ONE DESIGN BASED ON SMARTPHONES

Smartphones are an excellent choice as a next-generation probationary monitoring tool. First of all, they are already used widely; therefore they do not add an extra cost for both the probation officers and the offenders. Second important point to consider is that smartphones integrate a lot of high-tech features in one handheld device. They combine the features of popular mobile devices such as cell phones, personal digital assistants (PDA), media players and GPS navigation units. Another very important hardware support that these smartphones offer is their high-definition screens, cameras and voice recorders. Last but not least, especially some of the new-generation smartphones come with fingerprint reader, motion sensors, and support high-speed mobile broadband 4G LTE internet connections. Considering all these benefits, we argue that with a comprehensive system design, smartphones can replicate most of the functionalities of state-of-the-art monitoring devices. Thus, this easy-to-carry technology product is a good candidate for addressing the needs of our court system for probation period. The specifications and the features of the proposed design are discussed below.

5.1 GPS Location Tracking

GPS Location Tracking constitutes the backbone of the system providing 24/7 monitoring of the offender’s physical location. Smartphones integrate GPS navigation units that can be utilized to perform continuous monitoring. Android platform provides all necessary APIs for successful location monitoring. In order to achieve this functionality in our system, at first glance we realize that there are two different APIs and Frameworks that can be used: the platform location API in android.location framework which defines Android location-based and related services and the Google Location Services API which is a part of Google Play Services.

In this system, we propose using GPS in concert with Android’s Network Location Provider to acquire the offender’s location. We think that this approach would work best since both have their pros and cons. For example, while GPS is more accurate, it does not perform well indoors, consumes more battery power, and may not be as quick as we want in some time-critical scenarios. On the other hand, Android’s Network Location Provider determines the location using cell
tower and Wi-Fi signals, can work well indoors and outdoors, responds faster compared to GPS, and drains less battery power. As we can see from this brief discussion, Android provides several options that can be used to detect location. It is a matter of detailed assessment to make the best design decision about which one should be adopted within the scope of our problem.

Using this system, it is possible to define/redefine locations that the offender is allowed to or restricted from. An automated notification system can be implemented to contact the probation officer in case the offender leaves his confined zone.

Critical Issue 1: 24/7 Monitoring vs Battery Life and Accuracy of Location

Before we address this issue in terms of our system, we should point out that battery life has been on top of the major electronics companies’ critical issues list. Regardless of what types of apps are running on the system, this is one of the main problems yet to be solved in smartphone technology. If we still need to make some design decisions considering the battery life, we can propose to use Android’s Network Location Provider which takes up less battery power when the accuracy is not crucial factor and a rough estimate of the location suffices. With this approach, a more precise location can be requested at any given time. We can also use GPS to obtain more precise location information with longer time intervals to increase the battery life. Some studies show that location of the smartphone can be detected within 30 cm. of error range using Android as platform [17].

Critical Issue 2: Identity Verification

Most GPS Location Monitoring Bracelets come with a mechanism that prevents the removal, tamper and obstructions. Monitoring the location from smartphone may seem like an approach that can be misused. We have to answer the following questions to address this issue: how can we make sure that the offender himself is physically carrying his smartphone rather than leaving the phone in someone else’s possession while possibly leaving his restricted zone?

Solution to this issue requires some sort of identity validation. Luckily, smartphones provide several features that can be employed for that purpose [6]. The offender can be contacted through the system by the probation officer or an automated agent to start a video-chat or to request to either send a picture of himself or his fingerprint. Then the system can run a face or fingerprint recognition algorithm to validate the identity of the offender. This process can take place randomly or at a pre-defined time.

5.2 Rehabilitation Assistant

Rehabilitation is a very fundamental concept in probation to help the offenders to reintegrate into society and to prevent criminal recidivism. Through a successful rehabilitation correct and acceptable behaviors are promoted to ensure the safety of others by diminishing criminal habits of certain individuals. This compared to imprisonment gives the offenders a chance to rectify their behaviors and to become a part of the society again.

