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Mise en œuvre d'une application mobile pour la prédiction du traficroutier

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Implementation of an application mobile for the traffic prediction

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Dédicace

“

This thesis is dedicated to:
The sake of Allah, my Creator and my Master,. My great teacher and messenger, Mohammed (Peace be upon him).

dedicate this modest work:
To My father , my eternal example, my moral support and source of joy and happiness, the one who has always sacrificed himself to see me succeed.
A big thank-you.
In the light of my days, the source of my efforts, the flame of my heart, my life and my happiness; mom whom I adore. A great merit.

To the people who have always helped and encouraged me, who were always by my side, words are not enough to express the attachment, the love and the affection that I have for you, my brothers and my sisters.

To all my family members, young and old Please find in this modest work the expression of my affection To all my friends

”

Remerciements

“

We thank God, the almighty, who gave us the health and the will to start and finish this dissertation.

We thank our dear parents. This work is the result of your sacrifices that you have made for our education and training.

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Our gratitude to all our teachers Thank you to all those who have helped or encouraged me from near or far.

Thank you all….

”

Abstract

In this theis, we proposed a new deep learning model to predict travel time based on GPS data collected in the city of Adrar. Our approach is based on two essential parts:

The first part focuses on the data collection. In this phase, an android application, called GPS Adrar, is developed for the purpose of collecting GPS coordinates from Adrar's citizens.

The second part concerns data processing. In this phase, all the data collected in the first part must be analyzed using a depp learning model. Next, the new model is integrated with an android application, called Wassalni that offers the user a better prediction of road traffic among a set of available destinations. The experimental results show that the proposed model offers high accuracy than Google Maps in most of the routes.

Keywords : Ntelligence Artificielle -Réseaux De neurones - Système De Positionnement Global - Système De Transport Intelligent - Estimation Du Temps De Trajet – Apprentissage Automatique - Flux De trafic - Embouteillage - Apprentissage En Profondeur .

Résumé

Dans cette thèse, nous avons proposé un nouveau modèle d'apprentissage profond pour prédire le temps de trafic routier en se basant sur les données GPS collectées dans la ville d'Adrar. Notre approche s'articule sur deux parties essentielles:

La première partie porte sur la collection des données. Dans cette phase, une application Android, nommée GPS Adrar, est développée dans le but de collecter les coordonnées GPS des citoyens d'Adrar.

La deuxième partie concerne le traitement des données. Dans cette phase, toutes les données collectées dans la première partie doivent être analysées à l'aide d'un modèle d'apprentissage profond. Ensuite, le nouveau modèle est intégré à une autre application androïde, nommée Wassalni, qui offre à l'utilisateur une meilleure prédiction du trafic routier parmi un ensemble de destinations disponibles. Les résultats expérimentaux montrent que le modèle proposé offre une grande précision par rapport à l'application Google Maps dans la plupart des itinéraires testées.

Mots clés : Intelligence Artificielle - Flux de trafic - Embouteillage - Apprentissage en profondeur - Réseaux de neurones - Système de positionnement global - Système de transport intelligent - estimation du temps de trajet – Apprentissage automatique

ملخص

في هذه الأطروحة اقترحنا نموذجًا جديدًا للتعلم العميق للتنبؤ بوقت الرحلة باستخدام بيانات GPS التي تم الحصول عليها في أدرار. استراتيجيتنا مبنية على عنصرين رئيسيين:

يركز القسم الأول على جمع البيانات. خلال هذه المرحلة ، يتم إنشاء تطبيق اندرويد يسمى Adrar GPS بهدف جمع إحداثيات GPS من سكان ادرار.

القسم الثاني حول معالجة البيانات. يجب فحص جميع البيانات التي تم الحصول عليها في المرحلة الأولى باستخدام نموذج التعلم العميق في هذه الخطوة. ثم يتم دمج النموذج الجديد مع Wassalni ، وهو تطبيق اندرويد يوفر تنبؤًا أفضل لحركة المرور على الطرق بين مجموعة من الوجهات التي يمكن الوصول إليها. في معظم الحالات ، تشير النتائج التجريبية إلى أن النموذج المقترح أكثر دقة من خرائط قوقل.

