

SMART - SMartphone Addiction Reducing Tool

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Code repository: <https://github.com/aravindsagar/SMART/>

1 Introduction

With increasing capabilities of mobile devices, smartphone addiction has been increasing in recent times [3]. This has led to several issues such as depression that may lead to a decreased quality of life for smartphone users. As users spend more time on the phones due to the increasing quality and functionality of smartphones, there seems to be a minimal industrial push of ideas that would help users have more control over how much time they spend on their smartphones.

There have been some projects that we found that deal with providing visualizations of smartphone usage to its users for self-reflection. We also found apps and website blockers that allow users to block specific applications from their computer or smartphone. But we haven't found applications that blend these two ideas to allow for users to monitor applications on their phone, and set time limits for specific applications before blocking them. The problem with just showing the users information so they can decide on how to reflect on it is that people find it difficult to understand and choose alternative activities that will improve long term mood [7]. Completely blocking applications from a user's phone might be more frustrating than as allowing a person to use an application for a healthy amount of time.

The solution we decided to implement revolved around those two main concepts that were found through researching related work. We implemented SMART as an Android application which combines smartphone application monitoring and guided application

blocking to allow setting restrictions with minimal user input. SMART will not only block the user from using specific applications after reaching daily usage limits, but also provide recommendations on alternative activities that may lead to the user being more productive. Another aspect to more accurately block the applications from the user is to measure their mood as they are using the SMART application to make sure the monitoring and blocking features are having a positive effect on the user's mood.

To test our application, we decided to allow some users to try out SMART. The testers used the application for a short amount of time, and filled out a survey after using the application that asked questions about the usefulness of the application. Users generally thought that app usage visualization and daily usage limits is a good way to reduce smartphone addiction, and also that emotion recognition is great idea.

2 Problem Statement

Studies have shown that problematic smartphone usage is related to depression[4]. Furthermore, Twenge's survey on young adolescent's screen time and each individuals concurrent mood has shown that there is a correlation between the overall new media screen time and depression[1]. As excessive Internet connection and usage is considered to be one of the strongest factor for the cause of depression from smartphone usage[6], it would be effective to minimize the user's ability to access Internet. People also tend to turn to their smartphone to kill time, and often this eats into their productive time as well. Social media apps are common culprits, but other categories of apps like games also often tend to be addictive.

Keeping these results in mind, the problem that we are aiming to solve is how to reduce addiction to unproductive or distracting smartphone apps. We want to minimize the effort required by user for achieving this goal, and also minimize their frustration.

3 Related Works

3.1 Smartphone addiction

Smartphones have gained immense popularity in the recent years, and have surpassed other forms of computers as the primary device used to access the Internet. At the same time, smartphone addiction is also in the rise, with many recent studies suggesting that smartphone addiction has negative effects on mental health and well-being [8].

3.2 App usage trackers

Many tools exist that can track the usage of a smartphone. Apps like Moment [9] and Space [10] provide visualizations of smartphone usage, and come with additional features like "Addiction score" and setting goals. These class of apps are generally meant to provide users with data that can be used for reflection, which is based on the idea that understanding the amount of time we spend on smartphones will motivate us to abstain from excessive usage.

3.3 App website blockers

Plenty of website blockers can be found as desktop browser extensions, but relatively fewer such apps exist for smartphones. A notable app is Offtime [11], which provides smartphone usage visualization as well as profiles. When a profile is active, it allows only white-listed apps to be opened, and even restricts calls and messages to a few selected contacts. The paid version of the app allows profiles to automatically kick in at defined times of the day. The drawback here is that the phone will be in a highly restricted mode when a profile is activated, and hence users won't want a profile active all the time. However, there is no limit on app usage when no profile is active. There are also apps like Flipd and AppDetox which provides app block functionality without providing usage data.

