K. E. Society's

Rajarambapu Institute of Technology, Sakharale

(An Autonomous Institute Affiliated to Shivaji University, Kolhapur)

COMPUTER ENGINEERING

Second year

PROJECT ON

"GPS Tracker For Garbage Collecting Vehicles"

BY

Sr. No.	Name	Roll No.
1.	Mrinmayee Arde	1603015
2.	Swarooprao Patil	1603016
3.	Omkar Kadam	1603005
4.	Kalyani Shinde	1604020
5.	Priya Mamadge	1503050

UNDER THE GUIDANCE OF

Mrs.Sanmati C. Bedage

DECLARATION

We, the undersigned, hereby declare that this project is a genuine work conducted by us through practical on – site observations, and the data collected by us is true to the extent of our awareness.

Date: / / 2017-18

Signatures of the Students in the Project:

Roll No.	Name	Signature
1.	Mrinmayee Arde	
2.	Swarooprao Patil	
3.	Omkar Kadam	
4.	Kalyani Shinde	
5.	Priya Mamadge	

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CERTIFICATE

This is to certify that below mentioned students have successfully completed the project entitled ***"GPS Tracker for Garbage Collecting Vehicles"*** for Environmental science 2017-18.

Sr.no	Name	Roll no
1	Mrinmayee Arde	1603015
2	Swarooprao Patil	1603016
3	Omkar Kadam	1603005
4	Kalyani Shinde	1604020
5	Priya Mamadge	1503050

Guide **Head of Department**
(Computer Engineering)

CONTENT

K. E. Society's

Rajarambapu Institute of Technology, Rajaramnagar

(An Autonomous Institute)

Synopsis

Environmental Science Mini-project

Program : Computer Science and Engineering 2017-18

Class : S.Y. B. Tech (Semester-IV)

Course Code : ES1718II

Proposed Title : "GPS Tracker For Garbage Collecting Vehicles"

Name of the students in project group:

Sr. No.	Name	Roll no.	Mobile no.	Email ID
1	Mrinmayee Arde	1603015	-	-
2	Omkar Kadam	1603005	-	-
3	Swarooprao Patil	1603016	-	-
4	Priya Mamadge	1503050	-	-
5	Kalyani Shinde	1604020	-	-

Project Guide: Mrs Sanmati C. Bedage

1. INTRODUCTION:

This project aims to provide the Municipal Corporation of Islampur with a system to manage their waste collection vehicles in an efficient way. By providing route optimization we can eliminate the unnecessary travel made by these vehicles by going at places where no actual waste is available. This project has both hardware and software components which will work together to take "waste alerts" from people who need their waste collected and plot out an optimal route for the collection vehicles by connecting these locations.

2. PROBLEM STATEMENT:

Route optimization is crucial as it helps in reducing the emissions from the diesel vehicles used for collection of waste. Solid waste collection processes in small Municipalities like Islampur are usually carried out by vehicles with diesel engines. Currently the 6 vehicles consume 6 litres of fuel daily.

3. RELEVANCE:

Solid waste collection processes in small Municipalities like Islampur are usually carried out by vehicles with diesel engines. These vehicles emit to environment different emissions like CO2, NOx, HC, CO, PM from their exhausts. The collection process currently is being carried out by 6 vehicles that roam continuously across different areas of the city for 6 hours. This results in high fuel wastage, large amount of emissions and inefficient use of time.

4. LITERATURE REVIEW :

O Apaydin et al., (2008) studied Emission control with route optimization in solid waste collection process. This study was performed in Trabzon City with 39 districts; a shortest path model was used in order to optimize solid waste collection processes to minimize emission. A software was used as an optimization tool. The software provided Geographical Information System (GIS) elements such as numerical pathways, demographic distribution data, container distribution data and solid waste production data. In addition, thematic container layer was having 777 points for the entire city. By using the software, the optimized route was compared with the present route. If the optimized route in solid waste collection system is used, route distance and route time will be decreased by 24·6% and 44·3% as mean of nine routes, respectively.

N Christofides et al., (1976) studied The Vehicle Routing Problem. Vehicle routing problem (VRP) is a generic name given to all problems that involve the visiting of customers by vehicles. These problems derive their name from the basic practical problem of supplying geographically dispersed customers with goods using a number of vehicles operating from a common goods depot. The problem is one of routing the vehicles so that the total distance travelled by them is minimal. There are two basic objectives in the VRP-

1. Find optimal routes to be operated by available vehicles so as to supply the customer requirements at minimum total variable cost.

2. Find the smallest possible number of vehicles and their routes which can supply all customer requirements.

5. OBJECTIVES:

1. To provide the Health Department of the Municipal Corporation of Islampur city with an efficient way to manage their waste collection vehicles.

2. To optimize routes for the vehicles according to availability of waste thereby eliminating empty miles negativeness.

6. METHODOLOGY:

The methodology will be adopted as follows:

1. To achieve our objective our projects technical structure will be made up of 3 main subsystems- on boards, communication and interface and an shortest path algorithm.

2. On board will be made up of the GPS, which will provide our system the live location of the vehicle, with an accuracy of about 1 meter. This On Board subsystem will be mounted on the vehicle and connected to a computer, which will be an Arduino module connected to a communication system. The Arduino will control all of the functions occurring on the remote module.

3. Our communication system will be made up of the LoRa (Local Range) communication. It will be a draguino LoRa shield which will be connected to the Arduino. Arduino will take readings from the GPS and transmit it with the help of the LoRa shield over the range of the 24 km (In line of sight) and 10 km out line of sight. Our receiver module will receive this data provide it to the receiver computer. That received data will be processed and displayed on the computer screen.

4. The algorithm will process that data and will provide the driver with the optimum and shortest path available. The algorithm will take the coordinates, allotted routes and the traffic data (from Google) into consideration.

5. All systems will be integrated as one and will perform together.

7. REFERENCES:

1. Omer Apaydin and M Talha Gonullu (April 2008). "Emission control with route optimization in solid waste collection process: A case study" of S¯adhan¯a Vol. 33, Part 2, pp. 71–82. © Printed in India

2. Nicos Christofides(1976). "The vehicle routing problem" of Revuefrançaised'automatique,informatique,rechercheopérationnelle.Rechercheopératio nnelle, tome 10, Vol. l, p.55-70.

8. APPROXIMATE EXPENSES:

Sr No.	Component	Quantity	Price(Rs.)
1	LoRa dragino shield	2	3000/-
2	Arduino UNO	2	1000/-
3	GPS neo 6m	1	900/-
4	433 MHz antenna	2	300/-

Total Expense – Rs. 5200/-

Chapter 1: Introduction

This project aims to provide the Municipal Corporation of Islampur with a system to manage their waste collection vehicles in an efficient way. By providing route optimization we can eliminate the unnecessary travel made by these vehicles by going at places where no actual waste is available. This project has both hardware and software components which will work together to take “waste alerts” from people who need their waste collected and plot out an optimal route for the collection vehicles by connecting these locations.

1.0 Municipal strong waste (MSW) –

City strong waste, normally known as junk or trash, is a waste kind comprising of regular things that are disposed of by the general population. "Junk" can likewise allude particularly to nourishment squander, as in a waste transfer; the two are now and again gathered independently.

1.1 Composition –

The creation of civil strong waste fluctuates incredibly from district to region, and it changes altogether with time. In districts which have a very much created squander reusing framework, the waste stream for the most part comprises of obstinate squanders, for example, plastic film and non-recyclable bundling materials. In created zones without critical reusing movement it transcendently incorporates sustenance squanders, showcase squanders, yard squanders, plastic compartments and item bundling materials, and different incidental strong squanders from private, business, institutional, and mechanical sources. Most meanings of metropolitan strong waste do exclude mechanical squanders, horticultural squanders, medicinal waste, radioactive waste or sewage slop. Squander gathering is performed by the district inside a given zone. The term remaining waste identifies with squander left from family unit sources containing materials that have not been isolated out or sent for reprocessing. Waste can be characterized in a few ways however the accompanying rundown speaks to a run of the mill arrangement:

a) Biodegradable waste: sustenance and kitchen squander, green waste, paper (most can be reused albeit some hard to compost plant material might be barred)

b) Recyclable materials: paper, cardboard, glass, bottles, containers, tin jars, aluminum, aluminum, metals, certain plastics, textures, garments, tires, batteries, and so forth.

c) Inert squander: development and annihilation squander, earth, rocks, flotsam and jetsam

d) Electrical and electronic waste (WEEE) - electrical apparatuses, lights, clothes washers, TVs, PCs, screens, cell phones, wake up timers, watches, and so forth.

e) Hazardous squander including most paints, chemicals, tires, batteries, lights, electrical apparatuses, fluorescent lights, airborne splash jars, and manures

f) Toxic squander including pesticides, herbicides, and fungicides

g) Biomedical squander, lapsed pharmaceutical medications, and so forth.

1.2 Collection -

The utilitarian component of accumulation incorporates not just the social affair of strong waste and recyclable materials, yet additionally the vehicle of these materials, after gathering, to the area where the gathering vehicle is purged. This area might be a materials handling office, an exchange station or a landfill transfer site.

Appropriate strong waste accumulation is imperative for the insurance of general wellbeing, security, and natural quality. It is a work serious action, representing around seventy five percent of the aggregate cost of strong waste administration. Open representatives are frequently appointed to the errand, however some of the time it is more temperate for privately owned businesses to take the necessary steps under contract to the district or for private gatherers to be paid by singular mortgage holders.

Reject gathering as a rule happens at any rate once every week on account of the fast decay of nourishment squander. The measure of junk in the deny of an individual home can be decreased by waste processors, or trash transfers. Ground trash puts an additional heap on sewerage frameworks, however this can as a rule be obliged.

1.3 Transfer and transport -

This component includes two principle steps. To start with, the waste is exchanged from a littler accumulation vehicle to bigger transport gear. The waste is then transported, normally finished long separations, to a preparing or transfer site. For this, a driver and maybe a couple loaders serve every gathering vehicle. These are regularly trucks of the encased, compacting type, with limits up to 30 cubic meters (40 cubic yards). Stacking should be possible from the front, back, or side. Compaction decreases the volume of reject in the truck to not as much as half of its free volume.

1.4 Transfer stations –

On the off chance that the last goal of the reject isn't close to the group in which it is produced, at least one exchange stations might be important. An exchange station is a focal office where decline from numerous gathering vehicles is consolidated into a bigger vehicle, for example, a tractor-trailer unit. Open-top trailers are intended to convey around 76 cubic meters (100 cubic yards) of uncompact waste to a provincial handling or transfer area. Shut compactor-type trailers are likewise accessible, however they should be outfitted with ejector systems. In an immediate release sort of station, a few gathering trucks discharge specifically into the vehicle. In a capacity release kind of station, decline is first exhausted into a capacity pit or onto a stage, and after that hardware is utilized to crane or push the strong waste into the vehicle. Substantial exchange stations can deal with in excess of 500 tons of reject for each day.

