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Title: **ACCESSIBILITY AND ASSISTIVE TECHNOLOGY: A CASE STUDY OF AAROGYA SETU APPLICATION**

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ACCESSIBILITY AND ASSISTIVE TECHNOLOGY:A CASE STUDY OF AAROGYA SETU APPLICATION

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Abstract:

World is pacing in ultra-high speed with huge population along with drastic changes in the technology day-by-day. This results in new era of applications, tools, and devices to make human life simpler. But the advancements in technology and human life leads to number of problems like lack of security, privacy, health and many more. In recent time the most dangerous problem that has been haunting the whole human race in various continents is COVID-19 virus. There are number of assistive technologies that has been created and deployed around the world to cope up and sustain in this pandemic situation. Now we are going to discuss one of the mobile assistive applications which helps to reduce the spreading of this contiguous virus in our country which is named as AAROGYASETU by Indian government. This is a pan India application to monitor, prevent as well as analyse the spreading of covid virus around the country. The assignment follows with the pros and cons of the application along with accessibility audit of the mobile app and finally proposed solution for the problems identified by the analysis.

Key Words: Aarogya setu App, COVID – 19, Indian Government

Introduction

The mobile applications in short form App’s are used for assisting the mobile users for various applications in their day-to-day life. Now-a-days people are completely relied upon mobile apps which are handy to carry and at the same time easy to maintain. As the world is looking forward to 5G technology the processing speed of the devices are increasing drastically day-by-day[2]. To eradicate the most contagious current virus that is COVID-19, Indian government had initiated a mobile application and named it as Aarogyasetu app [1][7].

This application is specifically considered for accessibility auditing because this has been made a compulsion for all international travelling users, along with interstate travellers and to get access for many other public places. This is a government initiative to assess the population in our country to reduce the contamination of the virus [4]. There are number of apps that has been defined for the same application that are authorised by various states in India. The list of apps and their corresponding applications and their state authorizations are as shown below[3][5][7].

| INDIAN AUTHORITIES HAVE LAUNCHED NEARLY 62 COVID-RELATED APPS SO FAR | | | |
|----------------------------------------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------|
| FUNCTION | APP NAMES | WHO MADE IT | WHERE IT IS USED |
| CONTACT TRACING | AAROGYA SETU | National Informatics Centre (NIC) - IT Ministry | Pan India |
| | MAHAKAVACH | Maharashtra State Innovation Society- Maharashtra Govt. | Maharashtra |
| QUARANTINE MONITORING | BSAFE TRACKING | Kerala Police Cyberdome | Kerala |
| | SMC COVID-19 TRACKER | Surat Municipal Corporation (SMC) | Surat |
| PROVIDE COVID 19 & HEALTH RELATED INFORMATION | GOK DIRECT | Okopy Online Services Pvt. Ltd., Kozhikode ; backed by Kerala Govt. | Kerala |
| | KAVACH | Chhattisgarh Infotech Promotion Society - Chhattisgarh Govt. | Chhattisgarh |
| ESSENTIAL SERVICES RELATED (GROCERIES & MEDICAL SERVICE) | COVA | Ueusage Services Pvt. Ltd., Haryana ; Punjab Govt. | Punjab |
| | JAN SAHAYAK-HELPME APP | Electronics & IT Dept - Haryana Govt ; (OEBusiness) OEB Tech Pvt. Ltd., Gurgaon | Haryana |
| COLLECT USER SUBMITTED COVID RELATED INFO | COVID-19 FEEDBACK | IT Ministry | Pan India |
| | GCC CORONA MONITORING | Greater Chennai Corporation | Chennai |
| | JHARKHAND SAHAYTA | Jharkhand Space Applications Center - Jharkhand Govt. | for people of Jharkhand currently out of state |
| FINANCE RELATED | Collect data on migrant workers belonging to Jharkhand to provide financial assistance | | |
| | WEST BENGAL EMERGENCY FUND | West Bengal Govt. | anyone can use app to donate |

For users to donate to West Bengal State Govt. to fight pandemic

Figure 1.1 : Mobile apps for COVID prevention that are authorised by various states

In figure 1.1, we can observe that Arogya setu is considered as a PAN Indian mobile app that has been considered across the country [13]. The app is specifically targeted for the people who are either effected by COVID-19 or people who are having symptoms of the virus to maintain social distancing so that the containment of this virus would reduce [11] and at the same time government can analyse the situation to take necessary precautionary measures.

