

Location Tracking using Smartphones

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Abstract: *In this paper, we present an android application that facilitates seamless location tracking for an individual. Our application is based on GPS location services that provide accurate and approximately location information of an individual and updates the same on a cloud server. It fetches location every few minutes to provide to save battery of the device the application is running on as fetching location repeatedly might have poor impact on the battery health of the device. It allows authorized people to access this location from the server so that they can know the location an individual or a group of individuals.*

Keywords: Smartphones, Android, Location, GPS, Geofences, SMS.

I. INTRODUCTION

For the past 24 years, smartphones come equipped with Global Positioning System or GPS that uses satellites to calculate the current position of the device. The first ever smartphone with this capability was the **Benefon Esc!** that was developed in 1999 as the first mobile phone with GPS available to the commercial sector.

This research paper focuses on tracking location of a person using an Android application. The aim of the application is to track the location of a user and store it on a server for access by authorized people. Here, authorized people refer to those whom the user has explicitly granted the permission to track themselves. The app can be used to track the location of an individual or a group of individuals for safety purposes and to ensure that are where there are supposed to be. For example, a student whose routine is to be at college five days a week from morning till evening. The application would allow to set up alerts for when the individual reaches or leaves the marked area. Location tracking is the process of monitoring the movements of an object or a person. With the increasing popularity of smartphones, it has become possible to track locations using them.

However, location tracking has also raised concerns about privacy and security. Critics argue that the widespread use of location tracking can be used to monitor individuals' movements and activities without their knowledge or consent. To address these concerns, many companies and organizations have implemented policies and procedures to ensure that location tracking is used responsibly and transparently.

In this research paper, we present an overview of location tracking using smartphones that operate on the Android operating system. We discuss the various technologies used for location tracking, the security issues involved in location tracking, and the applications of location tracking in different fields. Location tracking has become an essential part of modern life. It is used in a variety of fields, including transportation, logistics, healthcare, and security. Location tracking using an Android app has become popular due to the widespread availability of smartphones.

The Android operating system provides a range of location-based services that allow developers to create location-based applications. This application uses GPS to get the device location and upload it to a cloud server. As we know, devices nowadays have a lot of applications running at them at the same time, all of which are performing different jobs and tasks and using different sensors. As such, this application fetches and uploads the location every few minutes instead of in real-time so as to not affect the battery health of the device and causes rapid battery drainage which might not be pleasing to the user in most of the cases. The application provides an invite feature that allows another user of the app to fetch the updated location of the individual

This is done using a One-Time-Password (OTP) that is sent to person sharing his/her location details to be shared on to the invited person to prevent any kind of unauthorised access to the location. It also has an SOS feature that sends the latest location of the user to people whom the user have pre-selected during the setup of the application. It sends the location details through SMS to the selected persons. This kind of feature can be extremely helpful in case of emergencies where there might not be enough time to call someone and inform them of the situation.

There's also a feature for setting up geofences. Once the device triggers the geofence, an alert is sent to the person tracking the device about the same. This keeps the person updated as to if the user has reached some destination or not.

II. TECHNOLOGY USED IN THE APPLICATION

GPS is a system of 30+ navigation satellites circling Earth. These satellites constantly send out signals. A GPS receiver within a smartphone listens for these signals. Once the receiver calculates its distance from four or more GPS satellites, it can figure the device is positioned. The basic GPS service provides users with approximately 7.0-meter accuracy, 95% of the time, anywhere on or near the surface of the earth. To accomplish this, each of the 31 satellites emits signals that enable receivers through a combination of signals from at least four satellites, to determine their location and time. GPS satellites carry atomic clocks that provide extremely accurate time. The time information is placed in the codes broadcast by the satellite so that a receiver can continuously determine the time the signal was broadcast. The signal contains data that a receiver uses to compute the locations of the satellites and to make other adjustments needed for accurate positioning. The receiver uses the time difference between the time of signal reception and the broadcast time to compute the distance, or range, from the receiver to the satellite. The receiver must account for propagation delays or decreases in the signal's speed caused by the ionosphere and the troposphere. With information about the ranges to three satellites and the location of the satellite when the signal was sent, the receiver can compute its own three-dimensional position. An atomic clock synchronized to GPS is required in order to compute ranges from these three signals. However, by taking a measurement from a fourth satellite, the receiver avoids the need for an atomic clock. Thus, the receiver uses four satellites to compute latitude, longitude, altitude, and time.