Based on our observation, current commercial products do not support rehabilitation directly. The design proposed in this paper can easily integrate elements of rehabilitation process. This design provides the probation officers to define and create a rehabilitation routine for particular individuals. The details of this rehabilitation program should be defined by the expert probation officer based on what kind of criminal behavior the offender has exhibited. After the tasks have been defined in this rehabilitation program, the offender will be requested to complete the task at a pre-defined time. This task may be scheduled to pop up on the offender’s smartphone randomly too. Some of these tasks may include watching short movies, reading assignments, meeting with an influential person who is assigned by the probation officer. These activities will be designed to enforce good behavior and help the offender to correct his behavior while on parole. At certain times, the offender may be asked to take a quiz to complement this education/rehabilitation process.

Through this rehabilitation assistant unit, offenders can be assigned a community service at a specific day and time. Working in the public library, mosque or another public place can be an example of community service. The system can
also track if the offender is where he is supposed to be during his assigned mandatory community service.

5.3 Good Citizen App

A novel characteristic of the proposed system aims to include the public in probationary monitoring. Those who volunteer will have chance to download the app designed for the public use to give feedback on an offender’s behavior in public place. When system detects an approved individual from public in a close proximity to an offender, it will automatically launch a form to fill in to evaluate the offender’s behavior. The appearance of the offender will be introduced to the individual and report will be requested only if the volunteer approves that he has recognized someone that matches to that appearance in his surroundings. Then he will share his observation about the offender including whether he thinks the offender has exhibited suspicious behaviors.

The report from the volunteer can include information such as whether the offender is consuming alcohol at the moment or whether he is hanging idly around a park or a school where there may be students around etc. The system can notify the probation officer when a suspicious behavior is reported by the volunteer. This option may be applied to those who are possibly low-risk and selected by the expert probation officer.

5.4 Social Media Profile

Social Media activities can give a lot of clues about what an offender is up to. In some countries such as the US, probation officers started to use the Social Media accounts of the offenders to keep an eye on them [16]. This relatively new concept helps the probation officers to supervise the offenders more easily and effectively. In our smartphone-centric design, we can easily integrate a module that handles this job. Meaning, besides the offenders’ social media activities, we can easily analyze their search, conversation and text histories.

After all this data is extracted from the offender’s smartphone, any suspicious behavior should be detected from this data. Manual analysis of this data may prove impractical as it will grow very quickly over time especially as the number of offenders on parole increases. To automate this process, we will employ natural language processing techniques to disclose activities that require attention of the authority. For this, we can create special lexicons for example to detect violent or faulty language on Social Media or in text messages.

Through this system, an offender’s social network can also be monitored. Therefore, any suspicious connection that has been formed between the offender and any other individual (possibly on parole also) can be reported immediately. Another network activity that may need to be caught can be when someone on parole creates a connection with someone who has another connection which is also on parole.

Scenarios given above are just some examples that we thought of. Once a new pattern of behavior is discovered, it can be defined and implemented in the system to be detected in future.

5.5 A Special Use Case: Domestic Violence and Personal Problems

If the offender has violated the law due to a personal problem with only one individual, this offender may need to be treated or monitored differently than other offenders. In other words, if the offender is known to be harmless in general towards public, but one specific person, the relationship between the offender and the victim should be monitored. Domestic violence can be a good example here. If a woman is the victim of domestic violence and concerned about her safety while the offender is on parole, locations of both can be tracked down to know whether the offender is approaching to the victim. Necessary precautions can be taken, when the proximity of the offender and the victim drops below a certain threshold.

5.6 Voice/Video Conference with Authority for Alcohol Test and Others

If the offender is an alcohol addict or restricted from drinking alcohol, the system can be adapted to monitor the alcohol test. We think that automated alcohol testing at home can easily be misused. Therefore, we need to analyze
different techniques that report the alcohol consumption of the offender without any supervision.

The most practical and credible approach seems to be supervising alcohol testing remotely which can easily be integrated in this proposed system via video chats. One possible scenario can be as follows. The offender can be requested to test his alcohol consumption using any alcohol testing devices including Alcohol Saliva Test Kit. These kits are very cheap and have high accuracy. During the testing, the probation officer can supervise the testing remotely through a video chat. Another option for supervision would be to request a volunteer (Section 5.3) to supervise the test if the offender is in a public place like hospitals. Of course, this should not be practiced if the authority thinks that the volunteer’s safety may be put in jeopardy. This process can be scheduled beforehand or started randomly. This way the offender and the probation officer will not need to travel to a testing center.

