ADV MATH SCI JOURNAL
Advances in Mathematics: Scientific Journal **9** (2020), no.7, 4631–4639
ISSN: 1857-8365 (printed); 1857-8438 (electronic)
https://doi.org/10.37418/amsj.9.7.31 Spec. Issue on RDESTM-2020

A MODERN APPROACH TO SIGNAL OUTAGE NOTIFIER AND RECORDER (SONR)

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ABSTRACT. Usage of internet application has an exponential growth over the years and there stands no barrier when it comes to our travel time. Handoff is the technique used to switch base station of cellular network when the user is on a move. Stability of the internet applications depends on the methodology used for session handling and the protocols used. When a hard handoff takes place, the applications that require contiguous connectivity with Internet tends to get terminated. The purpose of this application is to notify users about the upcoming signal outage that they are going to face while travelling. The GPS location of handoffs for every ISP is fed to the application when a user faces a signal outage. The application transfers the location details to the database after the reconnection to the network is successful. To find the dense clusters of handoff zones for every ISP is done by using k-means algorithm . Users approaching such zones are notified with a warning message which mentions that the user is going to face a signal outage and it is not recommended to use any application that requires contiguous mobile data services. Users can be notified about the upcoming locations where the signal drops down so that they don't indulge in any internet-based application.

1. INTRODUCTION

Pervasive and Ubiquitous computing is enhancing with the implementation of various schemes to refine the Cellular Network. Data Services have become the

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2010 *Mathematics Subject Classification.* 94A12.

Key words and phrases. Signal Outage, Handoff, GPS, Clustering algorithm,ISP..

need of the hour and the usage of internet applications has made exponential growth in the current day. This article provides a solution to the signal outage during handoffs by detecting the handoff [1] and collecting the geo spatial data and clustering the data [2] by using several clustering algorithms [3] [4].

Handoff schemes are used to switch base stations such that data loss is minimized and efficiency is improved [1]. Soft handoff smoothly switches the base station without any interruption in the data service but in the case of hard handoff there will be a termination of the application or an interruption in the process flow of the application. In this article we suggest to identify the handoff zones for every ISP and notify users with an alert regarding the Signal outage.

Users tend to face handoff when they are on a move and which is mostly frequently a road travel. We are going to identify when a handoff takes place and record the current GPS location [2]. The location is stored in the background variables of the Android Application and later transferred to the database along with the corresponding ISP after successful reconnection to the network. Clustering algorithms like k-means is used for data cluster [5], splitting k means, k medoids [3] and fuzzy c means [4] in order to obtain the handoff zones. Upcoming users are notified with the handoff zones using the central object of every cluster.

2. System Architecture and Proposed System

The Signal Outage Notification and Recorder is an Android Application as shown in Figure 1. The users can download the application and install the application onto their devices. The application continuously saves the user's location at the background of the application. When the outage occur the application marks the last received user location and waits until reconnection. The connection may be disabled by 2 ways:

- Signal outage due to Hard Handoff
- Signal Outage due to lack of signal strength.

In case of Signal Outage due to weak signal, the application still stores the user location and marks it as an outage zone, which may not be appropriate. To avoid this, Cluster centroids for the outage zone is formed. So, the vulnerable locations are turn out to be the centroid after clustering. When the user is approaching the zone, she/he receives a notification about the outage.

