

PERFORMANCE ANALYSIS OF AAROGYA SETU

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1. ABSTRACT

We study the Aarogya Setu – COVID-19 tracking mobile application developed by National Informatics Centre that comes under the Ministry of Electronics and Information Technology, Government of India. Considering the lack of coding of the application, we aimed our analysis on the front-end of the application and user sentiments about the applications. The front-end was analysed at an individual level by the group that comprised of functionality analysis and operational requirements from the mobile while the sentiment analysis of the Google Play Reviews was taken through 'Appbot', the web-portal for analyzing the mobile application. We also did an additional twitter sentiment analysis of the tweets with the hash-tags: #aarogyasetu and #aarogyasetuapp to further delve into the user reviews about the app. We depicted the Google Play-Store Review analysis and Twitter Sentiment Analysis with the help of Scatter Plots, WordCloud, Bar-Graphs and Percentage Compositions that are accompanied with the suitable tables and timelines. The analysis was performed on data from 2nd April 2020 to 10th May 2020

2. KEY TERMS USED IN THIS PAPER

- Aarogya Setu
- COVID-19
- DiD – Unique Digital ID
- WordCloud
- GPS
- Bluetooth
- BlueTrace Protocol
- Contact Tracing

3. INTRODUCTION

The COVID-19 virus has quickly taken over the world with more than 3 million confirmed cases around the world, the number of deceased is 2 hundred thousand and many developed countries like Italy, USA have been hit the hardest with each country having 20 thousand deaths each. India may not be in such a horrifying condition due to the rampant and remarkable efforts of the government in enforcing the lockdown around the country. Medical professionals and police are putting on all the lines to prevent this deadly virus from further spreading. In these grave conditions the government has launched an app called Aarogya Setu (formerly known as Corona Kavach) to prevent the virus from spreading by making the user of the app aware of people who are infected in their proximity (within 1 km to 10km). Owned by Home Ministry of India and supported by National Informatics Center (NIC), the app has over 9.08 Crore users on its board till date. Its security audit has been performed by IIT Madras. The app uses GPS and Bluetooth to find the location of the user. The app has currently 50 million downloads on Google Play store with a total 75 million downloads.

The app was launched on 2nd April 2020 and has been made mandatory for working officials of government and private sectors. The app is primarily focused and used to contain the increasing COVID-19 risk. The app

uses the GPS and Bluetooth features of the mobile phone to access the location of a person and calculate the number of other infected persons in 6 feet radius. The app alerts the user if a person is COVID -19 positive is in the radius. The tracking is done through a Bluetooth & location-generated social graph, which can show your interaction with anyone who has been tested positive. The app identifies by scanning the database of known cases across India. The app uses self-assessment test to know the risk of a person being infected. The app provides updates on the number of persons being infected state wise and across the whole country. The app is currently available in 12 languages (English, Tamil, Hindi, Telugu, Kannada, Malayalam, Punjabi, Bengali, Oriya, Gujarati, and Marathi, Assamese). The app also provides features like e-pass which is still to get active. The media feature gives the news update and information about the virus with a number of videos providing ways to increase awareness by the help of doctors and celebrity's that have a huge influence on the people.

After you have downloaded and installed the app you are required to register by entering your phone number on which you will receive an OTP after which you would be asked to complete your registration by entering your personal information like gender, full name, age and profession. Then you will be asked to give permission of Bluetooth and GPS location to the app and set location sharing to always so as to keep the information updated. The user can then give a self-test to calculate their own risk of being infected, the user is asked a number of questions regarding their recent activities and travelling history. If answers to some questions raise doubts of a person being infected, the information will be sent to government servers and further steps for isolation will be taken if necessary.

The provide an alert if you come in close proximity of someone who unknowingly have been tested positive for COVID-19, the app further provide directions for self-isolation and what do to if some symptoms are developed by the users.

The data provided by you to app is only available to government. Although, cyber-security expert Mr. Elliot Alderson have shared some security issues in the app via twitter.