كلمات مفتاحية :

تدفق حركة المرور , الازحام المروري , التعلم العميق , الشبكة العصبية , نضام تحديد المواقع , تقدير وقت السفر,

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General Introduction

General Introduction

Because time is valuable in our day, and because, as vladimir lenin stated, "time does not wait," the navigator is seen as a guarantee of success in the workplace, particularly in our era of speed.
According to the statistics website in adrar, the city of adrar is one of the most active algerian desert cities, as it has undergone changes and seen a growth in population, as seen in figure 1. As a result of this boom, there was a rise in public transit, which resulted in traffic congestion. [1]

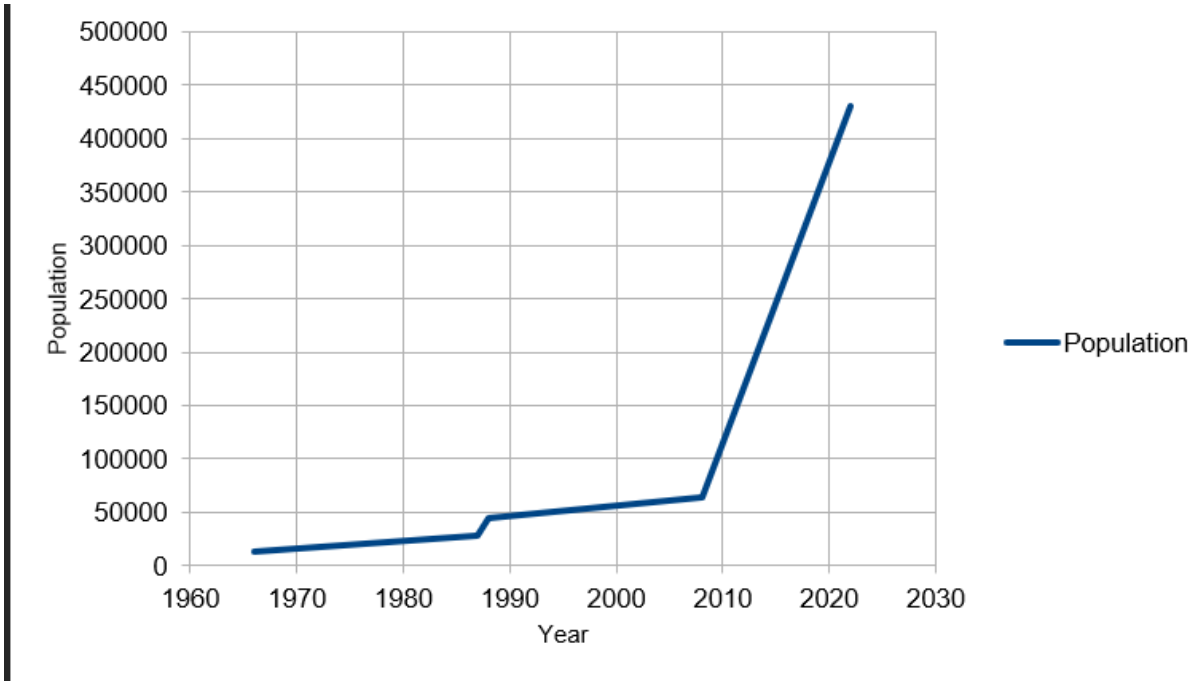


Figure 1: Population growth in the state of Adrar

To solve this problem, traffic must be estimated and travel time predicted so that people can manage their movements, but first, there is a need to study the criteria that fundamentally affect the process.