1.5 Literature Review

O Apaydin et al., (2008) examined Emission control with course advancement in strong waste accumulation process. This investigation was performed in Trabzon City with 39 areas; a most brief way show was utilized as a part of request to streamline strong waste gathering procedures to limit discharge. A product was utilized as an enhancement instrument. The product gave Geographical Information System (GIS) components, for example, numerical pathways, statistic appropriation information, holder conveyance information and strong waste creation information. Likewise, topical holder layer was having 777 focuses for the whole city. By utilizing the product, the improved course was contrasted and the present course. In the event that the advanced course in strong waste accumulation framework is utilized, course separation and course time will be diminished by 24·6% and 44·3% as mean of nine courses, separately.

N Christofides et al., (1976) examined The Vehicle Routing Problem. Vehicle steering issue (VRP) is a bland name given to all issues that include the meeting of clients by vehicles. These issues get their name from the essential pragmatic issue of providing geologically scattered clients with products utilizing various vehicles working from a typical merchandise station. The issue is one of steering the vehicles so the aggregate separation went by them is negligible. There are two essential destinations in the VRP-

1. Observe ideal courses to be worked by accessible vehicles in order to supply the client prerequisites at least aggregate variable cost.

2. Locate the littlest conceivable number of vehicles and their courses which can supply all client prerequisites.

Chapter 2: Methodology

Our methodology consist of implementation of two parts, one is software and another is hardware. Before implementing those two parts first we did the designing of App using UML diagrams.

Design Phase:

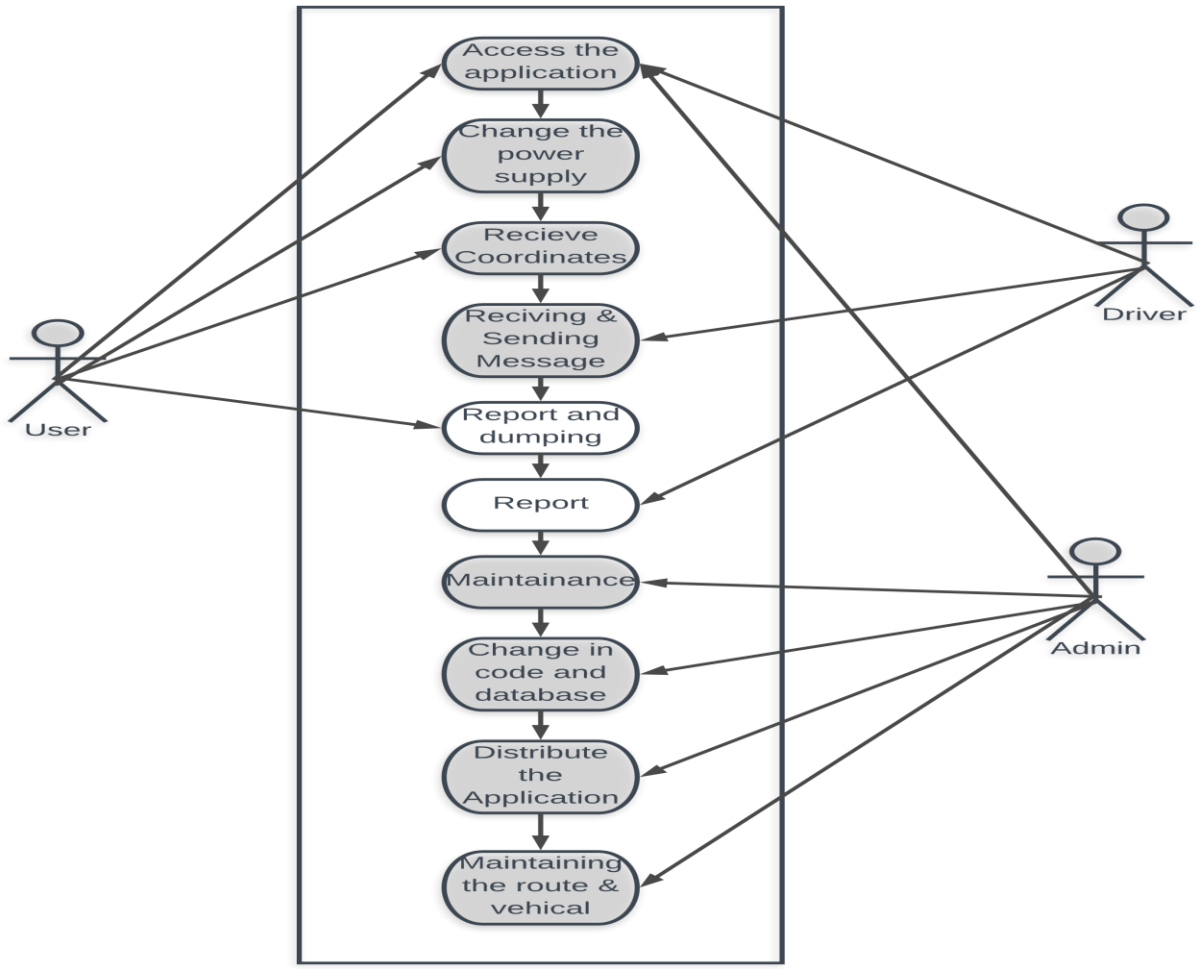
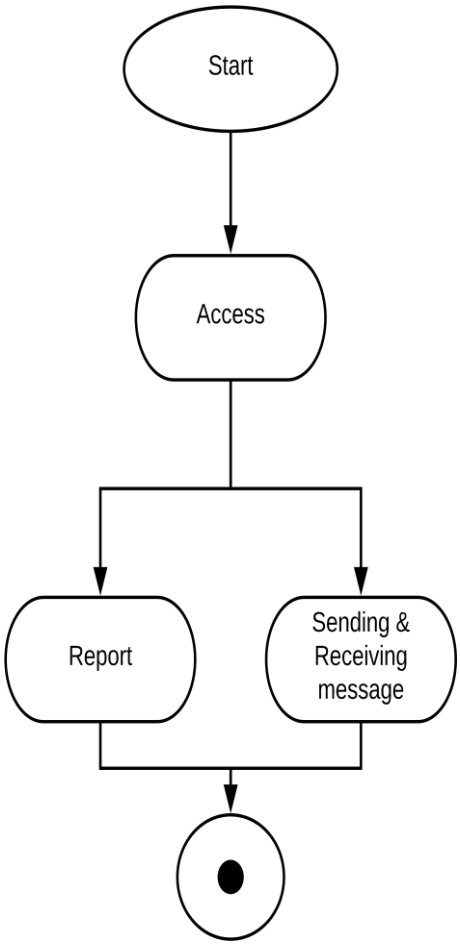
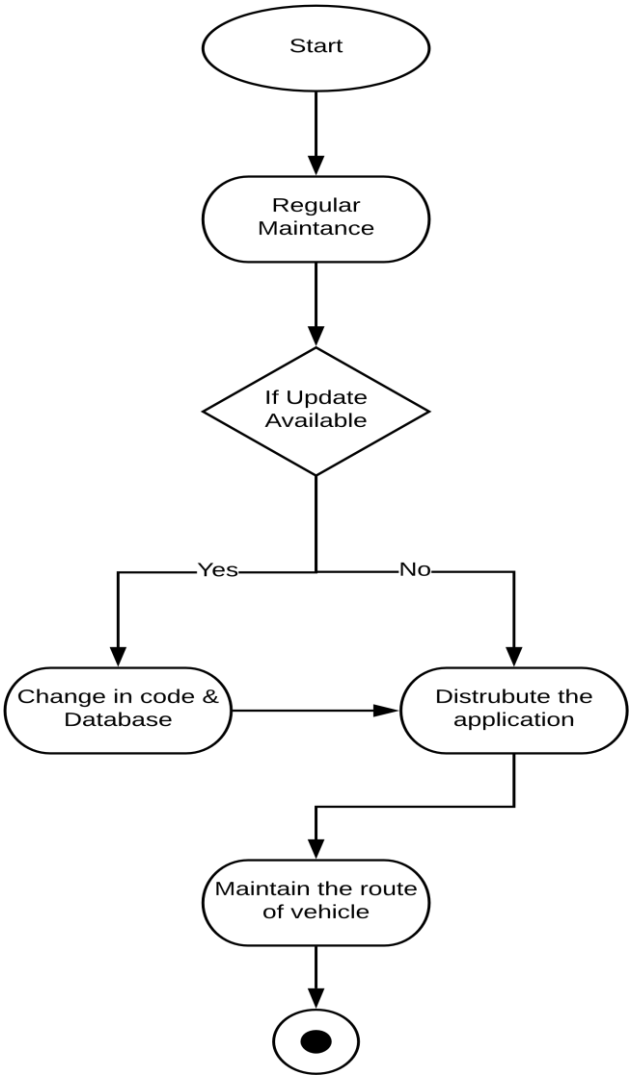