Prominent Team Members

- IIT Madras professor V. Kamakoti.
- former Google India executive Lalitesh Katragadda
- MakeMyTrip founder Deep Kalra
- Tata Group chairperson N Chandrasekaran
- Mahindra Group chairman Anand Mahindra
- Tech Mahindra CEO CP Gurnani

Other Applications

| S. No. | Application Name | Country | Release Date | Description |
|--------|------------------|-----------|---------------|--|
| 1. | Trace together | Singapore | 20 March 2020 | Digital contact tracing using the custom BlueTrace protocol; developed by the Government Digital Services agency |
| 2. | COVIDSafe | Australia | 26 April 2020 | Based on the BlueTrace protocol. The app augments traditional contact tracing by automatically tracking encounters between users, and later allowing a state or territory health authority to warn a user they have come within 1.5 meters with an infected patient for 15 minutes or more |

| | | | | |
|-----|--|-----------------|---------------|---|
| 3. | Pan-European Privacy Preserving Proximity Tracing (PEPP-PT/PEPP) | Germany | - | Full-stack open protocol designed to facilitate digital contact tracing of infected participants. The protocol, like the competing Decentralized Privacy-Preserving Proximity Tracing (DP-3T) protocol, makes use of Bluetooth LE to discover and locally log clients in close proximity of a user |
| 5. | Corona map | Saudi Arabia | - | Interactive Map application that allows users to track all COVID-19 cases in the world with statistics and charts and the ability to talk to BashairBot to answer questions about COVID-19 |
| 6. | BeAware | Bahrain | 20 March 2020 | Implementing contact tracing efforts to identify and keep track of all active cases and their contacts |
| 7. | CoronApp | Colombia | 8 March 2020 | It helps detect affected areas and nearby people with a positive diagnosis for COVID-19. It facilitates the real-time monitoring of data collected to the Emergency Operations Center of the National Health Institute, INS. It incorporates technologies such as those developed by the Governments of Singapore and South Korea |
| 9. | GH Covid-19 Tracker App | Ghana | 14 April 2020 | Equipped with location tracking technology to provide detailed information about people who have been at the same event, location, country or other defined locations in order to provide accurate information to health authorities overtime to know who to screen and provide needed assistance |
| 10. | HaMagen | Israel | 22 March 2020 | Hamagen tracks a user's whereabouts using standard location APIs and then compares them to known movements of those diagnosed with COVID-19. In order to check if paths were crossed within the previous 14 days |
| 11. | Gerak and MySejahtera | Malaysia | 3 May 2020 | Gerak - a tracing app which allows police and Ministry of Health to track and analyze user's movement, and register for permission to allow state border crossing MySejahtera - Retrieve information regarding the updated information and statistics of the pandemic |
| 12. | StopKorona | North Macedonia | 13 April 2020 | The Bluetooth-based app traces exposure with potentially infected persons and helps healthcare authorities to provide a fast response |
| 13. | Smittestopp | Norway | 16 April 2020 | Works on Bluetooth and GPS signals |

4. ABOUT AAROGYA SETU APPLICATION & TECHNICAL ARCHITECTURE

- When you register on the App, the following information is collected from you and stored securely on a server operated and managed by the Government of India (**Server**) – (i) name; (ii) phone number; (iii) age;

(iv) gender; (v) profession; and (vi) countries visited in the last 30 days. This information stored on the Server will be hashed with a unique digital id (**DiD**) that is pushed to your App. The DiD will thereafter be used to identify you in all subsequent App related transactions and will be associated with any data or information uploaded from the App to the Server. At registration, your location details are also captured and uploaded to the Server.

- When two registered users come within Bluetooth range of each other, their Apps will automatically exchange DiDs and record the time and GPS location at which the contact took place. The information that is collected from your App will be securely stored on the mobile device of the other registered user and will not be accessible by such other user. In the event such other registered user tests positive for COVID-19, this information will be securely uploaded from his/her mobile device and stored on the Server.
- Each time you complete a self-assessment test the App will collect your location data and upload it along with your DiD to the Server.
- The App continuously collects your location data and stores securely on your mobile device, a record of all the places you have been at 15 minute intervals. This information will only be uploaded to the Server along with your DiD, (i) if you test positive for COVID-19; and/or (ii) if your self-declared symptoms indicate that you are likely to be infected with COVID-19; and/or (iii) if the result of your self-assessment test is either YELLOW or ORANGE. For the avoidance of doubt, this information will NOT be uploaded to the Server if you are not unwell or if the result of your self-assessment test is GREEN.