In this note, a relationship between travel time and traffic congestion was researched and its impact on smart transport accession, where deep learning and neural networks were adopted to create a smart model embedded in the android app

This research is organized into four chapters:

- the first chapter, a definition of machine learning and deep learning, and an overview of the intelligent transport system and its features will be provided.
- The second chapter presents a description of previous work on the subject and a comparison between them.
- In the third chapter, the design of the proposed model are presented through the stages of data collection and the stage of filtering the collected GPS data, and the training of the neural network model to predict travel time and link it with the android application .

- In the last chapter, we will train the neural network model to predict travel time and link it to the android application, followed by the testing phase, by trying the application on the ground to evaluate the accuracy of the proposed solution and the efficiency of the application

Chapter 1
Backgrounds

Chapter 1

Backgrounds

1.1 Introduction

Many studies have been carried out in the field of its, especially in the areas of journey time and traffic predictions using machine learning, in this chapter we will introduce ITS approaches and branches of machine learning

1.2 Artificial intelligence, machine learning and deep learning

When someone hears the terms artificial intelligence, machine learning, and deep learning, they are likely to be confused about the differences between them. A computer system capable of performing activities that often require human intelligence, such as vision, speech recognition, decision making, and language translation. This is now possible thanks to artificial intelligence.

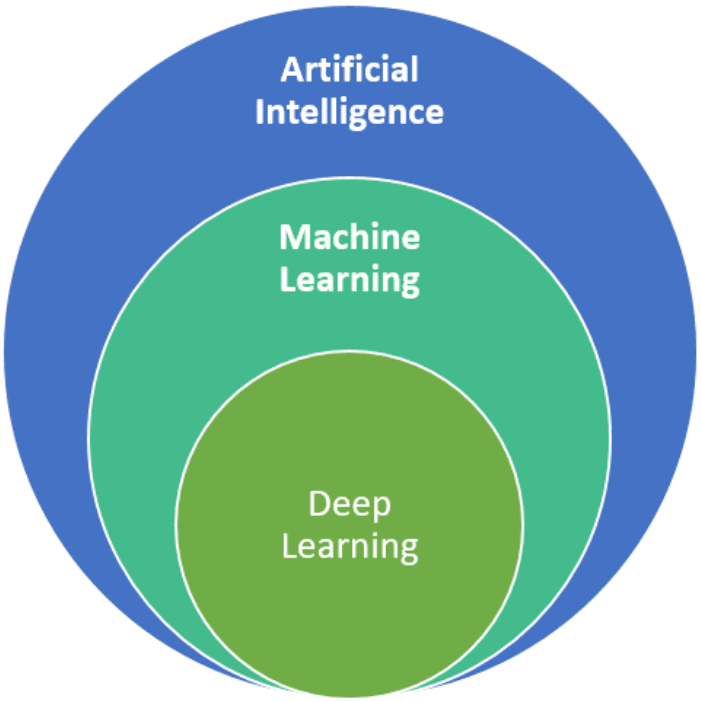


Figure 1.1: Relationship between deep learning , machine learning and artificial intelligence

intelligence Deep learning research is a subset of machine learning, an umbrella term. In other words, all machine learning is AI, but not all AI is machine learning, etc. [2]

1.2.1 Artificial intelligence

Artificial intelligence was initially proposed in the 1950s by a group of computer scientists who wanted to learn how to make machines think. This is a fundamental issue that many people continue to discuss to this day. [3]

1.2.2 Definition of machine learning

ML is a set of methods and techniques that can be used to create models or systems that can be trained to perform tasks that humans cannot perform. Scientists will prepare and clean the data before trying to select the right machine learning algorithm for training. A computer scientist creates the program code and prepares the data in traditional programming to get the desired results. [4]