- Usability testing
- Compatibility testing
- Interface testing
- Service testing
- Low-level resource testing
- Installation testing

Let us take a quick view of each testing process and at the same time discuss about the tools used while testing those aspects [2]. Most of the audit process is mainly done using Browser stack tool

Audit process:

The accessibility auditing of a mobile application must be done with various testing scenarios that has to be run on devices with different hardware/software specifications. To do this, there are several testing procedures in the audit process. Here, is the list of major tests that are done while auditing this mobile application.

- App security testing
- Operational testing
- Native and hybrid app testing
- Front end testing
- Network compatibility testing

which is a desktop-based interface tool to simulate the applications in various devices virtually to verify the app functionality and various aspects of the application. [7]

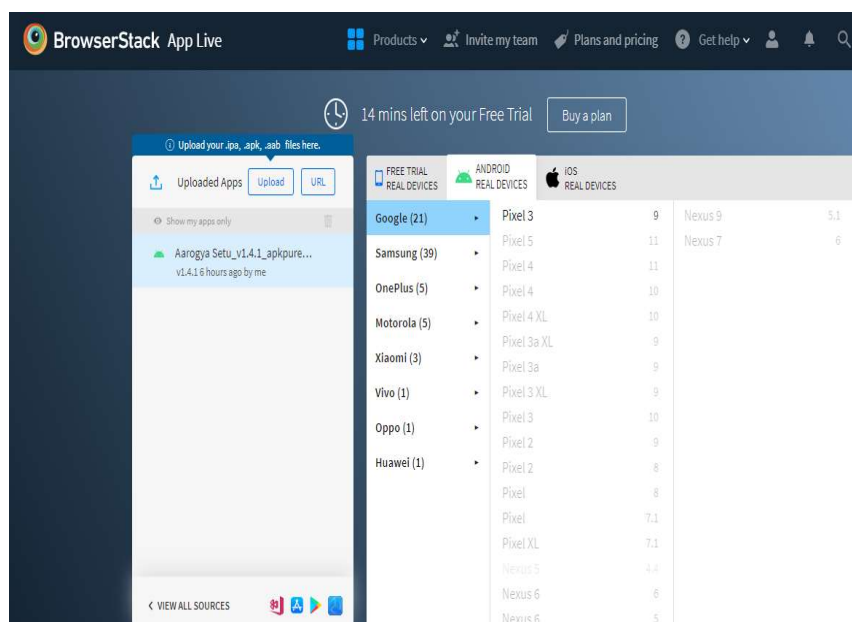


Figure 2.1: testing of mobile apps in various devices using Browser stack tool(<https://www.browserstack.com/>)

As shown in figure 2.1 the Aarogya setu app has been uploaded [15] as shown on the left side of the tool and the required android and iOS devices can be selected to audit the accessibility of the mobile app. The mobile apps in .apk and .ipa forms which used for android and iOS users respectively can be obtained from Apkmonk site which is an open-source platform for all kinds of apps and their versions.

The Aarogya setu app mainly uses Bluetooth along with mobile location services to identify the actual location of the user. So, it is compulsory to use Bluetooth and device location on all the time when the user must use this application. This can be seen in the figure 2.2 as shown below.

