Mobile Application for Commuters with Absence of Bus Scheduling Time in Developing Country: Jordan as Case Study

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***Abstract*—Transportation has always been the backbone of every culture; it connects everyone to everything, which is why a having well-organized transportation system is a sign of much developed country. In Jordan, we have a large transportation system, which fulfills the needs of the community to a somehow an acceptable point. The system we have lack scheduling and the modern features of a transportation system, we do not have a way of knowing when the available bus is coming or how far is my stop. If we decided to organize this system, the cost is quite dire and with no guaranteed results, it will work. The Passenger Travel Assistant Mobile App Tries to solve these problems with a different approach, the app will give the commuters a way to know when the closest bus will arrive and how far they are from their stop. Once the app installed it turns your phone into a GPS locater for other passengers on the road. Since most of the population have a smart phone with GPS capability and data transmission collecting location of people on buses never been easier, and will give a current and almost instant location of the bus on its route and send that location to commuters on the bus route to know how far the bus is from their current location. Also the ability to track user friend's location and estimate their time of arrival. In addition tagging a photo with its corresponding geographical location is a service provided by the application, which will help public agency to track people complaints and complements by using the users feedback on it.**

***Index Terms*—mobile application, scheduling, developing counties, geo tagging.**

I. INTRODUCTION

Life is about travel, and with modern ways of transportation, going from one place to another never been easier. With this commodity new problems emerged, one of these problems is managing and scheduling the transportation system. Before we answer how we can solves these issues, let's take a look at the Jordanian transportation system. Jordan, has a population of more than 6.4 Million resident [1] scattered across 12 Governorate, connected by a stretch of 7,999Km [2] of highways, with an estimated 6894 public bus operating on these roads. These large numbers depend on the transportation system to operate efficiently and effectively, from bus availability on different routes or a timely operation schedule of each route. The system currently in Jordan does not have these two major points, each route has its own independently operated buses, which operates without a schedule or fixed stops along its route. This issue has been going on for many years in Jordan and there has not been any sign of reform in the structure of that system, its utter and complete chaos.

On a global scale improving and managing public transportation the world seems to be on the fast track to make the perfect harmonized system. Some of these managerial approaches is the "GPS and GSM modem Integration for Public Transport Management Services"[3] , this approach proposes a solution for improving the services provided by the transportation system, using GPS and GSM modem integration, The system mainly consists of three modules. "Bus station module, Bus module, Base station". The proposed management system claims it will help manage the system and provide the user of the public bus a much better experience, with less time waiting, and the ability to track the bus whereabouts. This solution proposes to install hardware on every bus, meaning the cost of the hardware and installation fees would be high. Also considering the high rate of theft. Other issues with such system is the GSM provider and the cost of using the service to transmit and receive data. IBM has used such technology to improve the public transportation infrastructure in Ivory Coast in West Africa [4]. "Researchers at IBM, using movement data collected from millions of cell-phone users in Ivory Coast in West Africa, have developed a new model for optimizing an urban transportation system. The IBM model prescribed changes in bus routes around Abidjan, the nation's largest city. These changes—based on people's movements as discerned from cell-phone records—could, in theory, slash travel times 10 percent." The GPS-Phone system works to improve the system, because it takes the data from the actual passengers of the bus, which makes it close to real as possible. In the paper published by [5] , they pointed out the flexibility of the android platform to track user location. With the help of the platform Application Programming Interfaces (API), the application can determine the exact location of the user and a distance

from a one location to another. [6], have proposed a cost effective model to manage the transposition system using hardware to track buses and give the user the current location information of the desired bus. They have concluded that the system is cost effective and give the users a friendly environment to overcome the difficulties in finding bus route and reducing travel time. Microsoft Research Asia team members and Tsinghua University [7], have researched the data gathered from tracking application and managed to conclude the different frequency of different kind of traveling modes. Such transportation modes can feature a user's mobility and support a variety of pervasive computing systems, such as human behavior Recognition, trajectory sharing and smart route recommendation. [8] Points out the use of geographical tagging in disaster management event, and the different methodology of geotagging an image, and how geotagging pictures helped disaster relief teams gather the needed data to help the survivors.

II. APPLICATION ARCHITECTURE

Almost everyone nowadays has a smart phone with GPS capability and data transmission; many of them use the public transportation system. Those people make a large pool of resource to unlimited data that can help manage the transportation system.