4 Solution

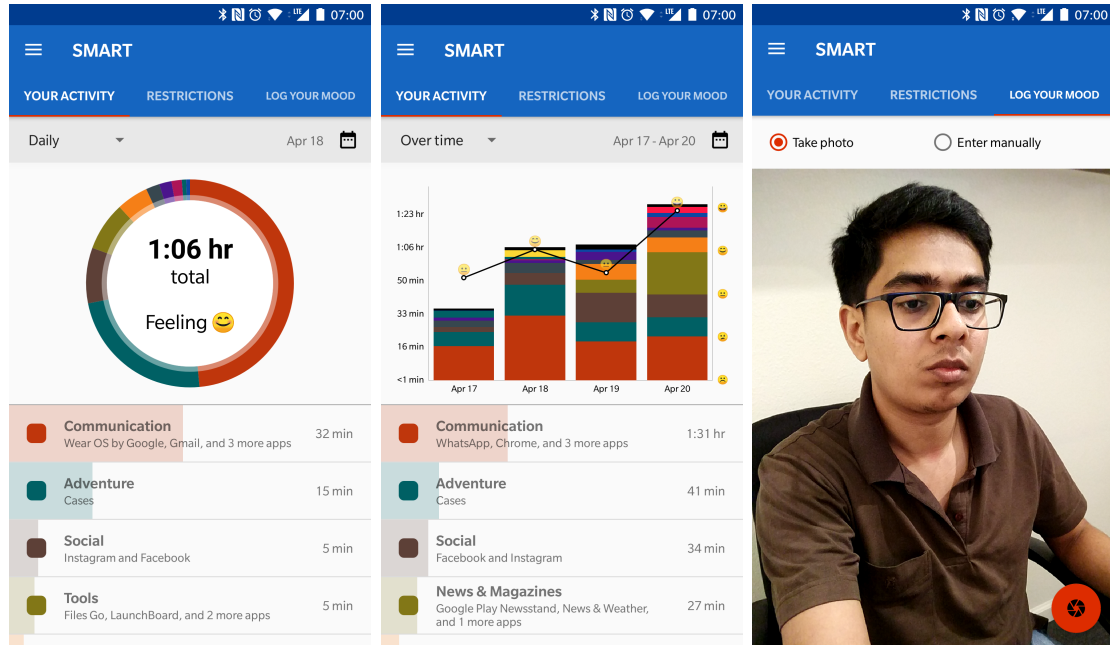
As our solution to reduce user’s smartphone usage, we developed an Android app ‘SMART’ - SMartphone Addiction Reducing Tool. SMART has 3 major features:

1. Collect and visualize smartphone usage: This can help users in understanding their usage patterns and get insights like most used apps, time spent on various categories of apps, among others.
2. Restrict app usage: SMART analyzes the app usage data and user’s goals to recommend the apps that should be restricted, and the threshold time duration. Once the user confirms a threshold time duration for an app, that app will be blocked by SMART after the daily usage of that app reaches the set threshold time. The blocking screen suggests alternate activities and news articles based on user interests.
3. Collect and visualize user’s mood: Since new media screen time has been correlated with mental well-being, SMART also tracks user’s mood. Users might get motivation to reduce smartphone usage if they see that lower usage corresponds to better mood. The mood data is also used to analyze whether app blocking is causing prolonged unhappiness to the user, and if so, relax the constraints.

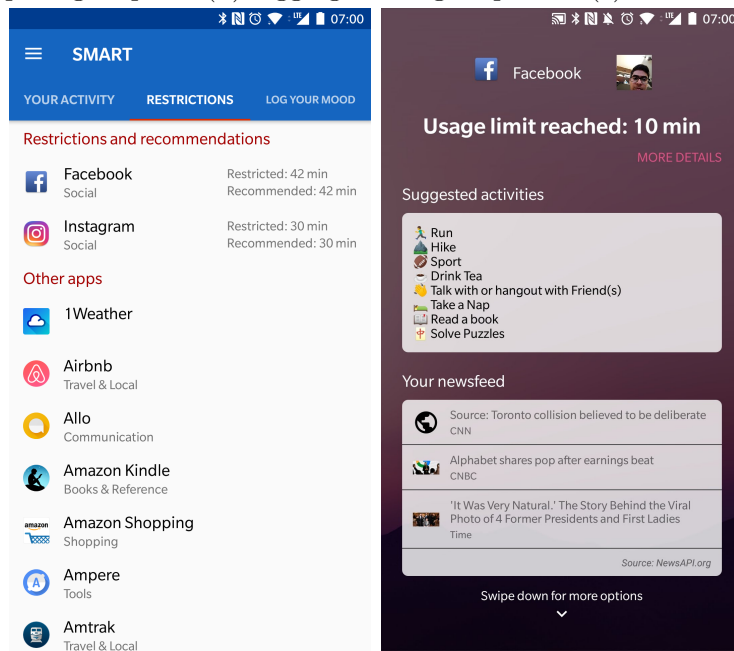
More details on each of these features can be found in the implementation section.