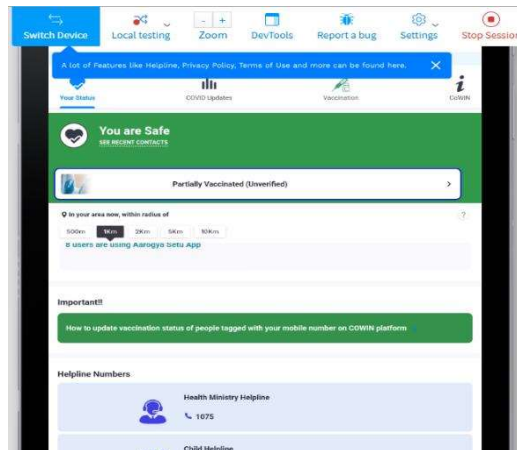


Figure 2.2: identification of number of users in the device radius (<https://www.aarogyaasetu.gov.in/>)

Usability testing: (Tool used: Browser stack, jadx-gui)

The usability testing deals with the app usage flexibility along with the flow that has been maintained for smooth functioning of the app. The application flow deals with:

- Background performance of the app: In

this testing we mainly check whether the app accepts the calls and messages while using the app[8].

- Integration with other services: In this testing we mainly focus of integration of the app with various services of the mobile device like GPS, Bluetooth, Wi-Fi, messaging etc

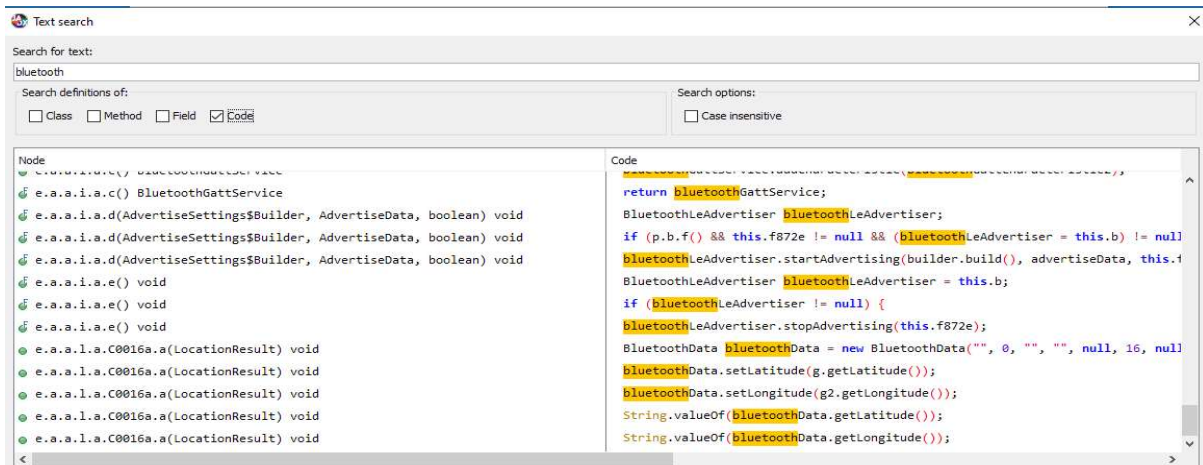


Figure 2.3: Usage of Bluetooth for the identification of user actual location

In figure 2.3, we can observe from the last two attributes in the code that the latitude and longitude of the device has been identified by using device Bluetooth[12].

Compatibility testing: (Tools used: Browser stack)

This testing deals with the app performance in various platforms and different devices like iOS, Android, Microsoft [13].

- Navigation of different screens easily: In this testing we mainly check whether the app works with split screen view.

Interface testing: (Tools used: Browser stack)

This testing mainly deals with the UI design and workflow which is mainly focused on the menu bars, navigations, gestures, settings etc.



Figure 2.4: Results showing how App not supporting device rotation gesture

In figure 2.4, we can observe the interface is not supporting device rotation gesture for this app [14].

Services testing: (Tools used: Browser stack)

This testing is mainly focused on the working of the app in online and off-line modes whereas, this app supports in both the modes which can be tested using the throttle network option in browser stack tool as shown in figure 2.5 below [9].