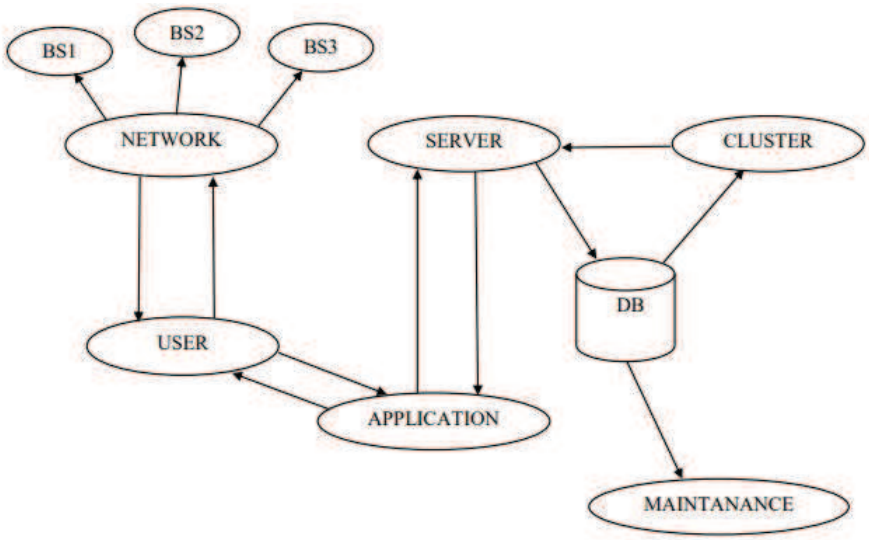

FIGURE 1. System architecture

3. RELATED WORK

J.A.Hartigan et al proposed the K means algorithm for clustering similar objects into clusters where inter cluster likeness is high and intra cluster likeness is low. K means algorithm helps in grouping similar objects together and provide a representative object for every cluster which is a centroid for the cluster. R. Amutha, Renuka. K et al discuss various clustering algorithms. Parallel k/h-means Clustering is used for Huge Data Sets and A Novel k means Based Clustering Algorithm used for High Dimensional Data Sets. Ahamed Shafeeq B M, Hareesha K S (2012) presented an improved k means algorithm to enhance the cluster quality and to fix the ideal number of clusters. In the real time scenario, it is very hard to predict the number of clusters. The optimal number of clusters on the run can be overcome. This algorithm takes more computational time for large data sets. Xiangbing Zhou et al came up with an article for an automatic k means clustering algorithm for Global Positioning System Data combining a NNG Algorithm with Noise and Mass. This article provides a trajectory scheme to collect GPS data from mobile devices and cluster data points using K means algorithm.

See references [6-10].

4. METHODOLOGY

4.1. **Modules.**

1. Android Application interface for GPS location.
2. Firebase Connection
3. Clustering Algorithm
4. Data Refresh and Update
5. Android Application Interface for Notification

4.1.1. *Android Application interface for GPS location.* In this module, the Android Application interface is the user interface which is used in both user application and the admin application. The user interface is a Map Activity that points the user's current location in green color and the handoff zones in red color geographically. This module continuously receives the user's GPS location and stores it in the database.

4.1.2. *Firebase Connection.* In this module, the application is connected to Google Firebase for storing data through internet and retrieving data from the admin end for clustering and from users end for notification.

4.1.3. *Clustering Algorithm.* In this module, the data from the database is retrieved to form a handoff zone. The handoff zone is identified by using k means clustering algorithm. The cluster is formed according to the type of ISP by referring handoff facts stored in the database. The handoff zones of one type of ISP may be different from another type of ISP. The clustering algorithms used are given.

A. k means: Hartigan (1975) define the clustering algorithm called k means. The sum of squares within cluster is minimized by splitting M facts in N dimensions into K number of clusters. We try to find solutions so that no measure of a fact from one cluster to another reduce the with in cluster sum of squares. The method used in this need as input a matrix of M points and a matrix of K primary cluster Centre with reference to N dimensions. NFC(L) is referred to number of facts in Cluster L. Euclidean distance among point I and cluster L are referred as ED(I,L). Moving points from one cluster to another is done by K partition with locally ideal within cluster sum of squares and formula shown in Figure 2.