5 Implementation

SMART is a native Android app. It can be used on any smartphone running Android 5.0 (Lollipop) and above, and supports the latest stable Android version as of writing (8.1, Oreo). In the subsections below, we detail the design and functionality of the major features of SMART.



(a) Per-day app usage report (b) Aggregate usage report (c) Interface to log mood



(d) Set restrictions interface (e) App block screen

Figure 1: SMART interface.

5.1 Onboarding

The onboarding screen is used to introduce the user to SMART, and allow them to setup the app based on their interests. The main screens of the onboarding screen are split into different tabs. The onboarding activity will only be shown once to the user, and that is the first time they use the application.

There are 4 different tabs that the user will see in the onboarding activity:

- **Permissions:** The first screen that the user will see when they use the application for the first time is the permissions tabs. This tab gives them a brief introduction to what SMART is for, and buttons to allow the application to gain permissions that are needed for the application to function properly.
- **User Account:** The second tab is the Account Sign up, and this currently is not being used much in terms of the logic in the current prototype of the SMART application. But in the future, this information can be used to allow for the monitoring not only on a user's smartphone, but on their computers as well.
- **Restriction preferences:** The aim of this screen is to understand the goals of the user, in terms of what kind of apps they want to reduce using. The most used apps in the phone are displayed here in a grid. The user can select the apps that they want to restrict, and SMART stores the categories of the selected apps, to be used later while recommending restrictions.
- **Recommendations:** The final tab on the onboarding activity is the recommendations tab. This tab was made to allow the users to choose different activities that they may see when an application is blocked. The four different sections of alternative activities are exercise, academic, relax, and news.

5.2 Reports

This is the main landing screen of SMART. Through a tabbed interface, this screen also provides access to the Restrictions screen (used to set app thresholds), and the Mood

logging screen.

There are 2 main types of reports: a day view and an aggregate view.

- Day view: This visualizes the app usage of any given day in the form of a ring pie chart. At the top level, it gives a breakdown based on app category, and users can dive into each category to see per-app details. The graph legend gives more insight since the legend background mimics a bar graph, which makes the entries easily comparable. The total usage and the day's mood is also shown at the center of the pie chart. Refer to Fig. 1a for an example screenshot.
- Aggregate view: Here, the user can see their daily app usages over a period of time using stacked bar graphs. Top level is organized based on app categories, and can be expanded to view per-app statistics. Legend background again mimics a bar graph and provide aggregate statistics. App usage bar graph is overlaid with a line chart showing mood data for the corresponding dates. Fig 1b shows a screenshot of an instance of aggregate reports.

Users can easily switch between the two different modes and select dates using controls situated above the graphs. With just 2 modes, the reports screen provides a lot of insights into the app usage. It allows users to track the total time they've spent on the phone today (or any previous day), most used apps and categories on a daily basis, how their overall, per-category or per-app usage is varying over time, and whether there is a correlation between their mood and smartphone usage. Users can also set app restrictions directly from the legend by long pressing app entries. App restrictions are detailed the the next section.

5.3 App Restrictions and Blocking

The central idea behind app restrictions is that users can set the amount of time an app can be used, per day. After this threshold time is reached for a particular app, that app will be blocked by SMART. SMART aids the user in this process all the way.