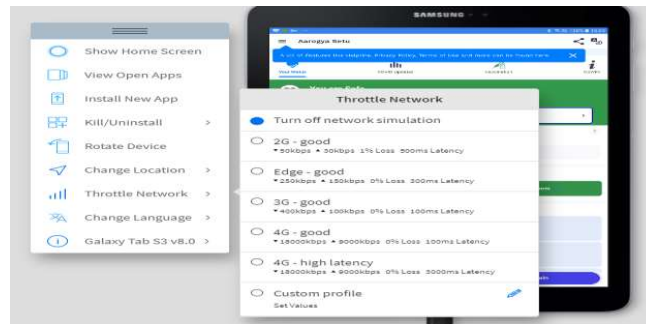


Figure 2.5: Service testing of App using network throttle option

Low-level resource testing:(Tools used: Browser stack)

This testing mainly focuses on Validating local data base issues. In figure 2.6 as shown below we

can observe that the data base will be deleted for every 3 months as per the terms and conditions app.

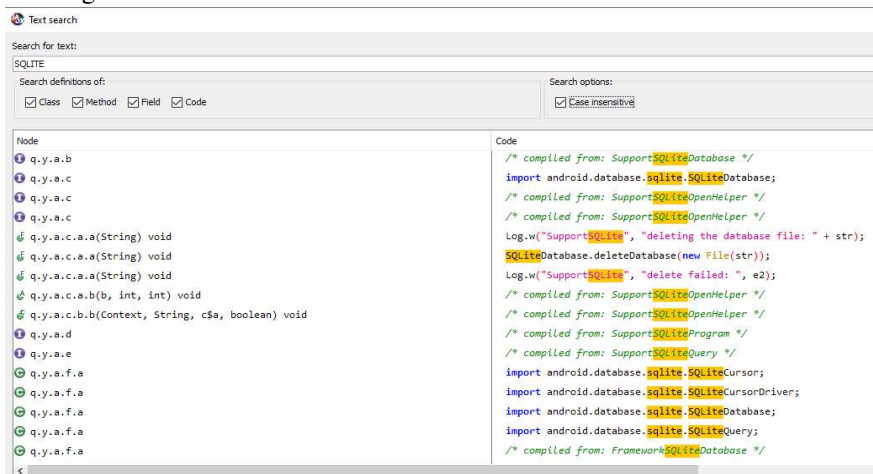


Figure 2.6 Verification of database issues using jadx-gui tool [15]

Installation testing:(Tools used: Browser stack)

This testing mainly focuses on the validation of installation and uninstallation of the app in various devices[15].

Application Security:(Tools used: jadx-gui, Browser stack)

The Application security testing deals with various vulnerabilities of the app while using in various environments like network usage, security, and privacy. The major functions of this testing are:

- Penetration testing:

A major part of testing that must be done for every application to identify the CIA triad of the application.

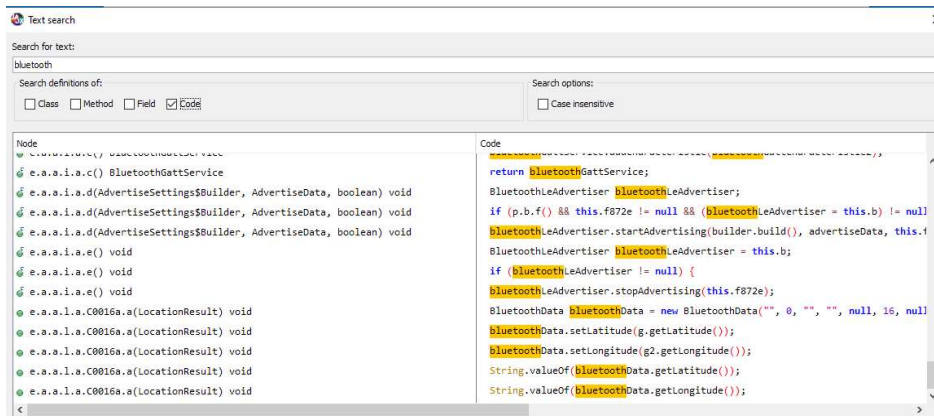


Figure 2.7: Penetration test result showing accessing Bluetooth for device location

- Data protection capability

The application must maintain the device secrecy to maintain privacy of the device

user. In figure 2.8, we can see that the app is accessing the contact list from the device.