Fig- Use Case Diagram for Garbage Vehicle Tracker





Dig 1 Dig 2

Fig- Activity Diagrams for Garbage Vehicle Tracker

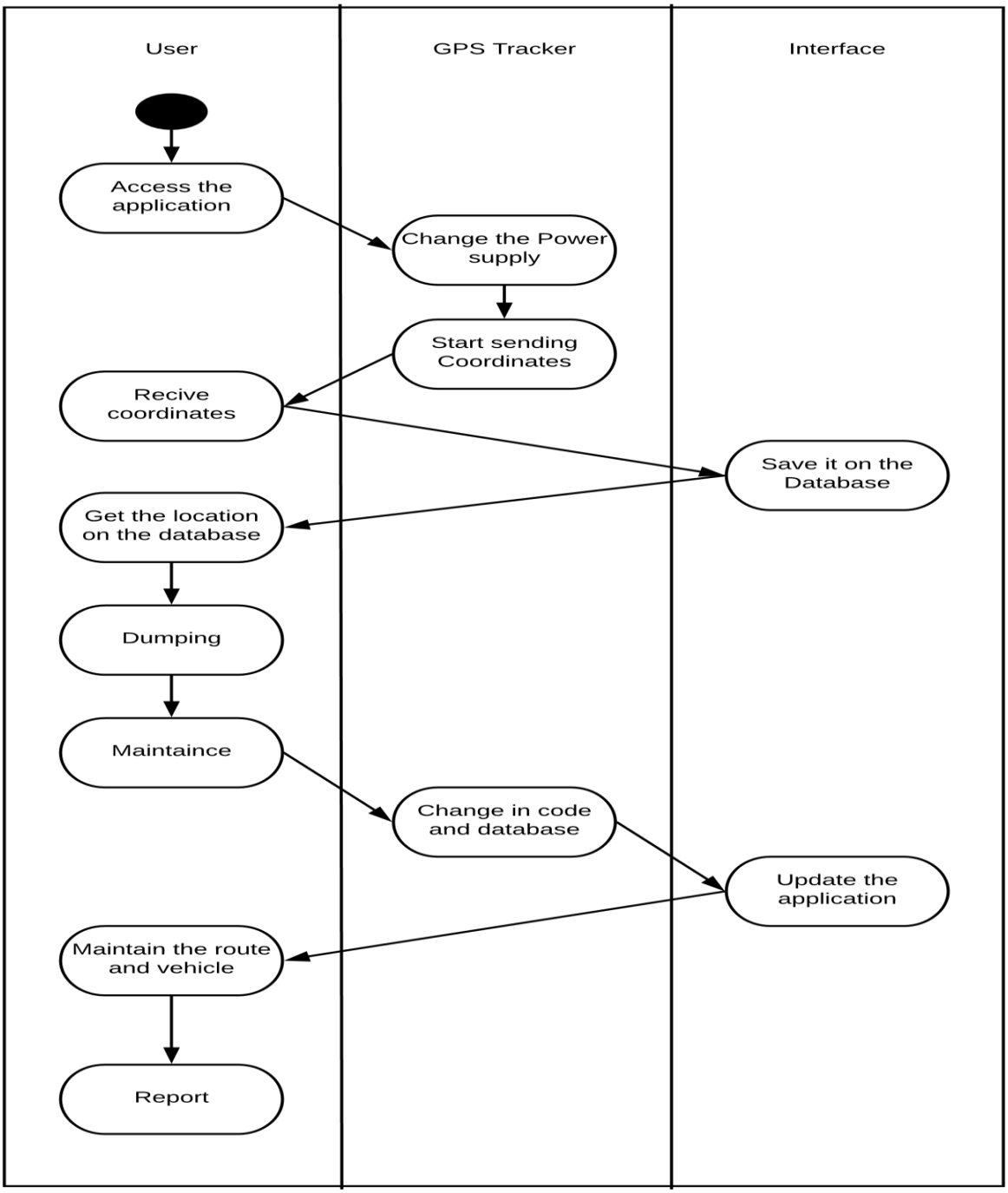
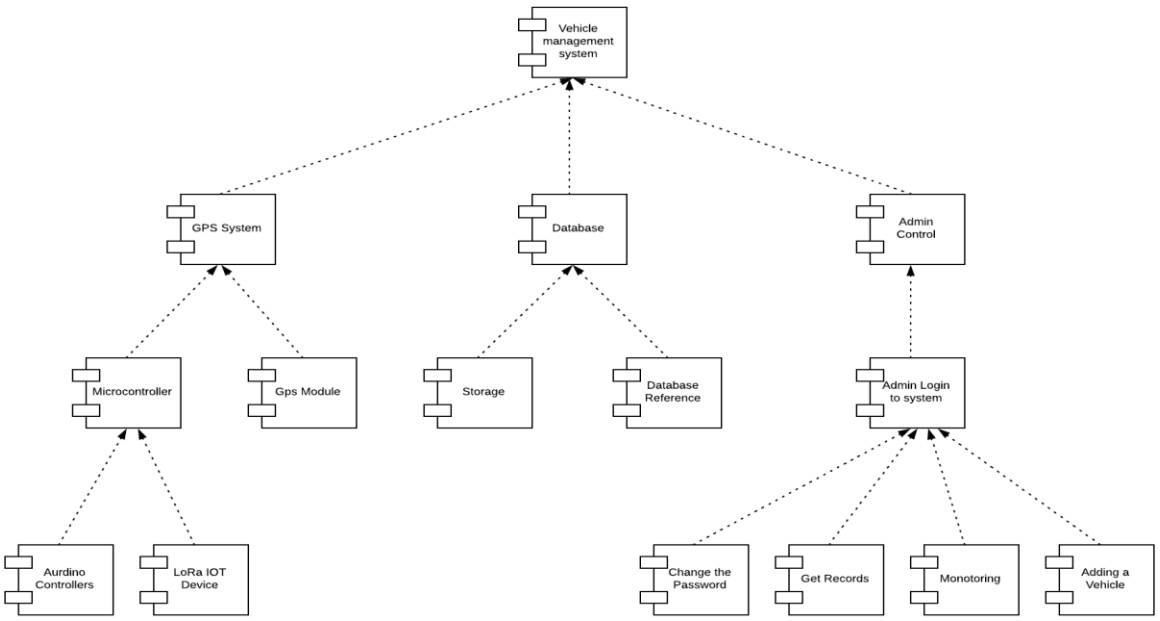


Fig – Swim lane Diagram for Garbage Vehicle Tracker



Component Diagram

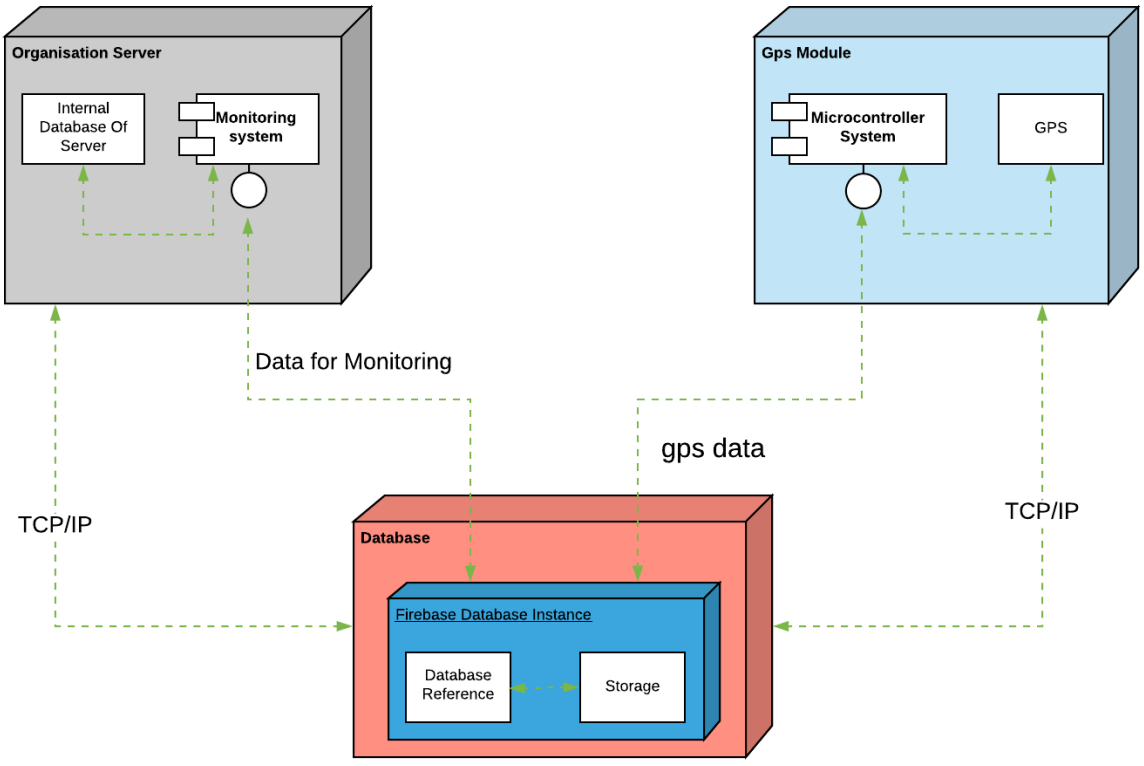


Fig – Component and Deployment Diagram for Garbage Vehicle Tracker

1) Software

We have developed an android app which will track down the garbage vehicles of islampur municipal co-operation. This app is connected to GPS of vehicle through internet. We have named the application as ‘Garbage Vehicle Tracker’.

Implementation:

Step 1) -- Designing Welcome Page and building manifest files.

In the first step we have created a welcome page and the activities required are declared in manifest files. This activities have assigned with the various roles and permission for App are declared in manifest. Welcome java class is then created which will then open the main page of application.