Restrictions screen is divided into 2 sections: Apps with enforced or recommended

restrictions, and rest of the apps (See Fig. 1d). SMART analyzes the usage data and recommends not just which apps should be restricted, but also the threshold time for each of these apps. To generate these recommendations, SMART considers 2 factors: the app categories of which the user is interested in reducing the usage time (collected during onboarding), and the apps whose average usage time over the last week exceeded 30 minutes. SMART initially recommends a threshold time of 90% of current average usage time of an app, and gradually reduces the recommended threshold time until the average usage time of that app falls below 30 minutes. SMART also takes into account recent mood data and recommends relaxed threshold times for already restricted apps, if the user's average mood is below a certain threshold. Users can enforce a recommended restriction using 2 touches, and customize the threshold time if they wish to do so.

An app is blocked for the rest of the day if usage time of that app goes above the set threshold on that day. This is done by showing a full screen overlay above the app to be blocked, as shown in Fig. 1e. This overlay provides usage stats of the app that has been blocked, and also provides alternate activity and news suggestions. These suggestions are based on user inputs during onboarding. By default, the block screen is bypassable by swiping down and hitting a button on a confirmation dialog. However, this bypass can be disabled in SMART's settings.

5.4 Mood Recognition

For the purpose of visualization and adjusting the app-blocking parameters, the user's mood is asked to be recorded. The mood is recorded in two occasions: the user's voluntary daily input and automatic camera activity when an app is blocked by SMART.

The user's voluntary daily input is taken by the user with a typical camera activity that is embedded in the local device. The user will take the picture, and SMART will collect the picture as a byte array to use it to determine the user's general mood of the day. The byte array, after determining the user's mood and recording daily mood score to the local database, will be discarded to preserve the device memory. Alternatively, the user can record daily mood by selecting one of the predetermined mood option to bypass

the mood recognition and the picture analysis.

The collected mood is then formed into a byte stream to be stored into Microsoft Azure cloud space, and Emotion API is used to retrieve feature scores of the taken photo. The retrieved data in JSONArray consists of a collection of mood feature scores that could be identified from given image, which is then parsed to record the user’s daily mood.

We use emojis for representing moods both during input and visualization, since we feel it’s more visually appealing and easier to interpret than text describing emotions.

Currently, because of the difficulty to maintain the subscription key to Microsoft Azure, mood analysis using Emotion API has been disabled. For testing purposes, we are instead mimicking the Emotion API using randomly generated values.

5.5 Design Choices

Here we explain the rationale behind some of the design choices that we made for SMART.

Allow user to bypass the app-block: While the goal of SMART is to prevent the addiction of smartphone by reducing the amount of time the user uses the app, we understand that complete restriction of an app usage can sometimes cause negative effects on the user as predicting one’s mood simply based on the previously recorded events is nearly impossible. Since causing further frustration by the app blocking may lead the user to abandon the app usage, we determined that it may be better to provide the soft blocking mechanism, which allows the user to bypass the block and continue to use the app if desired, rather than a hard block of an app. The user will still have to navigate through 2 extra screens to get to the blocked app. This is because we believe that the gradual reduction in the app usage time is more effective in preventing an addiction than short-term sudden decrease in the app usage. Furthermore, we believe that providing the user the report of the app usage and the summary of one’s own change in mood based on the app blocking would allow the user to be able to control own behavior more effectively. The app does provide a hard-block option, which hides the option to bypass the app-block screen, but this is disabled by default.

Recommending app threshold time vs automatically enforcing threshold:

We decided to recommend threshold time duration for apps rather than automatically start blocking apps since users might be surprised to find their apps blocked by SMART. As a result, users have to confirm the recommended app restrictions for the blocking to take effect.

Disable camera for mood recognition: Some users may be wary of allowing SMART to take pictures, due to privacy concerns, hence we allow users to turn off mood recognition using selfie capture. In this case, the only way to log a mood will be to select an option from a list of moods.

6 Results

We conducted a small-scale testing of our prototype and collected feedback about various aspects of SMART using a questionnaire. 6 participants explored the app either in their own device or a test device before answering the questions. Increasing the number of participants and testing long term effects of the app was not feasible due to time constraints. A summary of the feedback is presented below.