Figure 2.8: penetration test result showing app accessing the contact list from the device

- Network security protocol: The app is using SHA 256 with RSA protocol for secure transactions and signature.
- Authentication by certificates and permissions: the authentication is done by using MD5 fingerprint with SHA1/256

Operational testing: (Tools used: Browser stack)

This testing mainly focuses on the testing of backups during data loss while updating app.

Native and hybrid app testing: (Tools used: Browser stack, jadx-gui)

This testing mainly deals with the similar functionalities like using Bluetooth, location services etc of the device.

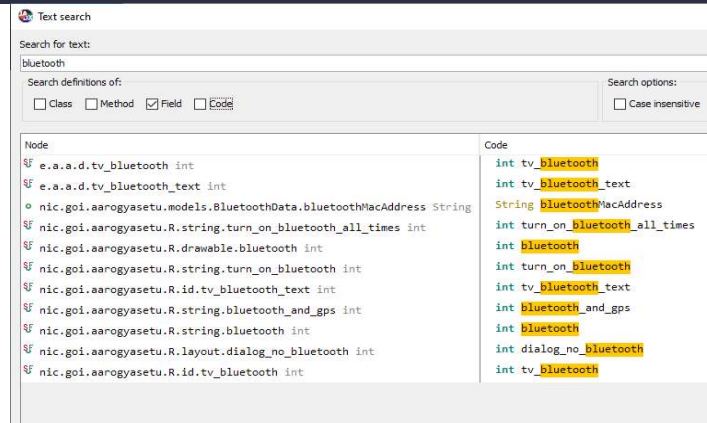


Figure 2.9: Native and hybrid testing showing access of Bluetooth while using the App

Front-end testing: (Tools used: Browser stack)

This testing mainly focuses on the frontend UI (User Interface) of the application and its performance analysis.

Network compatibility testing:(Tools used: Browser stack)

This test focuses on various network related issues like packet loss, Jitters, network speed test, storage databases and backend testing[12].

Problem identification:

The accessibility audit has been done to verify various vulnerabilities in the Aarogya setu App which results in various problems that have to be modified to maintain better compatibility, security and at the same time not to reduce the device capabilities. These are the major tools that has been used in the overall audit process:

- ❖ Browser stack: This tool is mainly used to test the app for various devices and cross platforms along with network level testing.
- ❖ Jadx-gui: A mobile app is a .apk file which is not in a readable format for the user. To penetrate test the app we need to convert the apk file into .Dex file (Dalvik executables) to find the vulnerabilities in the source code[15].
- ❖ Apkmonk: Apkmonk is an all-in-one application data base for .apk files and its

version updates so far from the date of release. In our analysis the Aarogya setu application has been updated from 1.0.1 to 1.4.1 (13 versions) adding various functionalities to the app. Recently the latest update includes vaccine registration and certificate download using registered user mobile number[6][14][15].

The following are the problems that are identified by the Accessibility audit for aarogya setu app:

- i. The app uses Bluetooth and location of the device to find the location of the user, but this makes the device get drained easily.
- ii. The application is not supporting screen rotation gesture which will become problem to old age people due to huge content and updates.
- iii. The algorithm shows that the app uses Bluetooth for location identification to give active user in the device radius, but Bluetooth gets signal only up to 30 feet which is around 900 cms.
- iv. The user data has been deleted for every 3 months for effected users and for everyone month for non-effected users which makes every user must register every time they reinstall the app.
- v. The Aarogya setu continuously uses data from government websites Mohfw.gov.in, registry.gov and swaraksha.gov to attain continuous covid updates which creates loss of energy and data from the device.