The applications need the following permissions in the mobile phone:

- Location: approximate location (network-based), precise location (GPS and network-based)
- Receive data from Internet
- View network connections
- Pair with Bluetooth devices
- Access Bluetooth settings
- Full network access
- Run at startup
- Prevent device from sleeping

5. USER INTERFACE

Aarogya Setu has four sections in the new UI, viz, Your Status, Media, COVID-19 Update, and E-pass (which is yet to go active). Your Status tells the risk of getting COVID-19 for the user. Self-Assess lets the user know the risk of being infected. COVID-19 Update gives updates on the local and national COVID-19 cases.

Aarogya Setu is currently available in 12 languages (English, Tamil, Hindi, Telugu, Kannada, Malayalam, Punjabi, Bengali, Oriya, Gujarati, and Marathi, Assamese) and expected to be available in more Indian languages soon. One is asked to provide health and other profiling information after signing into the app.

The app is also built on a platform that can provide Application Programming Interface (API) so that other computer programs, mobile applications and web services can make use of the features and data available of Aarogya Setu.

The specific features for each section go as follows:

Header

- Application Name

- A graphic with exclamation sign, when pressed it requests to share data with server if you've been tested positive for COVID-19
- A graphic for sharing the app
- An option to change language

Status

- Things to do next: This is on the second from the top of the screen. This contains a message if you are safe/unsafe from COVID-19 and in case you're safe it will suggest you to
 - Maintain Social Distance
 - Greet with Namaste instead of a handshake
 - Avoid social gatherings
 - Keep a 6 ft. distance from people
 - Take Self-assessment Test
 - Check app regularly for updates
 - The same is followed by 2 links:
 - Learn more about COVID-19
 - Safety measures against COVID-19
- At present in your neighborhood section:
- Call Helpline: Phone Number: 1075 is displayed. Click prompts the mobile's default dialer
- The same is followed by "Trending Now" section which contains videos for awareness about COVID-19
- Then comes a text box with a message from PM of India, Narendra Modi
- Then comes an appeal for donating on the PM Cares fund
- The section ends at Terms of Use followed by App logo and National Emblem
- The two floating buttons of "Share app" and "Access Again" remain constant

Media

- Divided in various sections: Trending Now, How To Boost Immunity, What Will App Do, How Does It Protect Me?, Make Your Own Mask, Together We Can, Hygiene Must-Dos
- Each video is presented with an image element with a caption which prompts in-app video once clicked.

COVID Updates

- The header followed by last updated time
- Statistics from all over the India with the increase in last 24 hours with sections: Confirmed, Recovered, Deceased
- State wise statistics in form of a table with following columns. Each column contains statistics from the state with the increase in last 24 hours with sections: Location, Confirmed, Recovered, Deceased

e-Pass

- First element is defined for the issued e-Pass, when issued the pass will show-up to you
- The second element contains FAQs about the e-Pass.

6. RESEARCH METHODOLOGY

User Feedback Analysis

The Play Store apps data has enormous potential to drive analysis of applications since they are based on the usage of the application. Actionable insights can be drawn that can explore the current scenario. The dataset chosen is Google Play Store reviews of the Aarogya Setu Application. It is the web scraped data of 2 lakh reviews and 6 lakhs ratings for the application. Considering the lack of expertise in Web-Scrapping, we switched to an online portal for the analysis of the reviews, viz. Appbot, <https://app.appbot.co/>. We created a dashboard on the portal and took the analysis and key findings from the portal.

Twitter Sentiment Analysis

Sentiment Analysis is a technique widely used in text mining. Twitter Sentiment Analysis, therefore means, using advanced text mining techniques to analyze the sentiment of the text (here, tweet) in the form of positive, negative and neutral. It is also known as Opinion Mining, is primarily for analyzing conversations, opinions, and sharing of views (all in the form of tweets) for deciding business strategy, political analysis, and also for assessing public actions.