Cloud server is a pooled, centralized server resource that is hosted and delivered over a network—typically the Internet—and accessed on demand by multiple users. Cloud servers can perform all the same functions of a traditional physical server, delivering processing power, storage and applications.

Cloud servers can be located anywhere in the world and deliver services remotely through a cloud computing environment. A cloud server is made possible through virtualization. A Hypervisor is installed on physical servers to connect and virtualize them: abstracting their combined resources and pooling them together to create virtual servers. These virtual resources can then be automated and delivered over the cloud for shared use in a single organization or across multiple organizations. This approach is known as the infrastructure-as-a-service (IaaS) model.

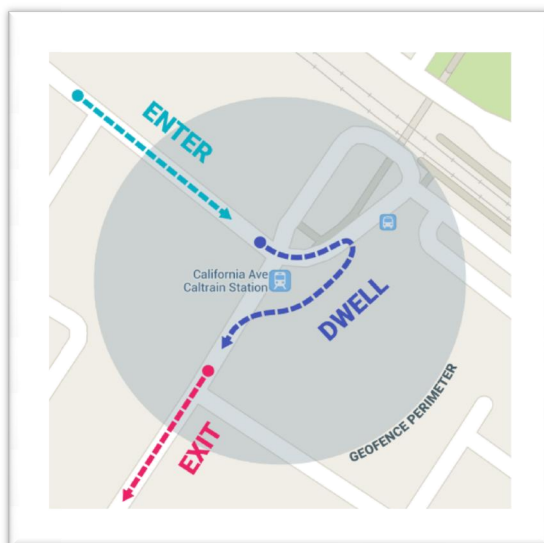
One-Time Password (OTP) is a temporary password that is generated for a single use and expires after a short period of time. OTPs are typically used for authentication purposes to verify the identity of a user during online transactions or access to secure systems. OTPs can be delivered to the user via various means, such as SMS, email, or a dedicated mobile app. OTPs are considered more secure than static passwords because they are valid only for a single use and for a limited time period, reducing the risk of unauthorized access to a user's account or system. OTPs are widely used in various industries, including banking, finance, healthcare, and e-commerce.

Geofences are virtual boundaries that are set up around a specific location or area using GPS or other location-based technologies. A geofence can be a circular area, a polygon, or a custom shape that defines a specific geographic location or area of interest. Geofences can be set up to trigger notifications or alerts when a device or person enters or exits the geofenced area. Geofences are commonly used in location-based applications for various purposes, such as marketing, safety, and security. For example, a retailer might use geofencing to trigger a notification or offer to a customer who enters a store, or a hospital might use geofencing to track the location of patients and ensure their safety. Geofencing can also be used in logistics and transportation to track the location of vehicles and monitor their movements. Geofencing technology can be implemented using various techniques, such as GPS, Wi-Fi, cellular networks, and Bluetooth. When a device enters or exits a geofenced area, it triggers an event that can be used to trigger an action, such as sending a notification or alert

Geofencing technology is widely used in various industries, including retail, healthcare, logistics, and transportation, and has numerous applications for improving efficiency, safety, and security.

It generates three types of alerts:

- **Enter:** It is triggered when the device enters the geofence marker.
- **Dwell:** It is triggered when the user stay within the bounds of the geofence for a certain period of time.
- **Exit:** It is triggered when the user exits the geofence marker.



III. SECURITY ISSUE INVOLVED IN LOCATION TRACKING

Location tracking can be a useful tool for many purposes, such as navigation, social media, and marketing. However, there are also significant security issues involved in location tracking that must be addressed to protect users' privacy and prevent unauthorized access to their sensitive information.

One of the most significant security issues associated with location tracking is the risk of data breaches. If location data is not properly secured, it can be intercepted by hackers or other unauthorized parties, potentially exposing sensitive information about the user's whereabouts and activities. This information could be used for nefarious purposes, such as stalking or identity theft.

Another security issue associated with location tracking is the risk of misuse by third-party apps or service providers. Many apps collect location data as part of their functionality, but may not provide clear information about how this data is being used or shared with other parties. This could lead to unintended consequences, such as the user being tracked by advertisers or marketers without their knowledge or consent.

In addition, location tracking can also pose security risks related to physical safety. For example, if a user's location is publicly available, it could make them vulnerable to physical harm, such as stalking or harassment.

To address these security issues, it is important for developers and service providers to implement robust security protocols and data protection measures. This includes encryption of location data during transmission and storage, clear user consent and disclosure policies, and strict data access controls to prevent unauthorized access to sensitive information. Users also have a responsibility to be aware of the risks associated with location tracking and to take appropriate measures to protect their privacy, such as disabling location tracking in apps or adjusting their privacy settings.