Distance formula: $d((x,y),(a,b)) = \sqrt{(x-a)^2 + (y-b)^2}$

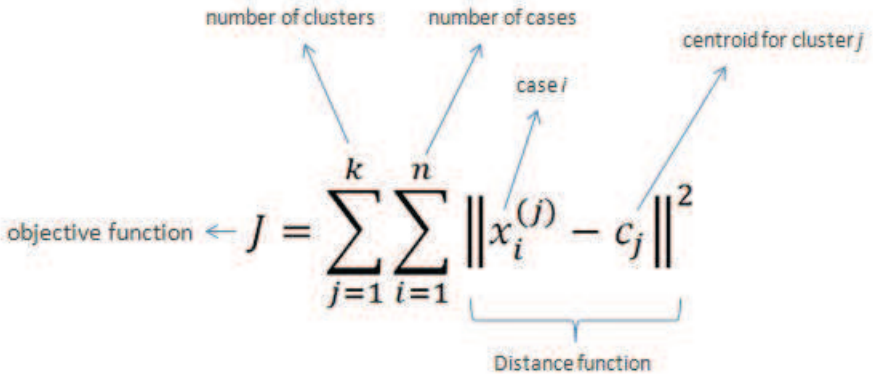

FIGURE 2. Square Root error Formula

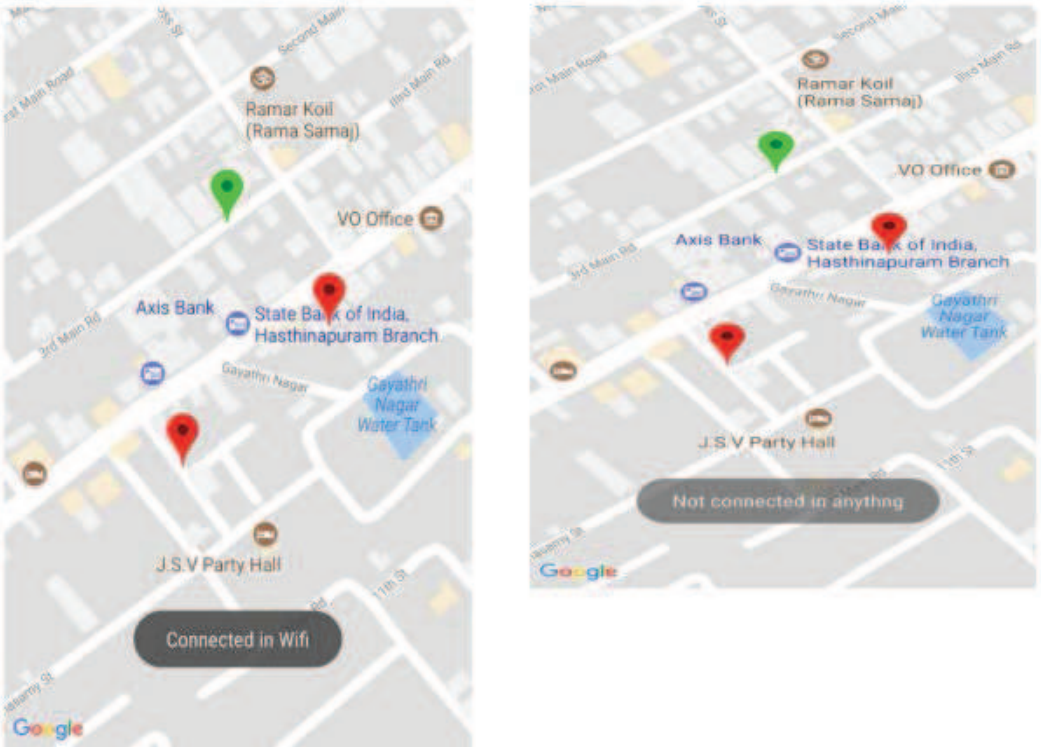

FIGURE 3. Network Status WIFI Connected and Not Connected

B. Splitting K-means: Splitting k means is like a grouping of k means and ranked clustering. Starts with entire matters in a sole cluster.