1. App usage reports: Most users liked the presentation of data, with some users even reporting that they were slightly surprised with the data. Users also indicated that the visualization greatly helps to provide motivation for reducing smartphone usage. One suggestion that we received was to provide an addiction score, or just the most important metrics of the data collected, for people who are uncomfortable with reading graphs.
2. App restrictions and blocking: All users reported that this could be very helpful. Some users suggested that non-bypassable blocking might be better, but others thought that having to do swipe down and press a button to bypass the block is sufficient to detract the user from opening the app frequently.
3. Activity suggestions on block screen: Users generally saw offline activity suggestions as a good idea, but did not see any usefulness in news suggestions. This was either

because they would have already read interesting news, or would prefer not to use the phone at all when they see the blocking screen.

4. Mood recognition: All users thought that this is a great idea. One user suggested that the users should not be made aware of how exactly mood recognition is used to tweak restriction parameters, because they might use it to work around app blocking.

7 Future Work

- More personalized suggestions in the app block screen, like their reminders, calendar entries, and to-do list. User will be able to customize what shows up on the block screen.
- Desktop version complementing the mobile version to properly tackle internet addiction, and not just smartphone addiction.
- Currently, users can easily overcome the app block by switching to soft-block mode or by simply removing the restriction. One solution to prevent abuse of this is to have such changes take effect only after a certain period of time, say 24 hours.
- Make the app harder to uninstall. There are a few ways to do this, including requesting administrator privileges. This will be an opt-in feature.
- Extract detailed emotion data using a cloud service like Emotion API.
- More user testing to validate some of the design rationales used in SMART.

8 Conclusion

Studies have shown that immoderate amount of smartphone usage leads to mental issues such as depression. In order to mitigate this, we developed SMART, an Android application that aims to inform users their applications usage and help reducing their time on addictive apps.

The feedbacks from test users show that most saw the visualization of their data to be useful and may have led to new realizations regarding how they are using their phones. Some believed that we should make a non-bypassable block while others believed that it was sufficient to have an overlay that was removable by a swipe down and a button click. The testers found that offline activity suggestions were a good idea but suggested that the news related suggestions was not a useful feature to deter their attention from continuous usage of addictive apps. Users also found that mood recognition was a good feature to ensure that the users of SMART were benefiting from the application. Based on the feedback received, SMART can be a sufficient tool to help reducing addictive usage of smartphone apps.

References

- [1] Twenge, Jean M., et al. "Increases in depressive symptoms, suicide-related outcomes, and suicide rates among US adolescents after 2010 and links to increased new media screen time." *Clinical Psychological Science* 6.1 (2018).
- [2] Van Deursen, Alexander JAM, et al. "Modeling habitual and addictive smartphone behavior: The role of smartphone usage types, emotional intelligence, social stress, self-regulation, age, and gender." *Computers in human behavior* 45 (2015): 411-420.
- [3] Gökçearsan, Şahin, et al. "Modelling smartphone addiction: The role of smartphone usage, self-regulation, general self-efficacy and cyberloafing in university students." *Computers in Human Behavior* 63 (2016): 639-649.
- [4] Elhai, Jon D., et al. "Fear of missing out, need for touch, anxiety and depression are related to problematic smartphone use." *Computers in Human Behavior* 63 (2016): 509-516.
- [5] Kim, Hyunna. "Exercise rehabilitation for smartphone addiction." *Journal of exercise rehabilitation* 9.6 (2013): 500.

- [6] Anderson L, Heyne L. Therapeutic recreation practice: a strengths approach. State College, PA: Venture Publishing; 2012.
- [7] Hollis, Victoria, et al. "What does all this data mean for my future mood? Actionable analytics and targeted reflection for emotional well-being." *Human-Computer Interaction* 32.5-6 (2017): 208-267.
- [8] Samaha, Maya, and Nazir S. Hawi. "Relationships among smartphone addiction, stress, academic performance, and satisfaction with life." *Computers in Human Behavior* 57 (2016): 321-325.
- [9] Moment app. <https://inthemoment.io/>.
- [10] Space app. <https://findyourphonelifebalance.com/>.
- [11] (OFFTIME) app. <http://offtime.co/>.