Our application offers an infrastructureless approach to try to give the transportation system the order it needs, to give the passengers a better knowledge of times and places on the transportation system. Infrastructureless means there is no need to install any form of hardware to be able to track. With just the help of commuters, the application can gather the data it needs to achieve its goal. The application uses the mobile phone GPS and GSM signals to track buses and stops along the route of the traveling passenger. This approach depends entirely on the passengers, the application broadcast GPS to other passengers on the route to determine how far the nearest bus, And with pre-determined stops stored in the application the user can tell how far he is from his final destination. All of these features and more provided in the application to help everyday passengers to use the public transportation system in a much more modern way than it is now. This solution will provide a less costly way of tracking the transportation system and it will ultimately lead to a higher percentage of passengers by providing the information that is needed to make their journey easier and time effective. Other features include the ability to know friends whereabouts and determine an estimated time of their arrival to the user location. Geographical location has never been easier to get with GPS phones. Moreover, with this functionality, tagging a picture with its corresponding geographical location is a feature HOON provides to the users. The ability to take a picture, tag it with the current location, and choose whether to share it with other users or send it to a specific government agency to check user complaint on an issue that is on the road. This will help government agency to see the complaint and know the exact location of it to be able to carry out their duties to fix it.

HOON is a new, self-contained product intended for use on the android platform. While HOON application is the focus of the project, also a server-side component will be responsible for database and synchronization services. The scope of the application encompasses both server- and client-side functionalities, both aspects covered in detail within this document. Below is a basic figure of the HOON system, which illustrates the interactions between the server and client applications when finding the nearest bus.

The application will need to use the embedded GPS device in the handset to get the user on the road current location see Fig.1, which in terms determine position related to a pre-determined bus stop. After which the application sends a request along with user current bus stop and route to the server to get the nearest bus location. Other user on the bus selects route and a bus stop to detriment how far the bus stop see Fig. 2.

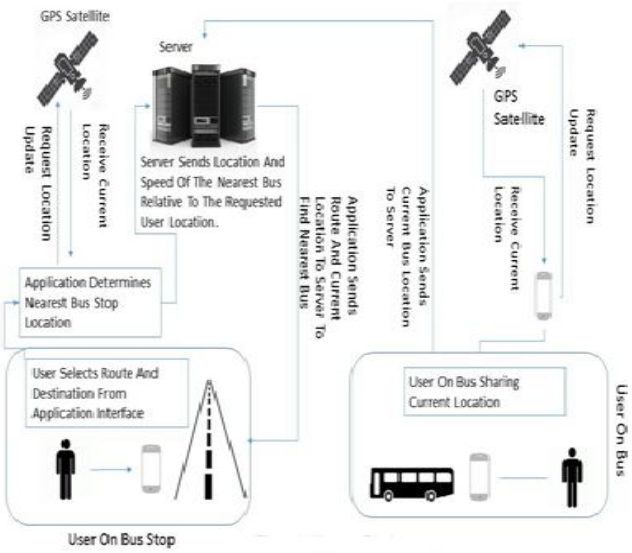

Fig.1 Nearest bus location

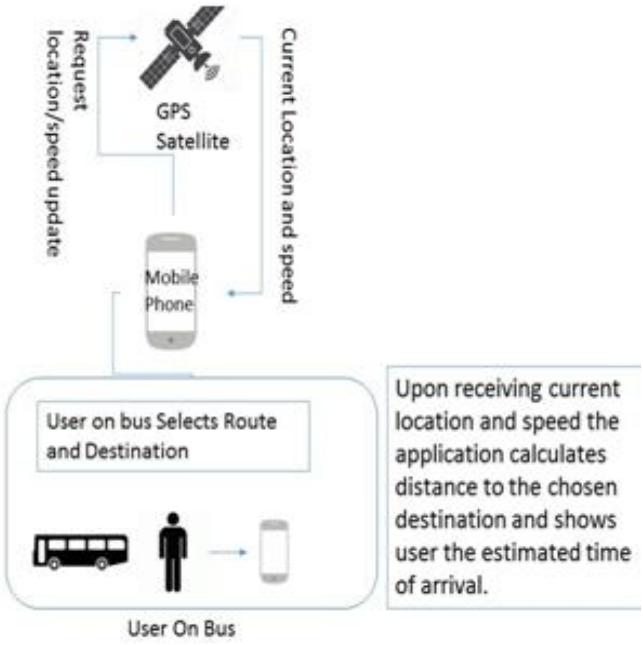

Fig. 2 Time to destination

Geographical location has never been easier to get with GPS phones. Moreover, with this functionality, tagging a picture with its corresponding geographical location is a feature HOON provides to the users. The ability to take a picture, tag it with the current location, and choose whether to share it with other users or send it to a specific government agency to check user complaint on an issue that is on the road. This will help government agency to see the complaint and know the exact location of it to be able to carry out their duties to fix it.