IV. APPLICATIONS OF LOCATION TRACKING

Location tracking has a wide range of applications in various industries and fields, including:

- **Navigation:** Location tracking is widely used in navigation apps, such as Google Maps and Waze, to provide real-time information about traffic conditions, routes, and directions.
- **Emergency services:** Location tracking can be used to improve emergency response times by providing first responders with real-time information about the location of the caller.
- **Asset tracking:** Location tracking can be used to track the location of valuable assets, such as vehicles or equipment, to improve efficiency and prevent theft.
- **Retail:** Location tracking can be used to provide personalized offers and recommendations to customers based on their location and past behaviour.

- **Healthcare:** Location tracking can be used to monitor the location of patients and ensure their safety, particularly in long-term care facilities or for patients with dementia or Alzheimer's disease.
- **Logistics and transportation:** Location tracking is essential for logistics and transportation operations, as it enables companies to track the location of shipments and vehicles in real-time and optimize routes and delivery schedules.
- **Social media:** Location tracking can be used to share the user's location with friends and family on social media platforms, such as Facebook and Instagram.
- **Marketing:** Location tracking can be used to target users with ads and promotions based on their location and past behaviour, which can help to increase sales and revenue.

Overall, location tracking has numerous applications in various industries and fields, and its importance is likely to continue to grow as location-based technologies become more advanced and pervasive.

V. SOFTWARE REQUIREMENT SPECIFICATION

The Software Requirements Specification is produced at the culmination of the analysis task. The function and performance allocated to software as part of system engineering are refined by establishing a complete information description, a detailed functional and behavioural description, an indication of performance requirements and design constraints, appropriate validation criteria, and other data pertinent to requirements.

The proposed system has the following requirements:

- System needs store information about new entry of Flight.
- System needs to help the internal staff to keep information of Ticket and find them as per various queries.
- System need to maintain quantity record.
- System need to keep the record of Booking.
- System need to update and delete the record.
- System also needs a search area.
- It also needs a security system to prevent data.

Identification of Need

The old manual system was suffering from a series of drawbacks. Since whole of the system was to be maintained with hands the process of keeping, maintaining and retrieving the information was very tedious and lengthy. The records were never used to be in a systematic order. there used to be lots of difficulties in associating any particular transaction with a particular context. If any information was to be found it was required to go through the different registers, documents there would never exist anything like report generation. There would always be unnecessary consumption of time while entering records and retrieving records. One more problem was that it was very difficult to find errors while entering the records. Once the records were entered it was very difficult to update these records.

The reason behind it is that there is lot of information to be maintained and have to be kept in mind while running the business. For this reason, we have provided features Present system is partially automated (computerized), actually existing system is quite laborious as one has to enter same information at three different places.

Documents and reports that must be provided by the new system: there can also be few reports, which can help management in decision-making and cost controlling, but since these reports do not get required attention, such kind of reports and information were also identified and given required attention.

- Details of the information needed for each document and report.
- The required frequency and distribution for each document.
- Probable sources of information for each document and report.
- With the implementation of computerized system, the task of keeping records in an organized manner will be solved. The greatest of all is the retrieval of information, which will be at the click of the mouse. So the
- proposed system helps in saving the time in different operations and making information flow easy giving
- valuable reports
- All hardware and software cost has to be borne by the organization.

- Overall we have estimated that the benefits the organization is going to receive from the proposed system will surely overcome the initial costs and the later on running cost for system.

After doing the project Flight Ticket Booking System, study and analysing all the existing or required functionalities of the system, the next task is to do the feasibility study for the project. All projects are feasible - given unlimited resources and infinite time.

Feasibility study includes consideration of all the possible ways to provide a solution to the given problem. The proposed solution should satisfy all the user requirements and should be flexible enough so that future changes can be easily done based on the future upcoming requirements.

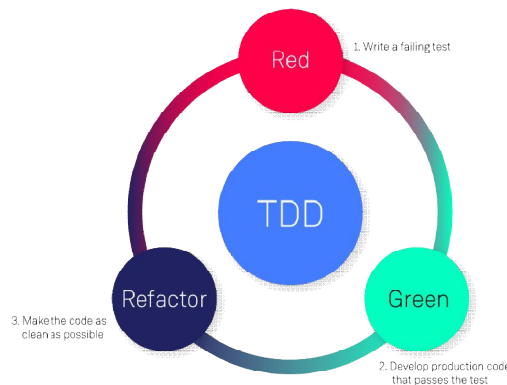
This is a very important aspect to be considered while developing a project. We decided the technology based on minimum possible cost factor.