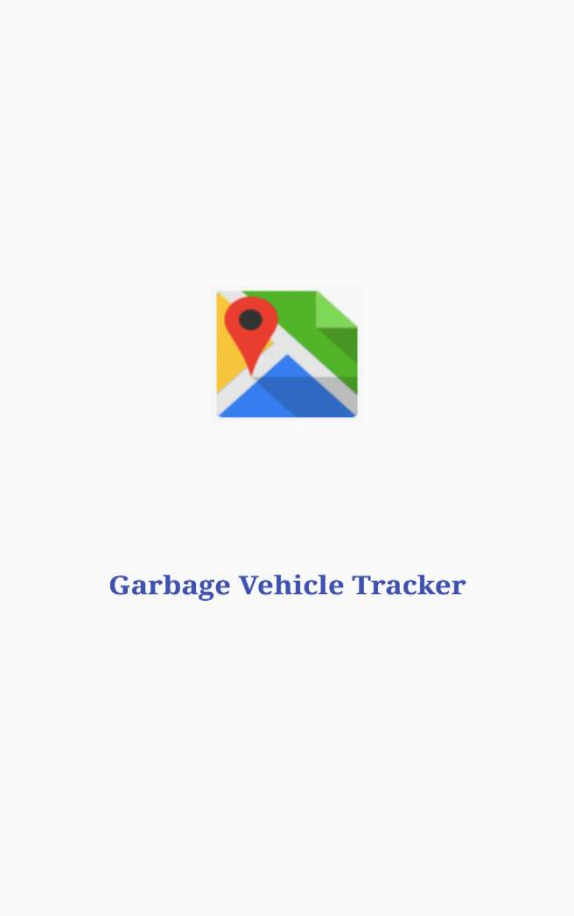


Fig – Welcome Page of App

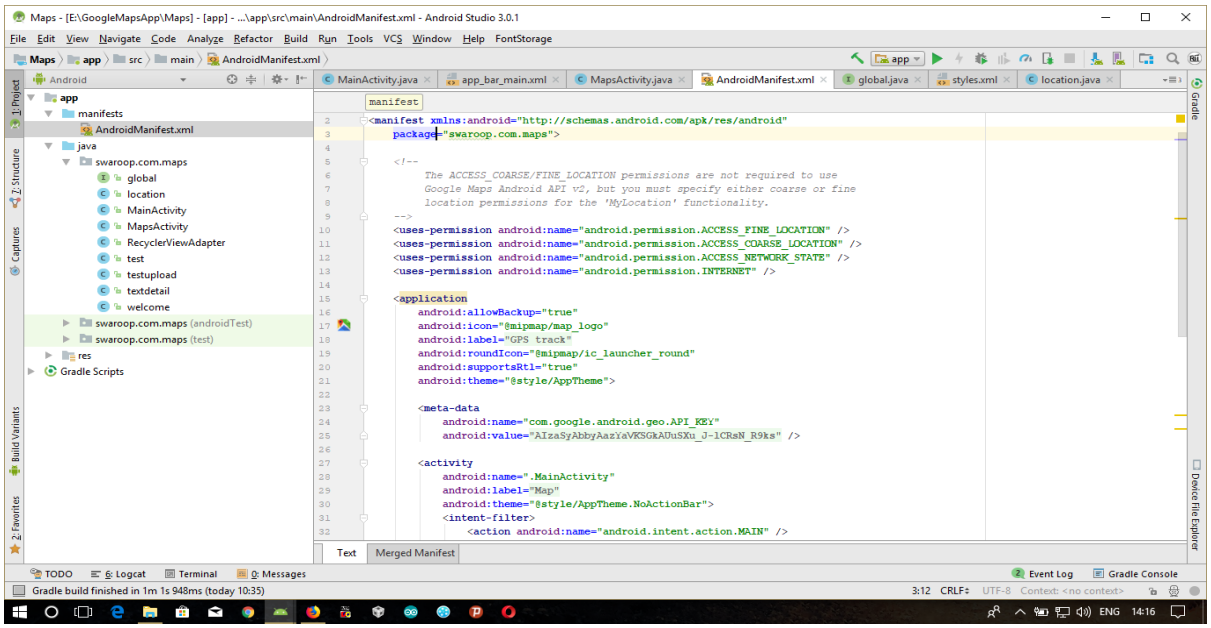


Fig - Manifest file

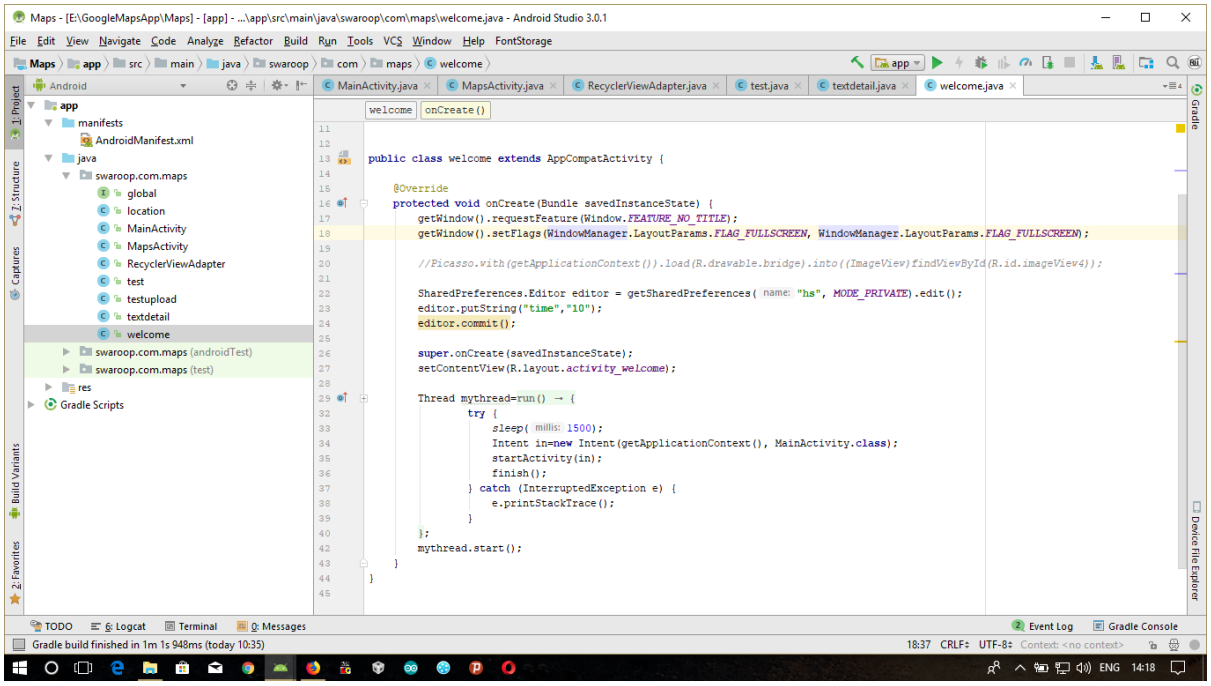
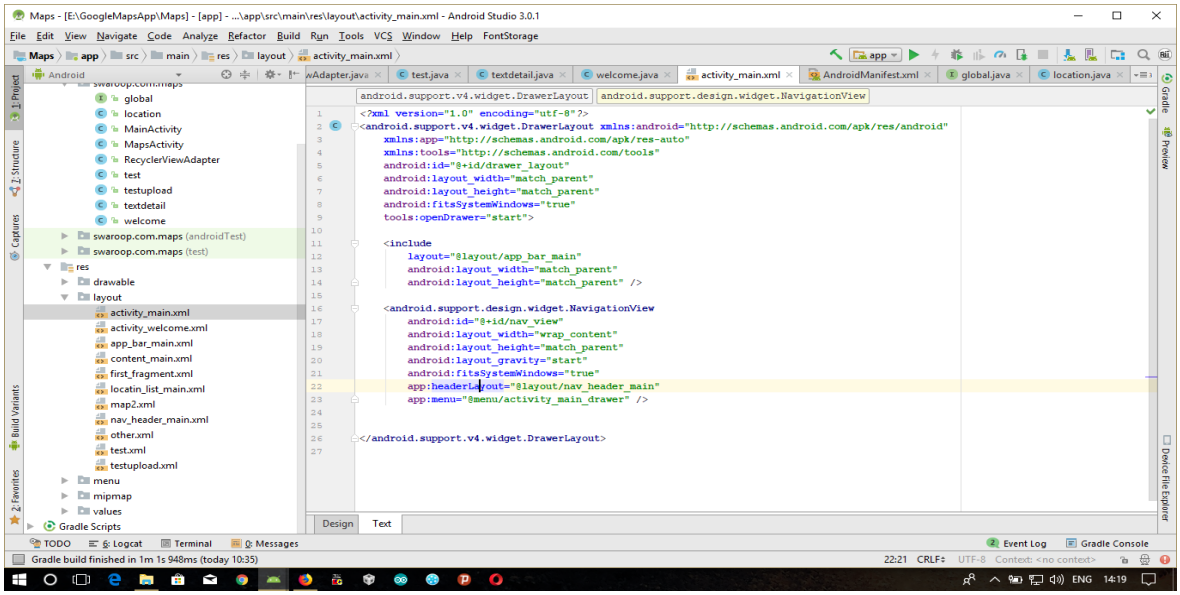


Fig – Welcome.java class

Step 2)-- Main Screen Activity

In this step, the coding for backend is done. Which includes fetching the data from database to show the last added latitude and longitudes (position) into the firebase. The map automatically zoom to the current position of vehicle when it is connected to internet. The floating button is provided to zoom back to the current location manually.

The implementation of backend and frontend is as follows:



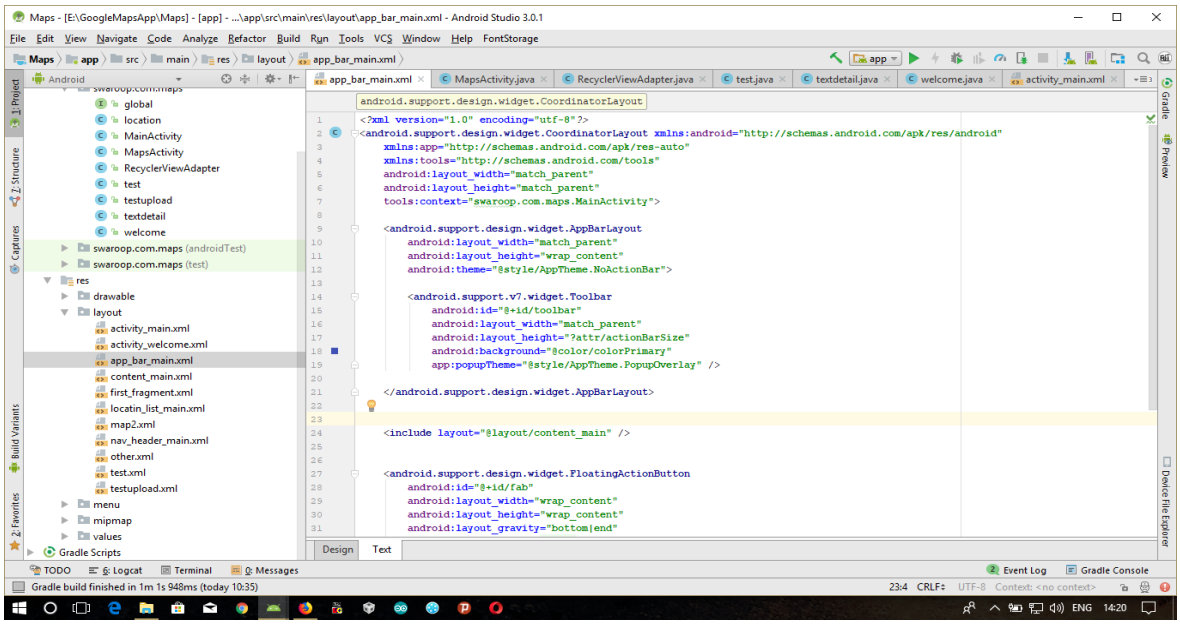
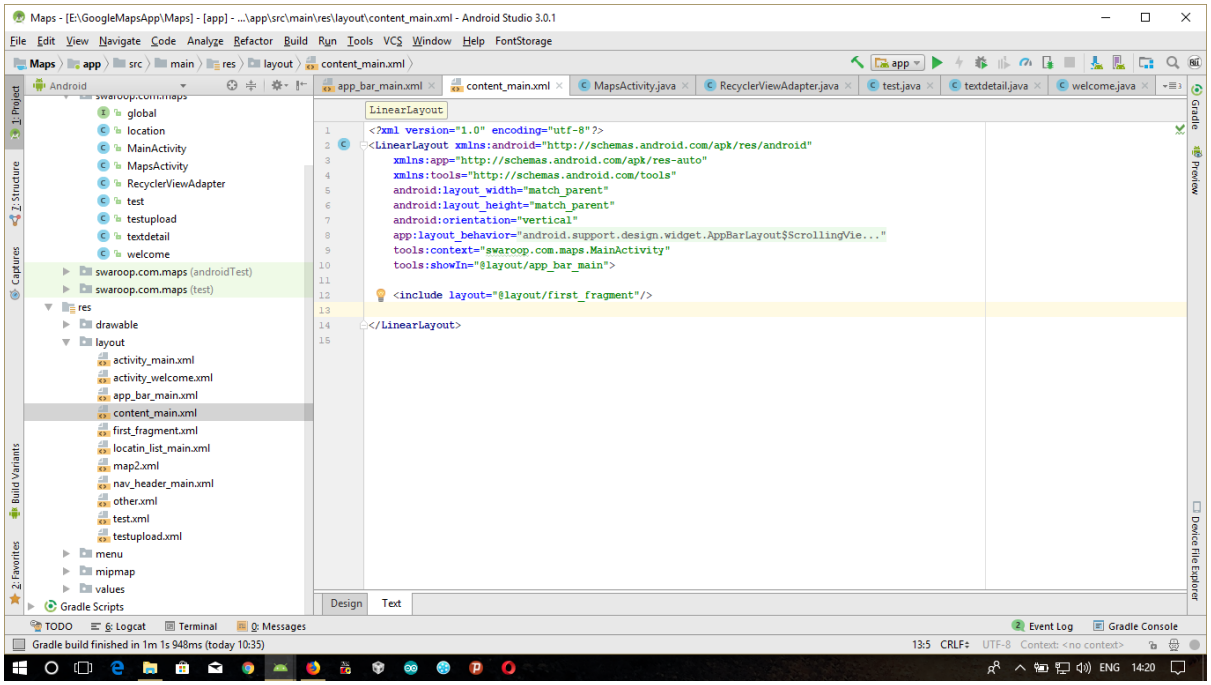