For our project, we focused our analysis on the main two trending hash-tags i.e. #aarogyasetu and #aarogyasetuapp. The key findings for the analysis are displayed in the jupyter notebooks. Some of the underlying tasks were preprocessing, cleaning, tokenization, stemming and use of python libraries: Numpy, Pandas, WordCloud, Bag of Words and machine learning models as well. The dataset comprised of the ~4K tweets with the two trending hash-tags about Aarogya Setu application.

Analysis of the Application

This is majorly based upon personal feedback and published articles about the application; we explored the aspects of the application by using the same; read articles on the web about the application and also referred to the privacy policy of the application and interviews by stakeholders. The same also included an analysis of the similar applications launched by other countries. This analysis has been the foundation for drafting of major sections including Introduction, User Interface, Technical Analysis and other major titles.

7. DATA ANALYSIS AND LEARNING FROM THE CASE

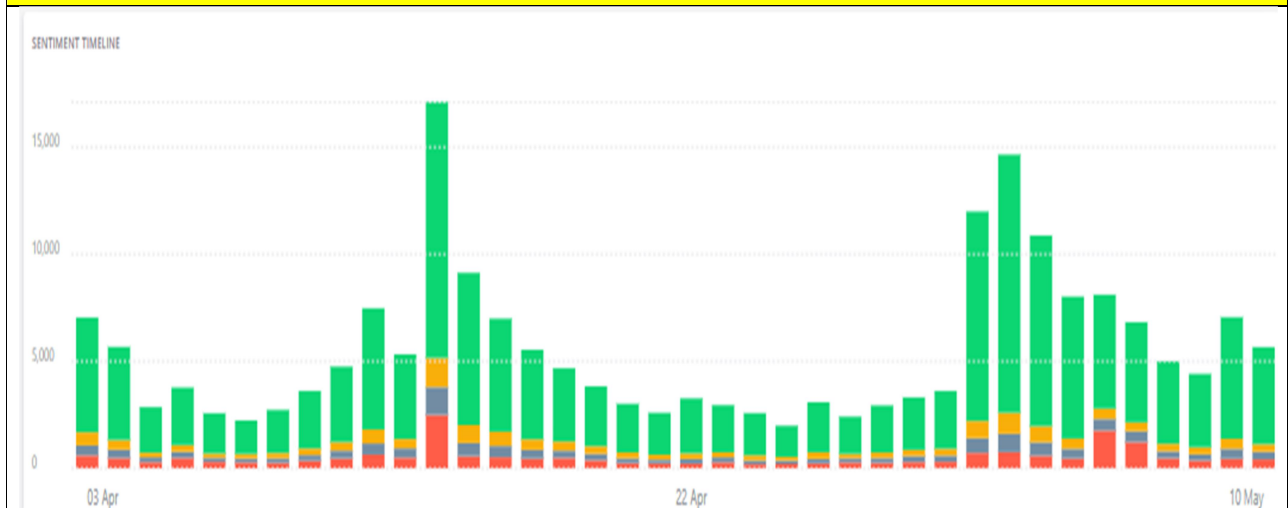
| Date | Average Rating | No. of Reviews |
|------------|----------------|----------------|
| 02/04/2020 | 4.3 | 2603 |
| 03/04/2020 | 4.5 | 7045 |
| 04/04/2020 | 4.5 | 5672 |
| 05/04/2020 | 4.4 | 2858 |
| 06/04/2020 | 4.3 | 3773 |
| 07/04/2020 | 4.3 | 2576 |
| 08/04/2020 | 4.3 | 2238 |
| 09/04/2020 | 4.4 | 2728 |
| 10/04/2020 | 4.4 | 3612 |
| 11/04/2020 | 4.4 | 4751 |
| 12/04/2020 | 4.5 | 7477 |
| 13/04/2020 | 4.5 | 5323 |
| 14/04/2020 | 4.3 | 17115 |
| 15/04/2020 | 4.6 | 9130 |
| 16/04/2020 | 4.6 | 6990 |
| 17/04/2020 | 4.5 | 5537 |
| 18/04/2020 | 4.4 | 4674 |

| Ratings | |
|----------------|--------|
| No. of 5 Stars | 471115 |
| No. of 4 Stars | 61245 |
| No. of 3 Stars | 23556 |
| No. of 2 Stars | 9422 |
| No. of 1 Star | 37689 |

| Reviews Break-Down | |
|--------------------|-------|
| Positive | 75.7% |
| Neutral | 7.90% |
| Mixed | 7.% |
| Negative | 9.40% |

| Sentiment Score |
|-----------------|
| 89% |

SENTIMENT TIMELINE



****The above are the analysis of the Google Play Store Reviews of the Application, the analysis of Twitter Sentiment Analysis is in the attached Jupyter Notebook and the Python File**