III. Algorithm

An algorithm was made to read user location and user destination. Then according to them calculations are made to determine the speed of the bus (as a user gives a speed of a bus). From speed, we can calculate time left for this bus to reach a user at a certain stop, which updates users on bus, with time left to reach their stop, and users on the stop with the time left for the bus to arrive to the stop.

```
Get Current Location () {

        Gets current Location of user ( )
        Gets current traveling speed ( )
        Calculate total distance to destination ( )
        If (Current Location Index == Destination Index AND
Current Speed < 15) {
          ("You Have Reached Your Destination")
          Flag Arrived = true
        }
        If (Current Speed > 15) {
          Flag on Bus = true
        Calculates Estimated Time of Arrival to Destination
(Distance to Destination / Current Speed)
        If (Estimated Time of Arrival < 5 AND! Five-Minute
Alarm Flag) {
          ("Less Than Five Minutes Away From Destination")
          Flag Five Minute Alarm = true
        }
        Upload To Server Current Bus Location ( )

        If (On Bus AND (Current Speed < 15)) ("Traffic")

        If ((Current Speed < 15) AND! On Bus AND Current
Location Index! = 0) {
          ("Searching For Nearest Bus")
          Index of Bus = find Bus (Route Index, Current Location
Index)

          If (Index of Bus! = -1) {
            Calculates Distance from bus to current location ( )
            Calculates Estimated Time of bus Arrival (Distance
from Bus / Speed of Bus)}

        If (Current Location Index = 0 AND Current Speed = 0)
("You Are at the Station")
If (! Arrived) Update Location ( )}
```

IV. Application's Key Features

A. Bus Location and Time to Destination

As described in the previous section, HOON application will provide the user with an estimated time of the arrival of the nearest bus relative to his location. Fig2 Estimated Time for bus arrival activity shows the flow of events that the application goes through to get the nearest bus location.

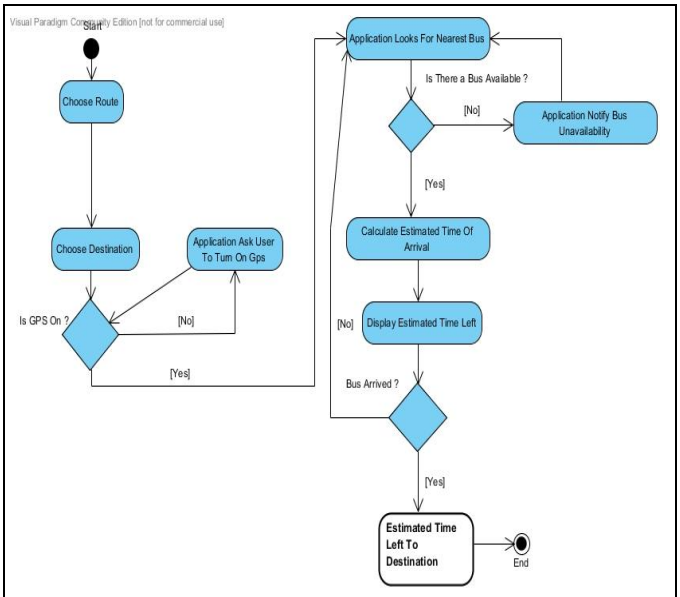

Fig 3 – Nearest Bus Location

It starts at the user choosing a route and a destination. A check is done on GPS provider to see if it is enabled, if not the

application asks the user to enable it. Then application looks for nearest bus according to user location. If there is no one on bus route to provide a location the application notifies the user. If there is a bus, the application calculates the estimated time of bus arrival. The application keeps on looping through these previous stages until the check of bus arrival passed with a confirmation that the bus arrived. The estimated time left to destination then starts.