Fig – XML files for Main Activity



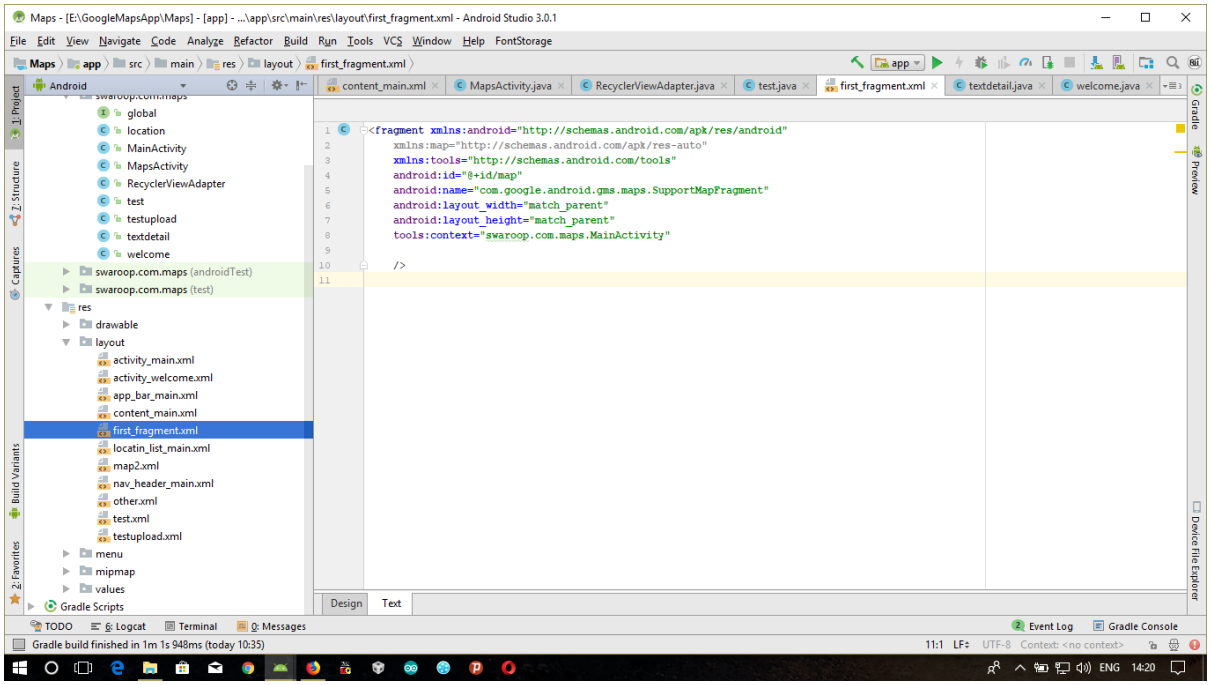


Fig – XML activities for Map fragment

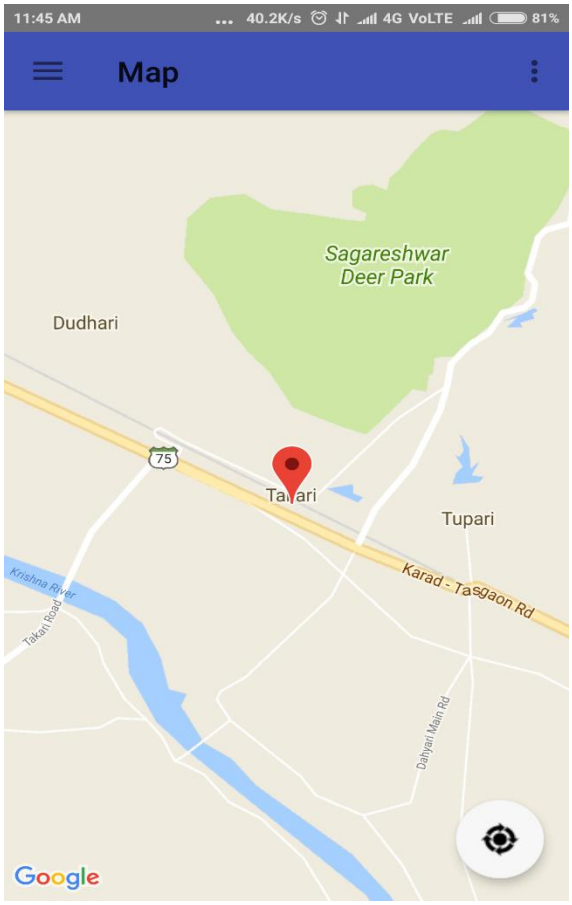
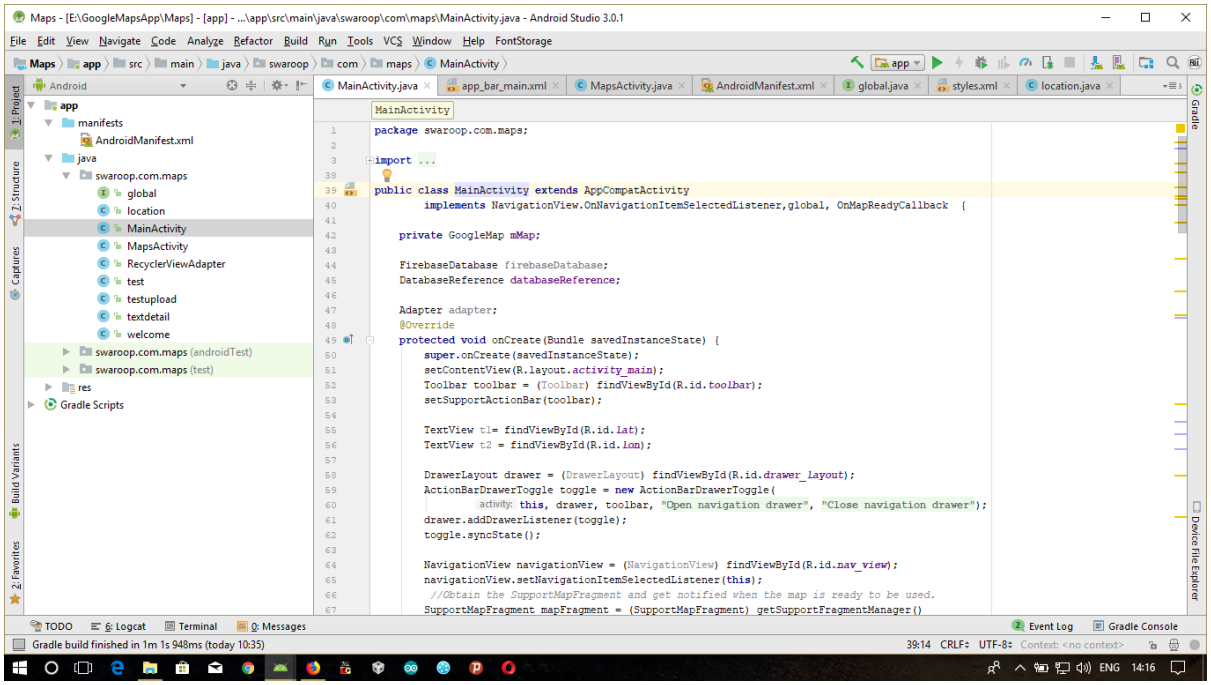
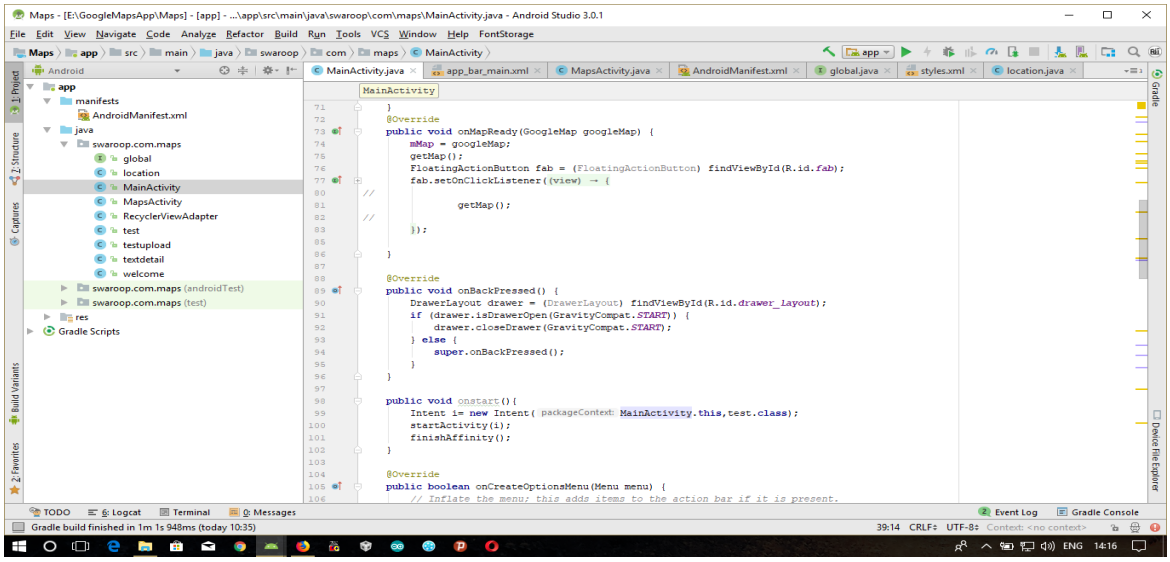
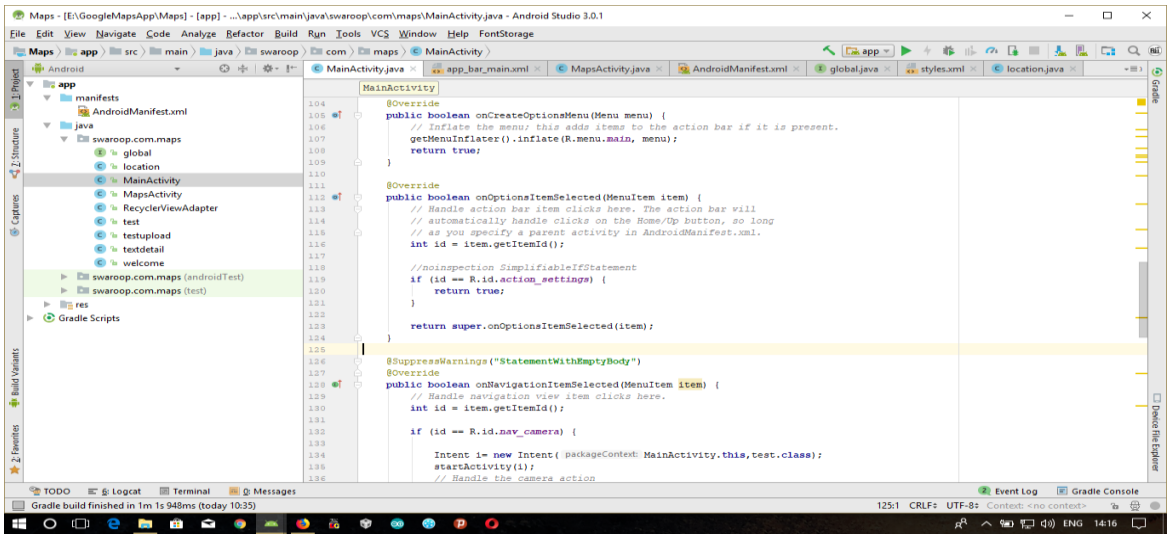