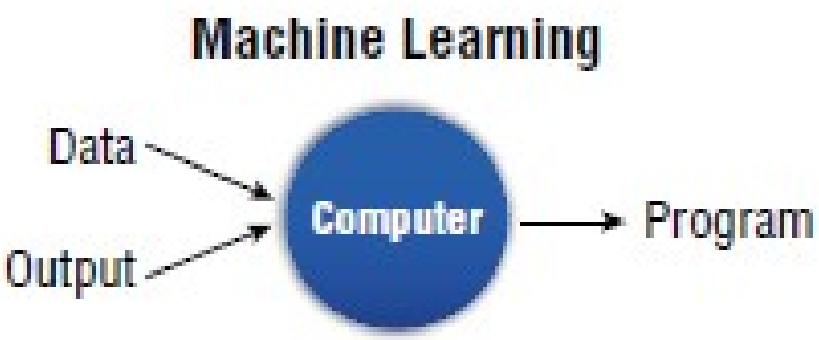


Figure 1.2: Production of the program using the data and the output (3)

1.2.3 The difference between machine learning and artificial intelligence

Machine Learning	Artificial Intelligence
Machine learning is a method of data analysis that automates analytical mode building	Artificial Intelligence is a method of data analysis that makes your model intelligent
Machine Learning results in data	Artificial Intelligence results in Knowledge or making your system intelligent
the aim is to extend accuracy	the aim is to extend probability of success
ML permits system to be told new things from knowledge.	AL is the higher cognitive process

Table 1.1: The difference between machine learning and artificial intelligence

1.2.4 Deep learning

Deep learning allows computational models with multiple processing layers to learn different degrees of abstraction to represent data. these technologies have greatly enhanced the latest technologies in voice recognition, visual object identification, object detection, and a variety of other fields including drug development and genomics.[5]

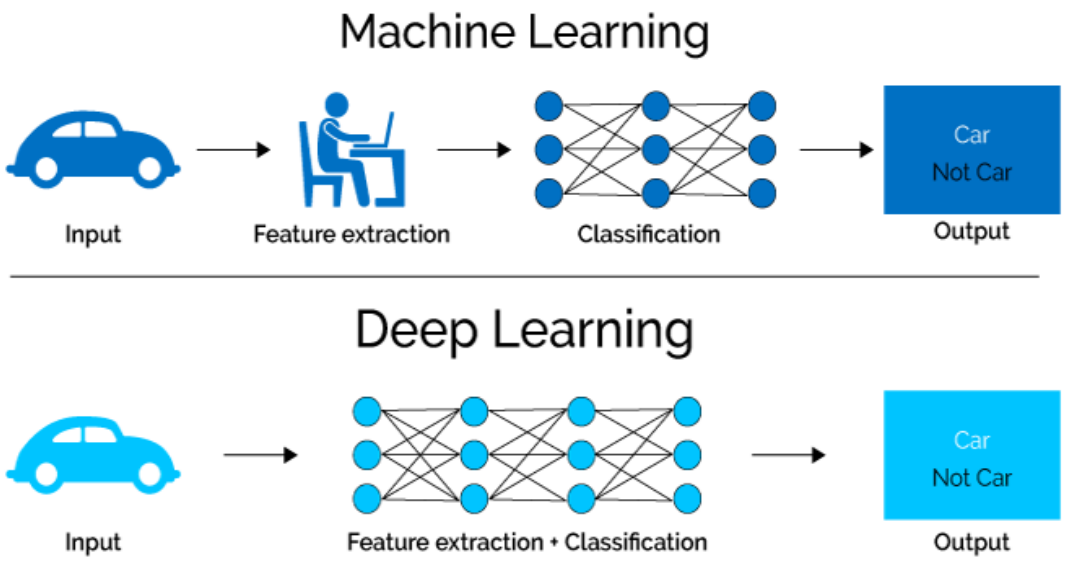


Figure 1.3: The difference between Machine learning and Deep learning [6]

1.2.5 The difference between machine learning and deep learning

While there are several distinctions between these two types of artificial intelligence, the following are the five most significant:

- Intervention by humans to produce outcomes, machine learning requires more continuing human engagement. Deep learning is more difficult to set up, but once it is up and running, it takes very little intervention.[6]
- Computer hardware machine learning algorithms are often less sophisticated than deep learning algorithms and may be executed on standard computers, whereas deep learning systems require far more powerful hardware and resources. The rising use of graphics processing units has resulted from the increased need for electricity. Due to thread parallelism, GPS are beneficial for their high bandwidth memory and ability to disguise latency (delays) in memory transfer (the ability of many operations to run efficiently at the same time.)[6]
- The passage of time machine learning systems are simple to set up and use, but their outcomes may be restricted. Deep learning systems take longer to set up but may provide results almost instantly (although the quality is likely to improve over time as more data becomes available).[6]
- Take a strategy Traditional techniques such as linear regression are used in machine learning, which often requires structured data. Deep learning makes use of neural networks and is designed to handle vast amounts of unstructured data.
- Applications In your email inbox, bank, and doctor's office, machine learning is

already in use. Deep learning technology allows increasingly complicated and autonomous programs, such as self-driving automobiles and surgical robots.[6]

1.3 Intelligent transportation systems and traffic congestion :

1.3.1 Intelligent transportation systems

Because it plays a significant role in all concerns linked to mobility in urban contexts, ITS has become an integral aspect of our technological lives. It is a collection of various technologies and applications to improve transportation safety and mobility while also minimizing traffic-related negative effects that primarily influence people's productivity and movements. [8]

1.3.2 Overview of the its applications

We present a taxonomy of current ITS-related applications in figure 1.4. ITS-related applications are now classified into two groups. The first category is entertainment apps. Its major goal is to give Internet access services (e.g., multimedia data streaming, etc.) to passengers in vehicles or other transportation system participants in order to improve their journey comfort. For such applications, important research focuses on increasing data transmission reliability and efficiency, such as lowering packet loss ratios and lowering data transmission latency, among other things. The second group of applications, driving safety and comfort-related applications .[8]

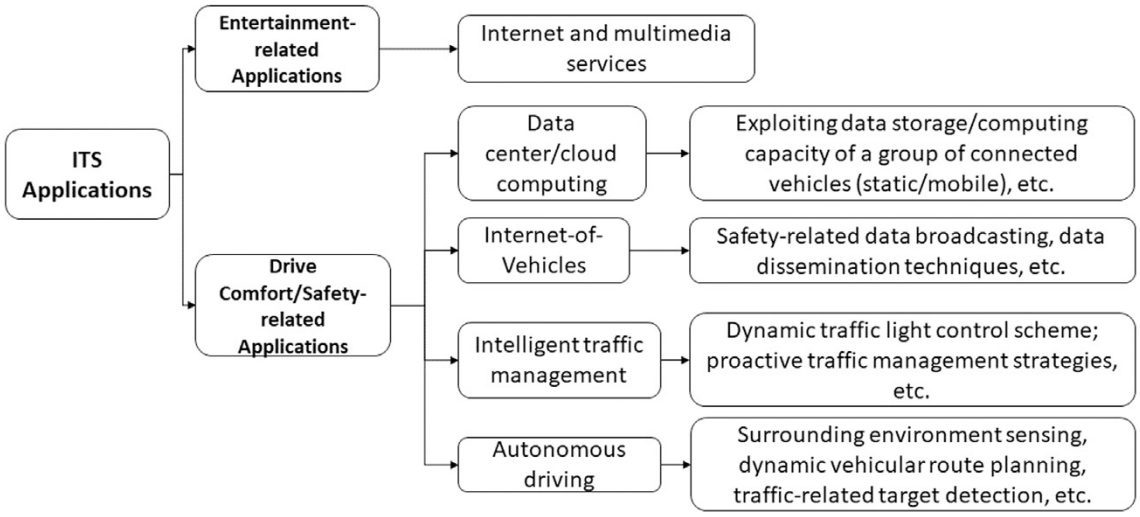


Figure 1.4: An illustration of the classification of ITS-related applications and the corresponding challenges

1.4 Traffic congestion

Traffic congestion is not a new problem in our society, and it is becoming worse every day. But before we go into the intricacies of these phenomena, let's look at their origins.