5.7 Installation of the New System and Compliance with the System

This paper proposes a system that includes several components that are explained in previous sections. The most important of which is the Android app that needs to be installed on the offender’s smartphone before his release. An important functionality of the system is that it enables monitoring the offender’s GPS location continuously. Just like the GPS monitoring bracelets in use today in many countries, this system should be able to detect the outside tampers with the app such as uninstalling it or switching off the smartphone all together.

Critical issue: Protecting the app from being uninstalled and/or the smartphone being switched off is not a trivial task. We need to be able to track the location of the offender 24/7 and detect any unexpected system behaviors. We can overcome this issue by integrating a heartbeat message in our app. We can design our system to send the GPS location information at certain time intervals together with this heartbeat message that indicates our monitoring app is up and running. If an expected heartbeat message is not received the probation officer can be notified to take an action.

6. COMPARISON BETWEEN OUR SMARTPHONE SYSTEM AND OTHERS

We argue that the point where smartphone technology has reached provides all necessary equipment and technology to run more successful probationary activities. To emphasize the advantages of the proposed system over existing probationary tools, we comparatively discuss some of the functionalities of our system and those of the existing tools.

6.1 Cost

The first point that needs to be highlighted is the cost of providing or obtaining the probationary tools and services. Although we have not discussed the cost benefits of the proposed design, it is clear that employing smartphones, which is already ubiquitous, instead of the commercial devices explained above for probationary monitoring will reduce the cost associated with obtaining the probationary services and monitoring devices for parolees and the court.

6.2 Integrity of Parolee

The proposed system respects the personal privacy and the integrity of the parolees as well. The current GPS monitoring bracelets are designed to be disguised when worn. Yet, it can never be fully guaranteed that others will not realize that someone is wearing them. In case of our proposed design, no special-purpose devices are needed. This, therefore, allows the parolees to continue their social lives without worrying about being uncovered and hence being discriminated against.

6.3 Flexibility and Functionality

The proposed design is also more flexible and supports more functionality in comparison with the special-purpose probationary monitoring devices. For instance, the probation officers can communicate with the parolee at any time through not only audio contact, but also video chat. Moreover, this system supports the rehabilitation for offenders as well by providing a platform where tasks can be given to them and their progress can be controlled.

Tracking two people simultaneously is also novel in this system. As explained before, when an offender is known to
be in conflict with a certain another individual, usually the victim, that other person can demand protection. In this case, the system can detect and notify the authority when the offender approaches to the victim while on parole.

Under certain circumstances, we think that pre-approved people can be included in the probation period to help monitoring an offender and/or rehabilitating them. For this purpose, a database of approved people can be created and they can be requested to report about the offender’s behavior or his rehabilitation tasks.

7. CONCLUSION

In this paper, we have investigated the smartphones in terms of how widespread their use is and what type of application categories exist indicating main use cases of these devices. We have also explored the current state-of-the-art probationary monitoring technologies and suggested a smartphone based approach for probationary monitoring. In order to assess the feasibility of smartphone use for probationary purposes in our court system, we have provided some statistics about the internet connectivity in Turkey.

We highlight in the paper that technology has changed the globe in many different ways. The way we learn, interact, entertain etc. has been dramatically changed as a consequence of recent technological advancements and devices, smartphones and mobile devices in particular. Therefore, we think that it is time to consider to and integrate smartphones more into our court system.

We conclude based on our discussions that smartphones can easily be used as a replacement to the existing commercial probationary tools. The ubiquitous use of these mobile devices and the fact that internet connectivity rates in Turkey has been rapidly increasing backs up the success and effectiveness of the proposed system. We have also compared the smartphone-centric probationary approach with exiting tools and concluded that this system will cost a lot less and be more flexible and rich in terms of functionality. Due to this flexibility, besides the novel features that have already been discussed and outlined such as the rehabilitation assistant and social awareness, more functionality can be integrated to this design based on expert guidance in judicial and probation system.

The next step in this study shall be the realization of this system into a real world application, followed by an extensive test for each of these functionalities and units. For this the required researches and funds shall be obtained. We plan to proceed with formation of our research group to work on the design, implementation and testing.

REFERENCES