Fig- Snap of App's Main Screen







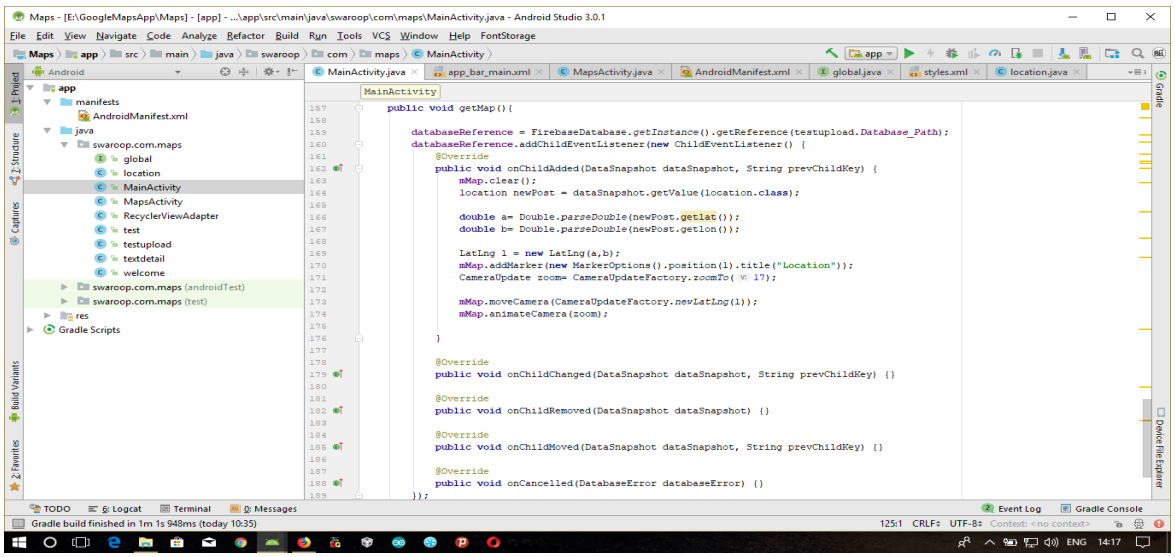


Fig – MainActivity.java class

Step 3) — Getting all the points travelled by vehicle

For getting all the locations visited by that particular garbage vehicle, we have created this page. If we open the page we will get to know all the locations in the islampur city which are visited by that garbage vehicle in the specific session of garbage collection.

Implementation of this step is as follows:

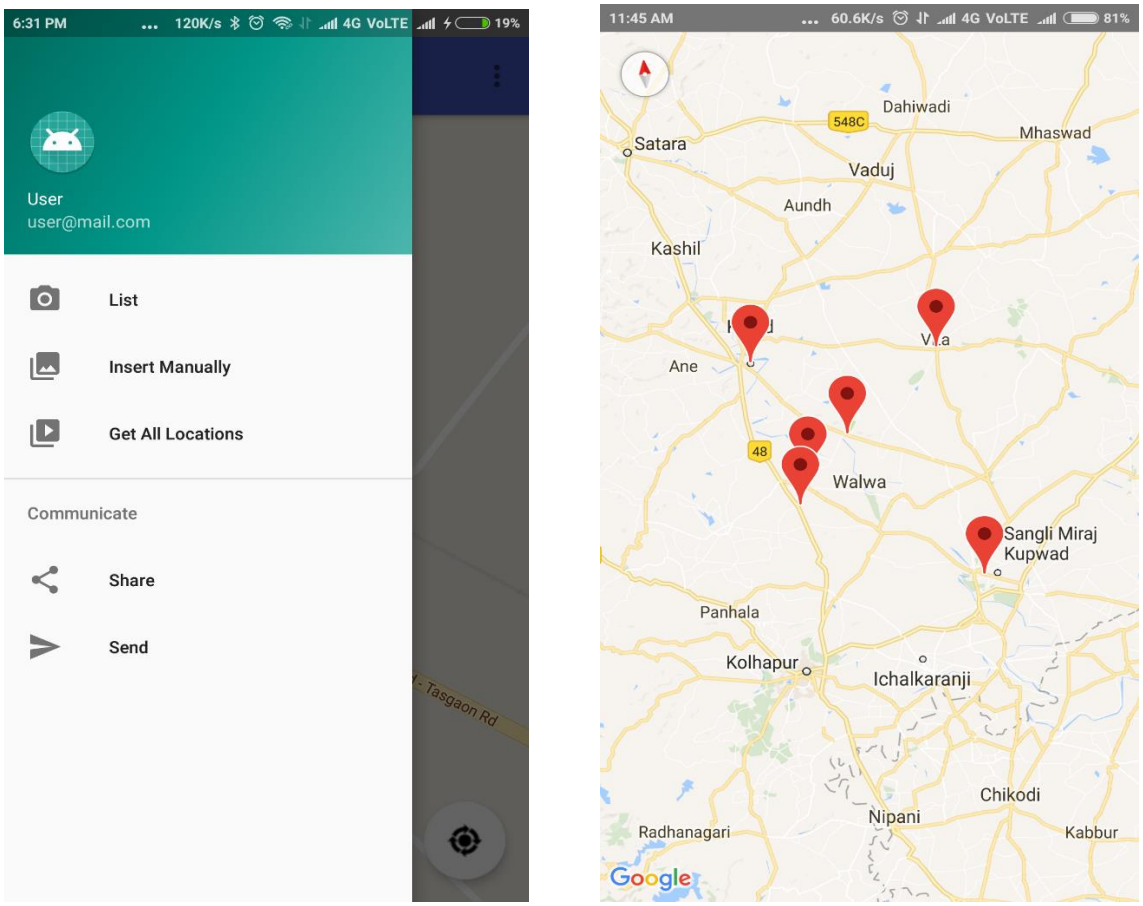
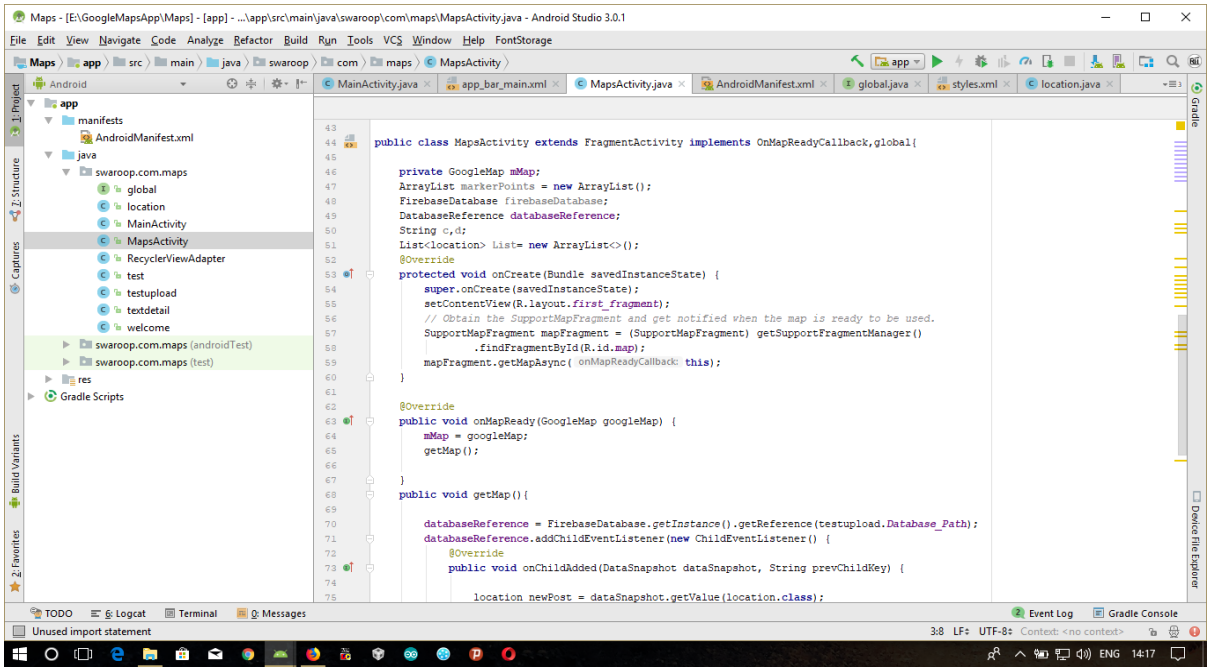


Fig - Activities to get all visited locations.