As for Estimated time to destination, as soon the application determines that the user is on the bus and moving, it will switch to estimate time to reach the selected destination.

Fig 4 shows an activity diagram of how it is done in the application.

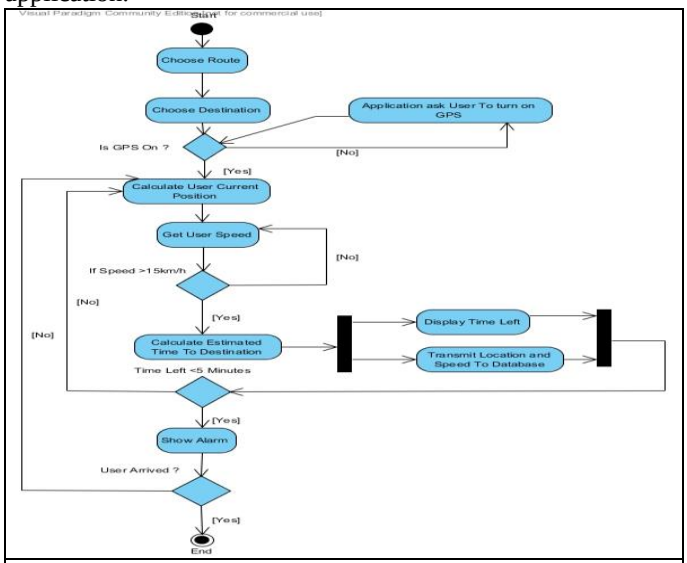

Fig 4 – Time to Destination

The activity at which the time to a selected destination is calculated. The first stage is when the user selects both route and destination. Before the application starts calculating, a check to see if GPS provider turned ON, if not the application asks the user to enable GPS on their device. On turning, it ON the application calculates the user position relative to a nearest bus stop and gets a distance to selected destination. Then the application gets the user traveling speed, if the speed is over 15km/h then application begins to estimate time to arrive at destination at this stage the application displays the estimated time on screen and transmits user current location and speed to the server to update.

B. Friend Location Service

Since the application uses GPS and internet connection to track user location another feature was added to the application to give the user an easy way to determine another user whereabouts by using the same services that the application uses to operate. When using the application, user can get time left for a friend to be at user location. User choose from main application bus screen "location from friend", which opens the user friend list. User chooses a friend, then the chosen friend gets a notification that the user wants to know their location, then he can either accept, or ignore the request. If ignored user on other end get a message that process denied, else if accepted the chosen friend current location is sent to the server, and from server into the application. The application then starts calculating estimated time left for the friend arrival and updates user screen with the time left. Fig 5 shows flow of events to find friends location.

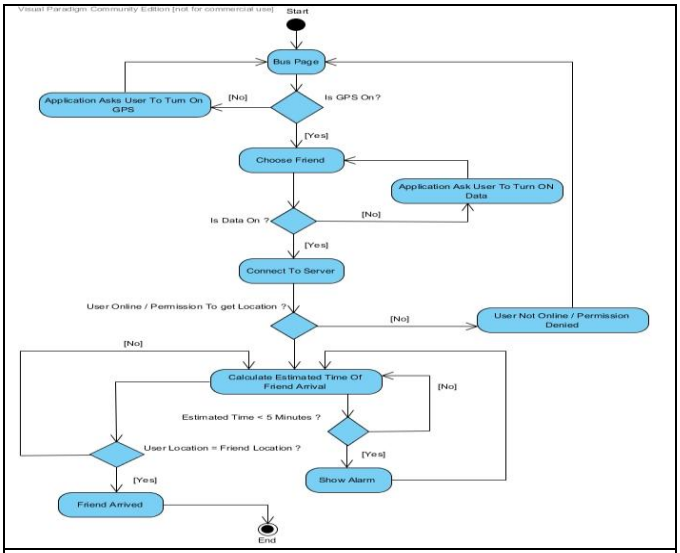

Fig 5 – Friend Location

Friend location activity at the start the user at bus page. Application checks if GPS turned ON, if not the application asks the user to turn it on. The user clicks on friend location that opens the list of friend to choose from, if data not turned ON, the application asks the user to turn it ON. Next step, the application connects with the server to request the friend location and speed. If the friend disapproves or the friend not online, the application notifies the user of such issue. On approval, the application calculates the estimated time of friend arrival. If the estimated time is less than five minutes, the application fires up an alarm of arrival. If friend location is same as users, the application stops calculating and shows a friend arrive dialog.