This included the study of function, performance and constraints that may affect the ability to achieve an acceptable system. For this feasibility study, we studied complete functionality to be provided in the system, as described in the System Requirement Specification (SRS), and checked if everything was possible using different type of frontend and backend platform.

No doubt the proposed system is fully GUI based that is very user friendly and all inputs to be taken all self-explanatory even to a layman. Besides, a proper training has been conducted to let know the essence of the system to the users so that they feel comfortable with new system. As far our study is concerned the clients are comfortable and happy as the system has cut down their loads and doing

VI. TEST DRIVEN DEVELOPMENT

It is a software development practice that focuses on creating unit test cases before developing the actual code. It is an iterative approach combining programming, unit test creation, and refactoring. The TDD approach originates from the Agile manifesto principles and Extreme programming. As the name suggests, the test process drives software development. Moreover, it's a structuring practice that enables developers and testers to obtain optimized code that proves resilient in the long term. In TDD, developers create small test cases for every feature based on their initial understanding. The primary intention of this technique is to modify or write new code only if the tests fail. This prevents duplication of test scripts. TDD is an agile development methodology where tests are written before the code is developed. In contrast, traditional testing is performed after the code is written. TDD focuses on testing small code units at a time, while traditional testing covers testing the system as a whole, including integration, functional, and acceptance testing. TDD follows an iterative process, where small chunks of code are developed, tested, and refined until they pass all tests. The code is usually tested once and then refined based on the results in traditional testing. TDD aims to catch errors as early as possible in the development process, making debugging and fixing them easier. Traditional testing, on the other hand, may require more effort to debug errors that are discovered later in the development process. TDD documentation typically focuses on the test cases and their results, while traditional testing documentation may include more detailed information about the testing process, the test environment, and the system under test.



There are three phases of test driven development:

- **Create precise tests:** Developers need to create exact unit tests to verify the functionality of specific features. They must ensure that the test compiles so that it can execute. In most cases, the test is bound to fail. This is a meaningful failure as developers create compact tests based on their assumptions of how the feature will behave.
- **Correcting the Code:** Once a test fails, developers must make the minimal changes required to update the code to run successfully when re-executed.
- **Refactor the Code:** Once the test runs successfully, check for redundancy or any possible code optimizations to enhance overall performance. Ensure that refactoring does not affect the external behaviour of the program.

Agile development demands regular feedback to develop the expected product. In simple terms, one can also term Agile development as Feedback Driven Development.

There's a high probability that project requirements may change during the development sprint cycle. To deal with this and to build products aligned with the client's changing requirements, teams need constant feedback to avoid dishing out unusable software. TDD is built to offer such feedback early on

TDD's test-first approach also helps mitigate critical bottlenecks that obstruct the quality and delivery of software. Based on the constant feedback, bug fixes, and the addition of new features, the system evolves to ensure that everything works as intended. TDD enhances collaboration between team members from both the development and QA teams and the client. Additionally, as the tests are created beforehand, teams don't need to spend time recreating extensive test scripts.

Benefits:

- Fosters the creation of optimized code.
- It helps developers better analyse and understand client requirements and request clarity when not adequately defined.
- Adding and testing new functionalities become much easier in the latter stages of development.
- Test coverage under TDD is much higher compared to conventional development models. The TDD focuses on creating tests for each functionality right from the beginning.
- It enhances the productivity of the developer and leads to the development of a codebase that is flexible and easy to maintain.

VIII. CONCLUSION

We presented an android app that is capable of fetching user location periodically and upload them to a cloud server. Permitted users can fetch these locations to know the whereabouts of the individual. It allows to set up geofences anywhere in the globe and alerts the tracker when the individual enters, dwells or exits the region marked by the geofence. It also provides an SOS feature that sends the latest location of the individual to select people at a time of emergency. It also verifies the tracker using an OTP to prevent unwanted access to an individual's location.

IX. FUTURE SCOPE

There are many scopes of improvements as well as addition of new features that are possible within the application. Some of these are:

Showing the route that the individual took in a map view by highlighting it

Using the location provided my mobile network vendors along with GPS to improve performance and battery health

A chat feature can be implemented so user can send messages to other people without hassle

A video call feature will enable people far away from each other to connect which will facilitate the purpose the application to a greater extent

X. LIMITATIONS

One major limitation of this application is that is heavily relies on a device to provide the location. It is totally possible to fake some location just by keeping the device at someplace other than where the individual is



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