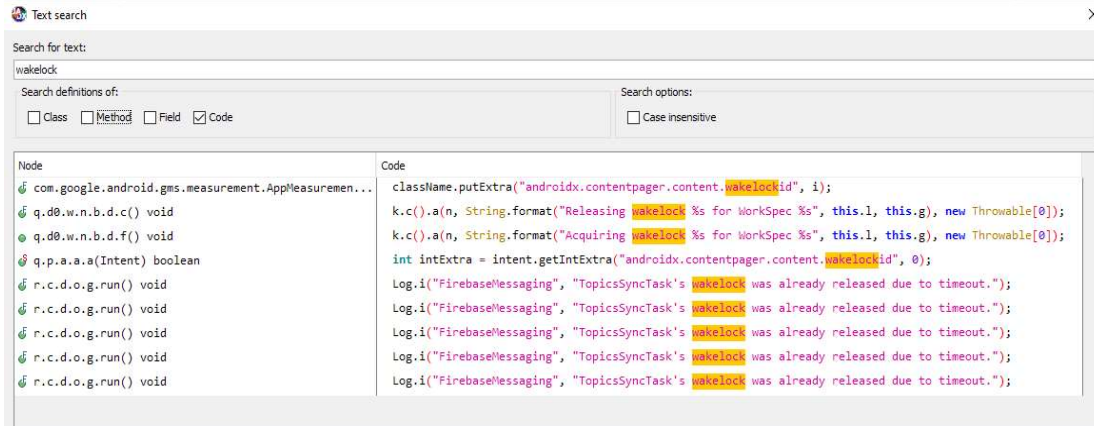


Figure 3.1: Identification of wake lock vulnerability due to Bluetooth and location access

In figure 3.1, we can observe a wake lock which defines that the developer can be able to change the conventional device power state which in return degrade the of the device battery life. This shows continuous usage of Bluetooth and location becomes big vulnerability for the app.

Proposed model:

Assisted GPS (A-GPS) is one of the major models which is used to identify the actual location of the device. Here we can see that along with satellite triangularization base station signals and the Wi-Fi signals can be used to confirm the actual triad when the user is in locked room. Since a base station that is a conventional mobile tower can cover up to 2.5kms.

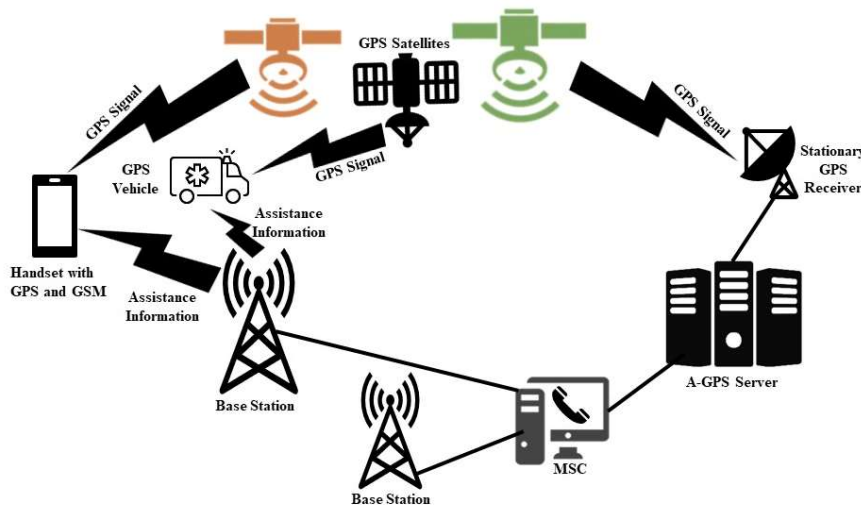


Figure 4.1: Proposed model for device location identification instead of using Bluetooth

In figure 4.1, we can observe assisted GPS (AGPS) model in which the local base stations will act as a backup for device location in critical situations like closed room or any buildings where GPS cannot find triangulation. [9]

Conclusion:

The accessibility assessment of aarogya setu app has been done to find various vulnerabilities in

the application which is degrading the performance of the application along with the device. The continuous usage of Bluetooth and location services in mobile device leads to device getting drained easily. The assisted GPS is a hybrid model of device location identification method where the actual device location can be obtained even more accurately with less losses to the device performance[10].

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