C. Geographical tagged picture public service

HOON focuses on using GPS location to benefits features other than estimate time. Some of which is embedding a picture taken with mobile phone with the current location of it, and share it to some of the public service departments, to give a location feedback of an issue that effects users. Fig 6 shows how it is done through a series of activity's.

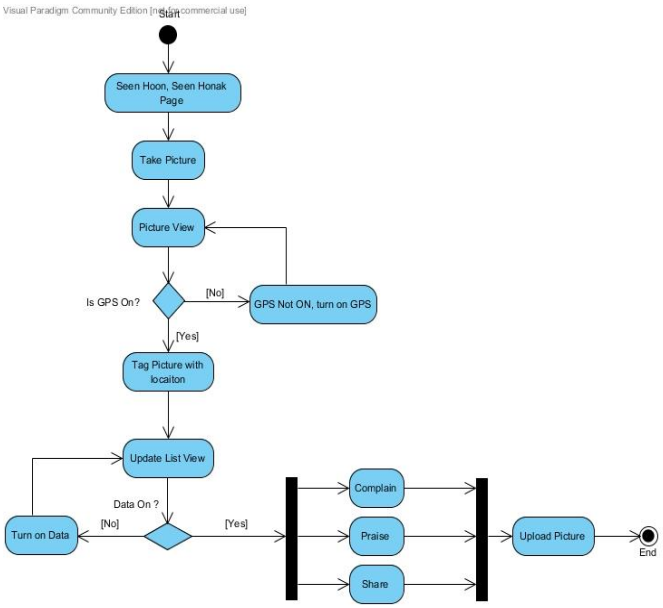

Fig 6 – Take Picture

Take picture activity illustrates the process of Seen HOON feature. User opens the seen HOON page, selects to take a picture once taken, a check done on the GPS if not available the application asks the user to turn it ON. The picture then tagged with user current location and the list of pictures updates. A check is done on data connection of not ON application asks user to turn it ON. If ON the application presents the user with a type tag either a complaint or a complement or simple share without any type. The application uploads the picture to the server.

V. SURVEY

A survey was carried out to determine if people will use the proposed application, the survey was published to a group of people, total of 200 people, with questions about features and application.

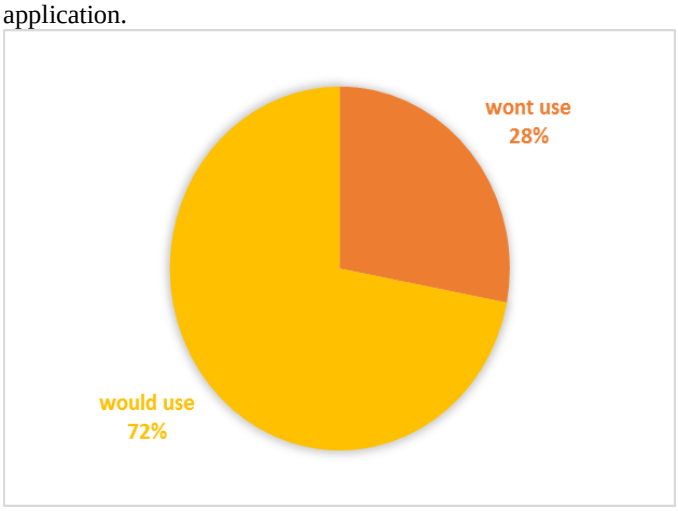

Fig 7 – Would use the application

After survey results, a field study was conducted, to collect information needed for the application. We made a simple application to read current location longitude and latitude and save them, we took two bus lines that services New-Zarqa area. Points collected as the bus moved, all bus stops were saved along with their names, and some points were taken as extra to build a track for the bus.

The below figure Fig-8 is a heat map that illustrates the actual bus route locations on a map.