Basic Splitting k means Algorithm for discovery of K number of clusters

1. Select cluster for grouping.

FIGURE 4. Network Status Connected To Mobile Data With Network and No Network

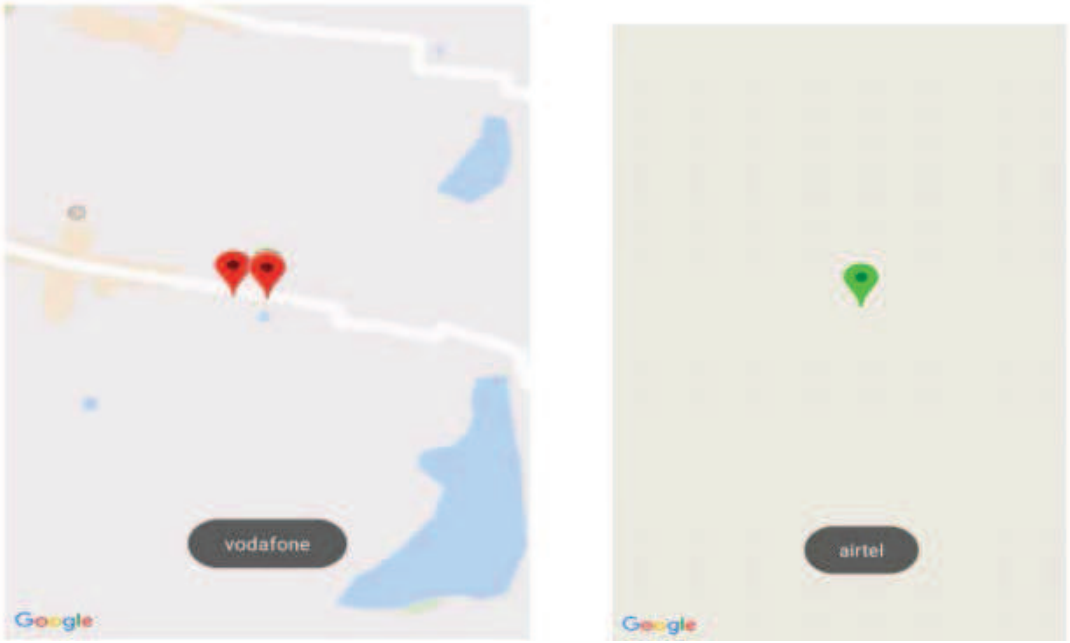

FIGURE 5. Carrier Name Vodafone and Airtel

2. The basic k means algorithm is used for finding two sub-clusters.

3. The clustering with the maximum overall similarity is selected and Repeat above step for I times.

4. Repeat steps 1, 2 and 3 until the required number of clusters.

Selecting the cluster for splitting is tedious task. Many methods are used to proceed, for example, either we can select the major cluster or cluster with the low quality or selecting of both.

4.1.4. *Data Refresh and Update.* In this module, the user's location is stored every 5 seconds. When a signal outage occurs the recently stored value is marked as a handoff point and waits until reconnection. After reconnection the stored handoff point is sent to Firebase and the data is clustered on data change happening in the firebase.

4.1.5. *Android Application Interface for Notification.* In this module, the user's location is monitored to send a notification alert, if the user is near a handoff zone.

5. Implementation And Its Results

The core implementation of the project is done using Asynchronous Tasks. This is because applications continuously checks for network status and monitors device location in the background and updates the database based on changes in the network status, thus the UI is refreshed while this is happening.

5.1. **Android Application Interface for Map View.** The system opens the Google map during its start up. The map is zoomed in automatically to the device's current location which is displayed as a green marker. The network operator is identified and the corresponding handoff points for that operator are displayed as a red marker in the map view depicts.

5.2. **Toast Once Handoff Point Is Updated.** The system continuously monitors for changes in network status in the background. When the mobile data is turned on and there is no internet connection the devices current location along with the internet provider is updated as a handoff point in the firebase database.

Once this is done a toast is displayed to the user indicating the completion of above operation.

5.3. **Map Update and Refresh on Data Change.** Each time when the clustering is performed and the data is populated in the firebase, the map update and refresh function is triggered which updates the handoff points in the user map view automatically.

5.4. **Notification When Approaching Handoff Point.** The distance between the user's current location and the nearest handoff zone is monitored continuously in the background. When the user approaches near a handoff zone a notification is triggered, warning the user about the approaching handoff zone.

6. System Testing And Maintenance

6.1. **Validating Network Status.** The network status is continuously monitored in the background. The validation is done by a combination of checking the signal strength and monitoring the device settings. The various cases of status are given in Figure 3 and 4.

6.2. **Requesting Permission for Turn on GPS.** On application start up if the GPS is turned off in device then the application requests for turning on the GPS, since the application continuously needs to track the device location with the help of GPS.

6.3. **Identifying Carrier Name.** The carrier name (network provider) for the mobile device is monitored in the background and used while refreshing the map view and updating the handoff points as shown in Figure 5.

7. Conclusion and Future Enhancement

The key concept of notifying the users about the upcoming signal outage is achieved from the results of clustering geographical locations and marking the locations on the Google Maps API. Google Firebase connectivity helps in recording the handoff and retrieving centroids for every carrier with the helping of serving the users under the corresponding ISP. Though clustering is done based on carrier name, bandwidth of the device also plays a major role for better efficiency. Hence identifying the devices reporting for handoffs and clustering data

based on device models will be the next step to improve the service with higher accuracy and make the application resolve the problem more reliably.

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