8. MAJOR CHALLENGES

One of the major challenges of this app is that it is prone to wrong estimation of a user's chance of being unhealthy as it depends on the user's self-assessment test for the purpose. A user may be unable to assess him or her correctly for symptoms because of ignorance or any other factor. In cases of asymptomatic COVID-19 positive cases, which have been on a rise lately, this app could fail severely as it assesses users based on symptoms, which might not show till very late in these types of cases.

The app only works when the phone is connected to the internet either via Wi-Fi or mobile network data. So, if there is a lack of internet connectivity in an area, then the app won't be able to collect data. Furthermore, it requires location permissions and persistent Bluetooth connectivity which may lead to faster consumption of device battery. Thus, the performance of the app highly depends on how technologically capable the user's device is.

Though the target audience of this app consists of each and every citizen of India, still it is unable to reach a large portion of the population. The reason behind this is that the app has been developed for smartphone's only. Although more than 77% of India's population is using smartphones, some citizens still use older phones due to affordability reasons.

Another major challenge is that even if the user has a compatible smartphone, the application may be overwhelming for a person who is not exposed to such a technical environment. This leads to a major concern with regard to digital literacy and awareness among the population.

The app does not have any specialized features for people with vision disability which is a major drawback and also poses a challenge as to how to incorporate special features in order to help the specially-abled citizens of India during the worldwide pandemic.

The Aarogya Setu App uses contact tracing as a means to improve the situational awareness to manage Covid-19 pandemic, but there have been legitimate concerns about whether it is privacy-friendly as has been claimed.

Cyber security experts are worried that Aarogya Setu could violate its users' privacy and be a surveillance tool in the hands of the government.

Technical challenges include the use of static ID for unique identification of the user. The unavailability of the source-code for testing and location is stored in an encrypted format. These create ambiguity in the user and a feeling of doubt in the user and thus ending in refrain from using the application.

Challenges for the research have been unavailability of the source code, lesser knowledge of web-scraping and the scarcity of governmental records for analysis and review.

9. CONCLUSION

- The overall architecture of Aarogya Setu application is in synchronization with those of other countries, almost all other applications are using the similar protocols for tracing contact
- There is a feeling of doubt in the users, this is basically due to lack of transparency from the developer's end till now and also due to 'unclear statements' from application committee spokespersons
- The overall outlook of the user is somewhat positive about the application that is being depicted by the Sentiment Score of 89% in the Google Play Store reviews
- The average ratings received from application users per day have been 4.3+ from the time the application is released
- The most commonly used phrases in tweets are "covid", "indiafightscorona", "lockdown", "stayhomestaysafe" and "privacy"

10. SUGGESTIONS

- The government of India needs to release the open source code of the application at the earliest so as to avoid any possible misconceptions being raised by the country
- There needs to be a release of proper reports containing quantitative data to illustrate the efficiency of the application in contact tracing and preventing the spread of COVID-19
- An elaborated analysis of the application needs to be released via proper media channels from the concerned authority

11. REFERENCES

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12. CONTRIBUTION OF EACH STUDENT:

The team worked jointly to finalize the report. We collectively identified the challenges we had, discussed about the same and ideated several methods to eradicate the same. We made sure to allot some analytical and some content work to each of the group members. Aayush was responsible for researching about the applications in other countries and played a key role in the initial analysis of the

application, Abdal was responsible for Google Play Store Analysis, and he researched about the possible ways to scrap data and was also responsible for listing down the conclusion and suggestions and the final compilation of the document. Anshuman analysed the challenges faced by the application in terms of technicalities, user-reviews, and wrote the research methodology for the project. Saksham was the only person responsible for Twitter Sentiment Analysis and executed the duty with utmost sincerity. He also paraphrased the user interface of the application. The team worked diligently in the project report.