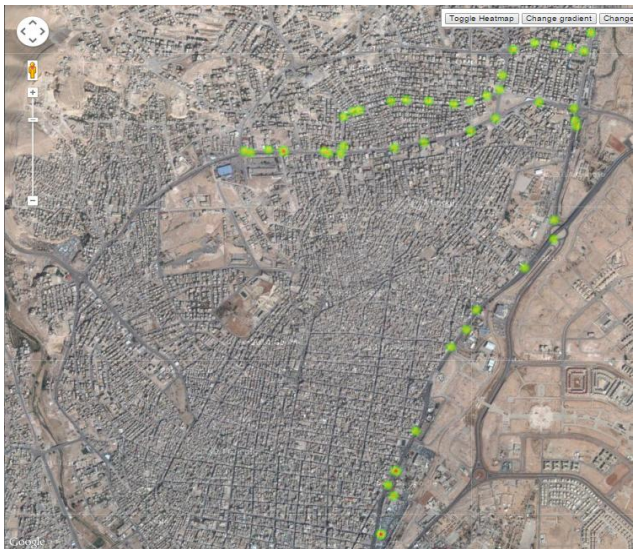

Fig 8 – NewZarka, Jeesh Street Route

The red spots on the map shows the close proximity of bus top along the route which inclines that the area is red, services a large number of people since it has many bus stops. Another route was also surveyed and location were collected along that route.

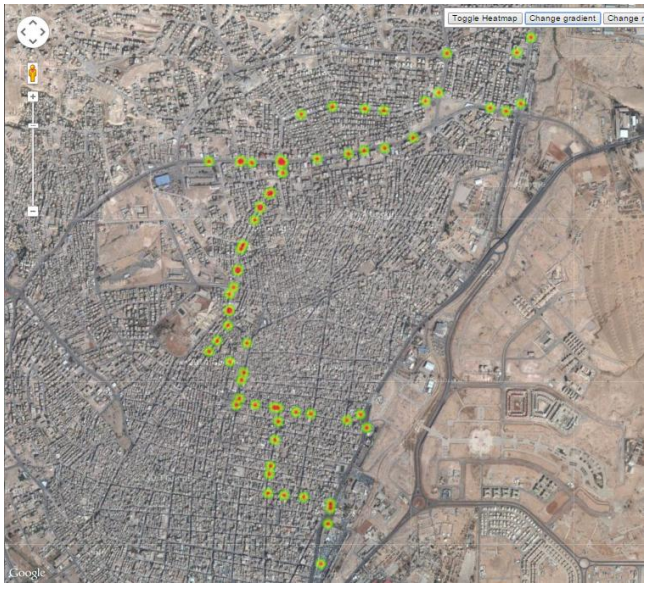

Fig 9 – New Zarka, Ameer Mohammad Route

VI. Application Interfaces

Below, is some of the application key features interfaces and how it works, the application interface was built as simple as possible to be as much user friendly as possible.

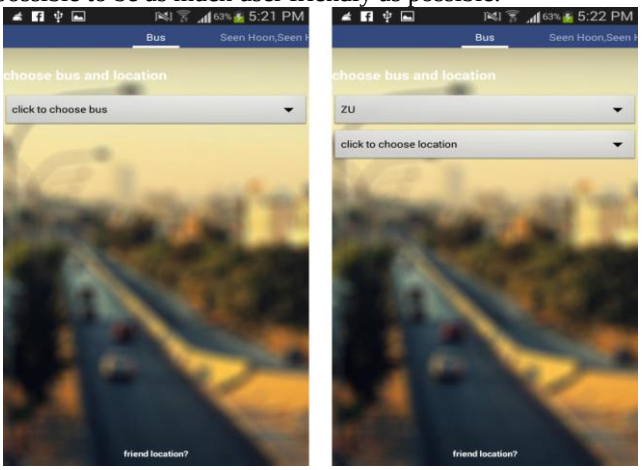

Fig 10 – Bus Location View

Fig 10 shows the screen that opens after user logs in. User can use this screen or swipe to user other screens. In this screen, user can select bus route, then destination, as we implemented our algorithm, we made a test on two actual bus routes and one of Zarqa University bus routes (Zarqa new bus station to university). user can also get updated from a friend location, when click on "friend location?", friend list will show, user choose friend and send location request, and get updated with time left estimated for their friend to arrive.