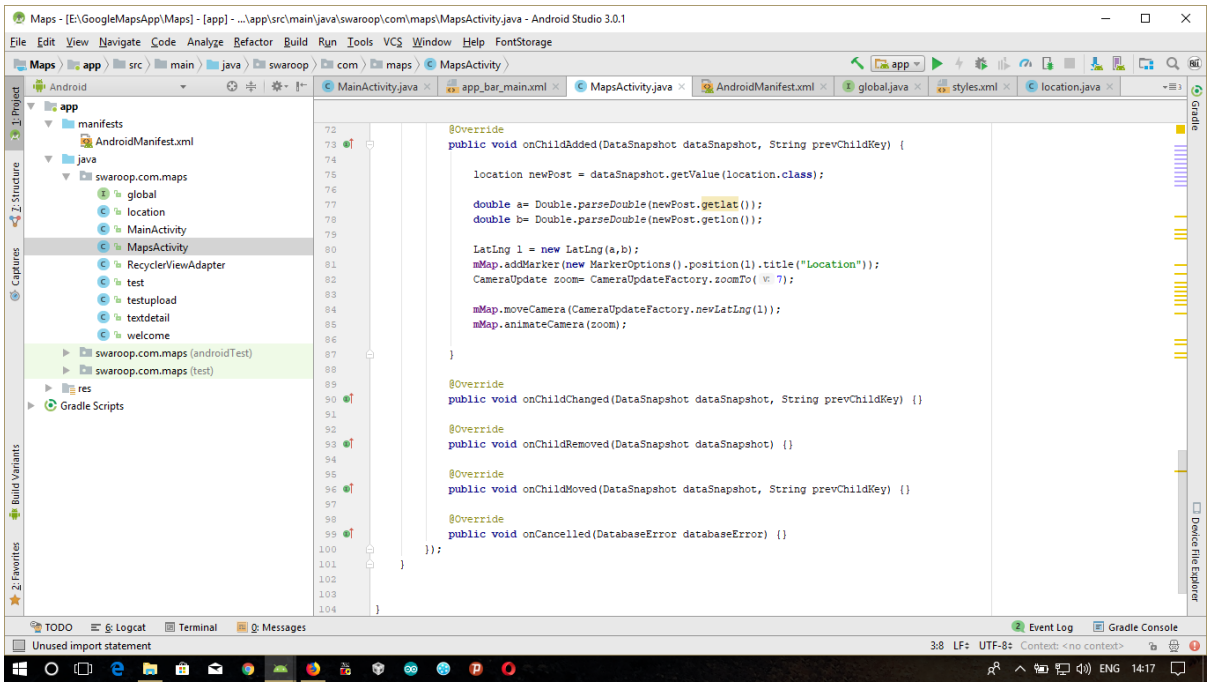


Fig- MapsActivity.java class for visited locations

Step 4) – Adding Database to app.

We have added google firebase to the app for interfacing the gps module wirelessly. Wifi module of aurdino connected with LoRa communication module is used to store the location of garbage vehicle in firebase. We have written a java file named location. Location file fetches the lattitude and longitude from database which is then parsed to maps activities for pointing the location on map.

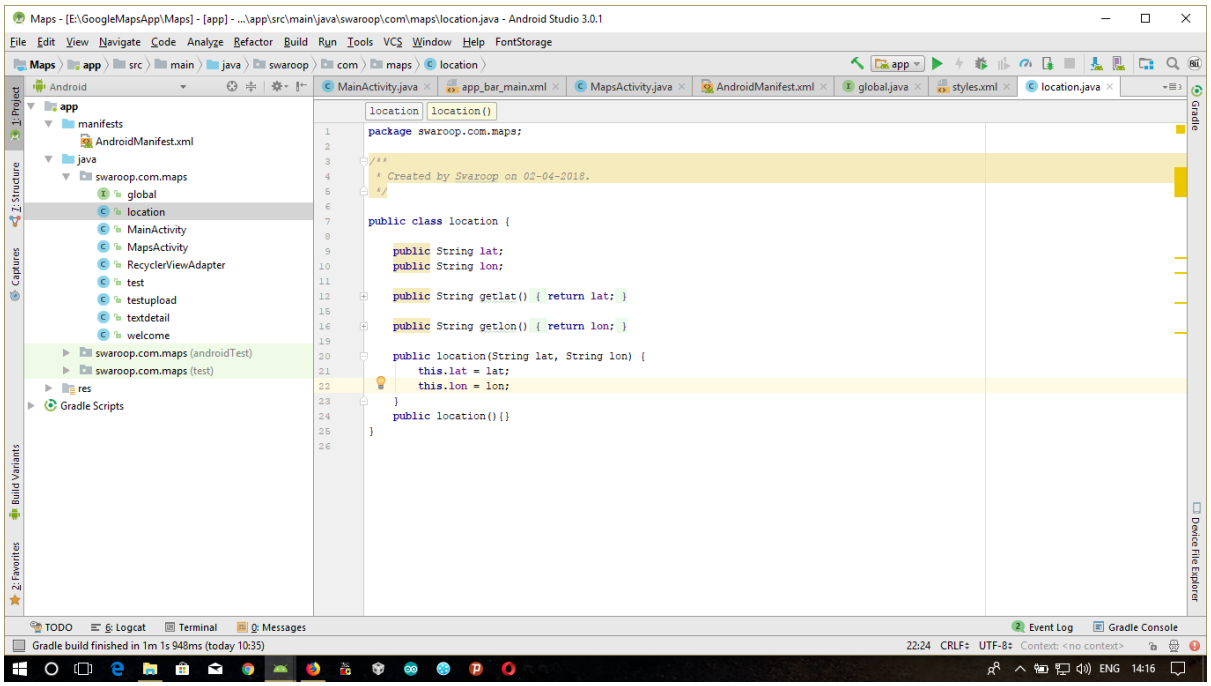


Fig – location.java class for firebase data fetching.

2. Hardware

LoRa Shield

Introduction-

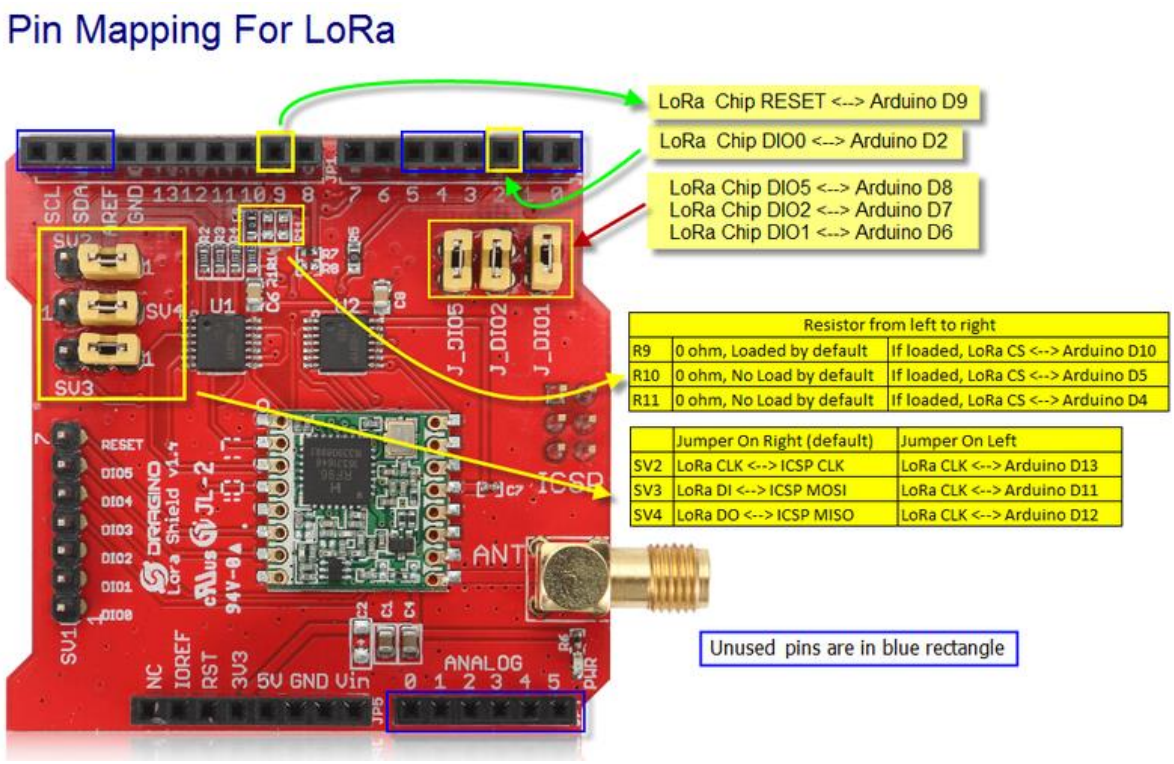
The Dragino LoRa Shield is a long range transmitter and receiver on a Arduino shield form factor and based on Open source library.The LoRa Shield useful for the user to send data and reach extremely long ranges at low data-rates.It provides very-long range spread spectrum communication and high interference immunity whilst minimising current consumption.

The LoRa Shield is utilized for proficient remote sensor arrange applications, for example, shrewd water system frameworks, brilliant metering system,smartphone recognition framework, building robotization framework, et cetera. Utilizing Simtech's licensed LoRa tweak innovation the LoRa Shield can have the capacity to accomplish an affectability of over - 148dBm utilizing an ease gem and bill of materials.

The high affectability joined with the coordinated +20 dBm control intensifier yields industry driving connection spending making it ideal for any application requiring reach or power. LoRa™ likewise gives noteworthy preferences in both blocking and selectivity over regular regulation systems, unraveling the customary outline trade off between go, obstruction insusceptibility and vitality utilization. These gadgets additionally bolster elite (G)FSK modes for frameworks including WMBus, IEEE802.15.4g.

The LoRa Shield deliver exceptional phase noise, selectivity, receiver linearity and IIP3 for significantly lower current consumption than competing devices.

Pin Mapping-



Resistor from left to right		
R9	0 ohm, Loaded by default	If loaded, LoRa CS <--> Arduino D10
R10	0 ohm, No Load by default	If loaded, LoRa CS <--> Arduino D5
R11	0 ohm, No Load by default	If loaded, LoRa CS <--> Arduino D4

	Jumper On Right (default)	Jumper On Left
SV2	LoRa CLK <--> ICSP CLK	LoRa CLK <--> Arduino D13
SV3	LoRa DI <--> ICSP MOSI	LoRa CLK <--> Arduino D11
SV4	LoRa DO <--> ICSP MISO	LoRa CLK <--> Arduino D12

Specifications

168 dB most extreme connection spending plan.

- +20 dBm - 100 mW steady RF yield versus +14 dBm high effectiveness PA.
- Programmable piece rate up to 300 kbps.
- High affectability: down to - 148 dBm.
- Bullet-confirmation front end: IIP3 = - 12.5 dBm.
- Excellent blocking insusceptibility.
- Low RX current of 10.3 mA, 200 nA enroll maintenance.
- Fully coordinated synthesizer with a determination of 61 Hz. FSK, GFSK, MSK, GMSK, LoRaTM and OOK balance.
- Built-in bit synchronizer for clock recuperation.
- Preamble discovery.
- 127 dB Dynamic Range RSSI.
- Automatic RF Sense and CAD with ultra-quick AFC.

Features-

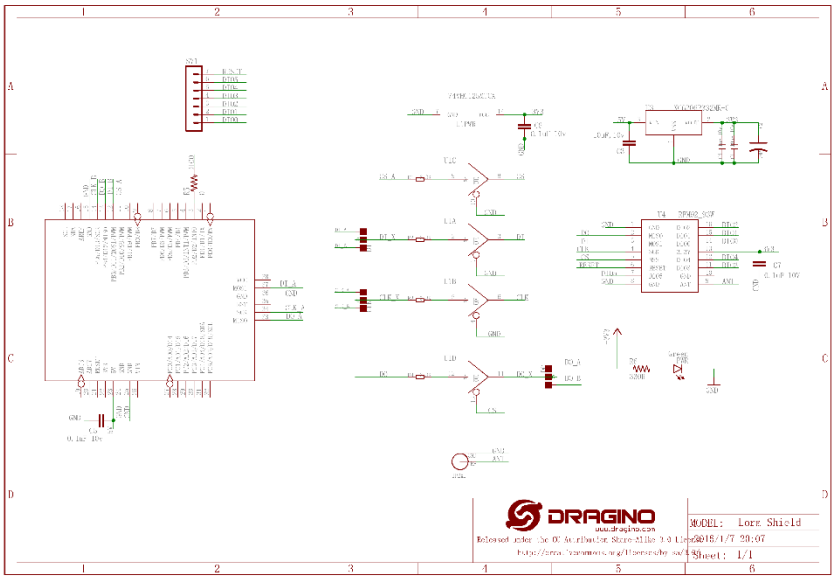
- Compatible with 3.3v or 5v I/O Arduino Board.
- Frequency Band: 915 MHZ/868 MHZ/433 MHZ (Pre-configure in factory)
- Low power consumption Compatible with Arduino Leonardo, Uno, Mega, DUE
- External Antenna via I-Pex connector

Power-Consumption-

Table 6 Power Consumption Specification

Symbol	Description	Conditions	Min	Typ	Max	Unit
IDDSL	Supply current in Sleep mode		-	0.2	1	uA
IDDIDLE	Supply current in Idle mode	RC oscillator enabled	-	1.5	-	uA
IDDST	Supply current in Standby mode	Crystal oscillator enabled	-	1.6	1.8	mA
IDDFS	Supply current in Synthesizer mode	FSRx	-	5.8	-	mA
IDDR	Supply current in Receive mode	*LnaBoost* Off, band 1 *LnaBoost* On, band 1 Bands 2&3	- - -	10.8 11.5 12.0	- - -	mA
IDDT	Supply current in Transmit mode with impedance matching	RFOP = +20 dBm, on PA_BOOST RFOP = +17 dBm, on PA_BOOST RFOP = +13 dBm, on RFO_LF/HF pin RFOP = + 7 dBm, on RFO_LF/HF pin	- - - -	120 87 29 20	- - - -	mA mA mA mA

Schamatics-



Arduino UNO

Arduino is an open-source tool stage in light of simple to-utilize equipment and programming. Arduino sheets can read inputs - light on a sensor, a finger on a catch, or a Twitter message - and transform it into a yield - enacting an engine, turning on a LED, distributing something on the web. You can guide your board by sending an arrangement of directions to the microcontroller on the board. To do as such you utilize the Arduino programming dialect (in view of Wiring), and the Arduino Software (IDE), in light of Processing. Throughout the years Arduino has been the mind of thousands of ventures, from regular items to complex logical instruments. An overall group of producers - understudies, specialists, craftsmen, developers, and experts - has accumulated around this open-source stage, their commitments have indicated a staggering measure of available information that can be of awesome help to beginners and specialists alike. Arduino was conceived at the Ivrea Interaction Design Institute as a simple instrument for quick prototyping, went for understudies without a foundation in gadgets and programming. When it achieved a more extensive group, the Arduino board began changing to adjust to new needs and difficulties, separating its offer from basic 8-bit sheets to items for IoT applications, wearable, 3D printing, and inserted conditions. All Arduino sheets are totally open-source, enabling clients to manufacture them autonomously and in the end adjust them to their specific needs. The product, as well, is open-source, and it is becoming through the commitments of clients around the world.

Features-

- Economical - Arduino sheets are generally modest contrasted with other microcontroller stages. The slightest costly form of the Arduino module can be collected by hand, and even the pre-amassed Arduino modules cost under $50

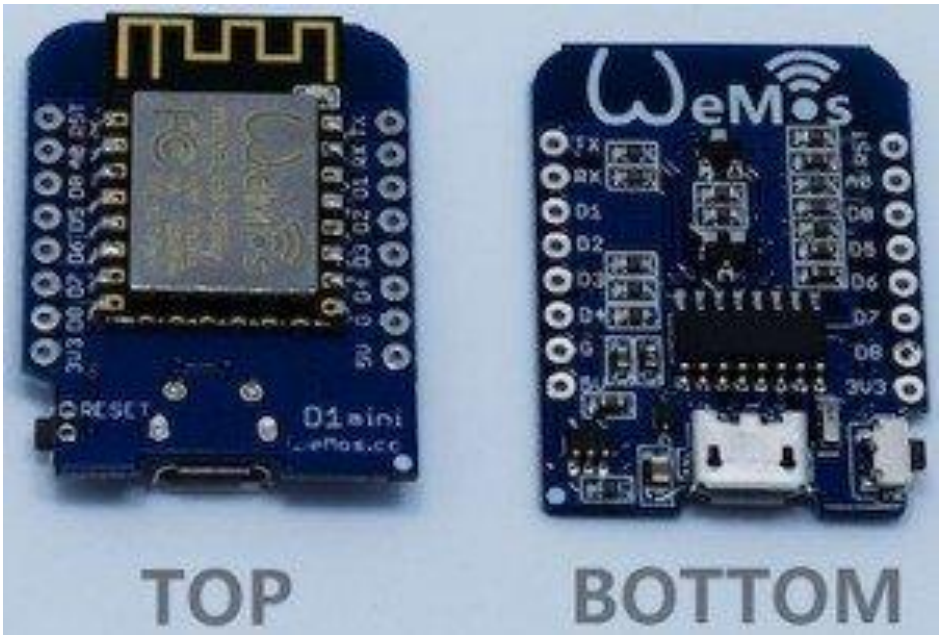
- Cross-stage - The Arduino Software (IDE) keeps running on Windows, Macintosh OSX, and Linux working frameworks. Most microcontroller frameworks are restricted to Windows.

- Simple, clear programming condition - The Arduino Software (IDE) is anything but difficult to-use for novices, yet sufficiently adaptable for cutting edge clients to exploit too. For educators, it's helpfully in view of the Processing programming condition, so understudies figuring out how to program in that condition will be acquainted with how the Arduino IDE functions.

- Open source and extensible programming - The Arduino programming is distributed as open source instruments, accessible for expansion by experienced developers. The dialect can be extended through C++ libraries, and individuals needing to comprehend the specialized points of interest can make the jump from Arduino to the AVR C programming dialect on which it's based. Likewise, you can include AVR-C code straightforwardly into your Arduino programs on the off chance that you need to.

- Open source and extensible equipment - The designs of the Arduino sheets are distributed under a Creative Commons permit, so experienced circuit originators can make their own variant of the module, broadening it and enhancing it. Indeed, even generally unpracticed clients can fabricate the breadboard variant of the module with a specific end goal to see how it functions and spare cash.

ESP 8266 WiFi



The ESP8266 is an ease Wi-Fi module compatible with aurdino and microcontroller ability developed by, Espressif Systems. The chip initially went to the consideration of western producers in August 2014 with the ESP-01 module, made by an outsider maker, Ai-Thinker. This little module enables microcontrollers to associate with a Wi-Fi system and make straightforward TCP/IP associations utilizing Hayes-style summons. In any case, at the time there was no English-dialect documentation on the chip and the summons it acknowledged. The low cost and the way that there were not very many outer parts on the module which proposed that it could in the end be extremely modest in volume, pulled in numerous programmers to investigate the module, chip, and the product on it, and to decipher the Chinese documentation.

Chapter 3: Result and Discussion

The system with a cheap cost and a long range, working on a very low power budget was developed and about to be deployed in the city of Islampur. LoRa systems range was also tested by the scientists of UK, and in results, it found to be around 702 km. During the project, the LoRa system was tested at the range of the 28 km in the semi-urban area.

This system was used for the first time for the student project, so there were no available statistics, to make them available we have tested our system categorically. The by-product of this project is the expertise in the LoRa system.

Chapter 4: Conclusion

Government organizations like Municipal corporations responsible for collection and disposal of the garbage, outsource the responsibility to the privet firms. These private firm's activities must be tracked, as some of them try to manipulate the route by avoiding it, due to this behaviour of these firms, a major amount of garbage does not get collected and neither gets disposed of properly according to the environmental standards.

To keep track of garbage vehicles, having the location of the vehicle is mandatory. There are some systems available, to track vehicles, but most of them are costly and dependent on the private telephone and mobile network, which are not available in the rural areas. Maintaining such system is neither efficient nor simple task.

A complete new system was required, without any flaws from the last system. To do so, private network of the LoRa communication system was used with an urban range till 28 km, and line of sight range of 702 km. This system was way cheaper than the older one. The Islampur city Municipal corporation is about to use this system to track their garbage vehicles.

Chapter 5: Future Scope

- The system developed was developed in ₹7000, it was cheaper than the current system available is of ₹13000, but our system was possible in ₹4000 if mass produced in the quantity of 10 and with more time margin. Due to tariffs for China-made products and time, it was not possible, but while developing the actual product used in Islampur Municipalities, the system will cost ₹4000.

- The system is accommodated in the plastic box, as it was a prototype. The next system will be placed inside a box, specially developed to accommodate this system. The case will be rugged, and water-resistant, and will be tested before deployment.

- LoRa has a very limited range (28 km) in the city areas, the network of LoRa IOT gateways will be developed in the cities confirm the connection to the network throughout the city.

- The current system is developed for only one node or we can say only one vehicle, we can add multiple nodes with the expansion.

Chapter 6:References

1. Omer Apaydin and M Talha Gonullu (April 2008). “Emission control with route optimization in solid waste collection process: A case study” of Sadhana Vol. 33, Part 2, pp. 71–82. © Printed in India
2. Nicos Christofides(1976). “The vehicle routing problem” of Revuefrançaised’automatique,informatique,rechercheopérationnelle.Rec hercheopérationnelle, tome 10, Vol. l, p.55-70.
3. https://developers.google.com/maps/documentation/android-api/start
4. http://wiki.dragino.com/index.php?title=Lora_Shield