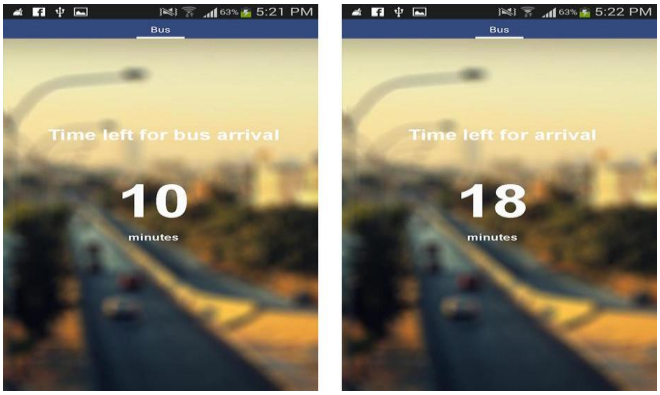

Fig 11 – Estimated Time Of bus Arrival / Destination

After user picks a route and destination, application calculates nearest bus time estimation. Then, when user and bus are on the same geographical range of 10 meter, application reads user speed from GPS, if user speed is 15km/h or greater and moving in same geographical range with bus signal, user get updates with time left estimation to reach their stop.

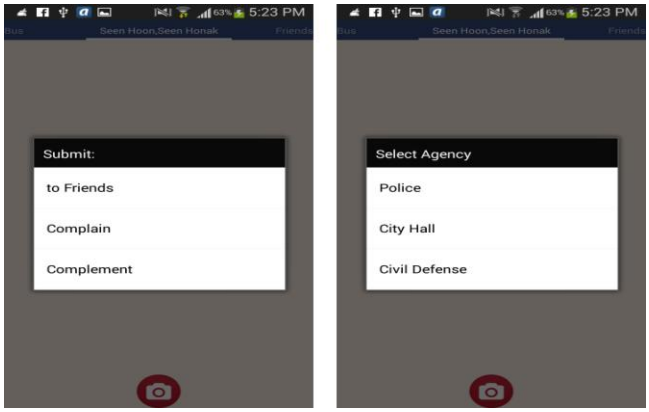

Fig 12 - seen hoon, seen honak interface

In seen hoon, seen honak, users can upload pictures and share them with friends, or submit to one of the three agencies: police, city hall or civil defense. For a complement of some issue the have seen maybe on the road or at some building. If user choose to friends, application just uploads the picture. If user choose complain or complement, agency list opens, user choose which agency they want to submit to, and a copy of the image they upload goes to them with its caption.

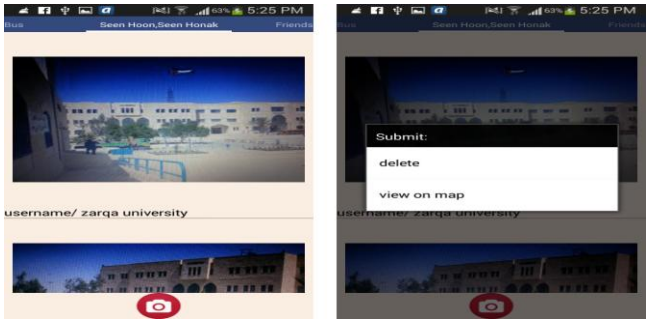

Fig 13 - seen hoon, seen hoonak pictures

VII. Conclusion, Constraint and Future Work

A. Conclusion

The application helps the public transportation system in Jordan to be more efficient and organized by providing live data of bus whereabouts, thus giving a way to determine an estimated time. Since the application is free of cost and the distribution platform is available through the google play store, getting the application to a wide base of users does not take much effort. By using GPS data, the application aims to improve geographic applications on the public transportation system and build closer connections between locality and mobility. The knowledge gained as well as the connections enable applications that are more novel and improve user experience in a variety of tasks. The application is dependent on users and their devices for the proposed solution to work fully and efficiently. In addition, with Seen HOON feature will help public agencies in their work to serve the public, by providing them a service that has a spyglass look at a complaint or a complement and track progress through user feedback.

B. Constraint

Some constraint on the system is the validity of information provided from users, we tried to limit the miss use of the application by providing a geographical weight, if we have more than four users on the same location traveling on the same speed then the validity of the information is much higher than from a single user.

C. Future Work

The data gathered from the application usage will help the transportation agency to get accurate data of bus routes and times, which will be helpful to devise optimum routes and check which routes needs more service.

Follow up work include adding a feature that will let user add routes to the list of application routes to help expand the services of the application to reach more routes of the public transportation system. In addition, a plan is under development to improve the geographical tag feature of seen HOON to let user track the progress of their complaint and give feedback of it.

ACKNOWLEDGMENT

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