Figure 1.5: Bottlenecks in a highway

1.4.1 Causes of traffic congestion

Excess demand, signaling, accidents, work areas, weather-related events, or special events can contribute to urban traffic congestion. Based on the investigation of these factors, traffic congestion can be divided into two categories:

Frequent crowding

During rush hours in the cities, commuters encounter traffic practically every day. This recurrence occurs on a regular basis for a variety of reasons, one of which is that the number of convergent lanes on a road, bridge or tunnel exceeds the number of available lanes [9]

Nonrecurring congestion

Accidents and traffic incidents: Accidents are one of the primary causes of traffic congestion. It may take many forms, from car accidents and breakdowns to road debris. The traffic flow is disrupted as a result of this issue.

1.4.2 Consequences of traffic congestion

From an economic standpoint, road traffic congestion causes: [10]

- loss of competitiveness for a region, a country, or a continent due to congestion that blocks highway arteries .
- A loss of productivity, not just as a result of individuals taking longer to get to work, but also as a result of late deliveries of goods or services that are delayed or even canceled.
- Users' quality of life is affected because drivers who are subjected to regular traffic jams are more likely to experience tension, worry, and nervousness, which increases the likelihood of an accident.

1.5 Conclusion

The materials presented in this chapter provided an overview of ITS technology and its utility in researching traffic flow. Moreover, traffic congestion was mentioned as a primary factor directly affecting ITS systems. This chapter is divided into two parts:

- The first part focused on the concept of artificial intelligence, machine learning and deep learning .
- The second part included the concept of intelligent transportation systems .

Chapter 2

Related Works

Chapter 2

Related Works

2.1 Introduction

Many methods have been conducted in the field of intelligent transport integration, particularly in the areas of time of flight and traffic forecasts, in this chapter we we'll present different approaches of intelligent transport systems based on the machine learning.

2.2 Previous works

To collect data and analyze traffic situations on the roadways, obuhuma and moturi [14] employed GPS technology combined with road mapping focusing on traffic statistics. The adopted system also has the capability of triggering speeding vehicle alarms. The research was conducted in two major cities in kenya: nairobi and mombasa. The findings revealed that real-time traffic information analysis is in high demand. The researchers determined that using GPS for traffic analysis was the most effective method compared to other options and that it also provided a complete analysis of traffic conditions.

Poo kuan hoong et al [12], proposed a method for employing bayesian networks to give theoretically limitless coverage of road traffic situations. The researchers used a dataset of traffic flow collected in london for six months to train and test the prediction algorithm. Finally, the authors identified variables that can be used to predict traffic conditions, such as accidents, weather, road work, roadblocks, and vehicle speeds. Furthermore, while the model produced encouraging results, the accuracy of road traffic prediction was significantly lower. They plan to refine the BN model in the future to get more accurate findings.

Mohamed zaki et al [16] demonstrated a model-based method for predicting journey time. This model was created using DSMT (Dezert- Smarandache Theory) as a fusion approach and neural networks as an artificial intelligence tool. The researchers used two websites for data collection: bey2ollak and wassalny, which provide traffic conditions based on user complaints. When comparing the anticipated journey time to real-world instances, the model accuracy appears to be satisfactory. The researchers, on the other hand, said that there are restrictions in the acquisition of traffic data, which is a step that has to be automated.

Abhijeet tikar et al [13] developed a technique to forecast taxi trip travel times using machine learning and GPS data. The KNN method was used to calculate taxi journey estimates. When compared to real-life cases, the system performed admirably. They also devised a location clustering-based technique for mapping raw GPS co-ordinates to meaningful places, which they then utilized to estimate journey time.

Anil pingale et al [15] presented a statistical approach to predicting public bus arrival time based on GPS data and taking into account all factors affecting bus travel time, including departure time, workdays, current bus location, number of links, and so on. The proposed approach, according to experts, would not make bus tracking and passenger service as convenient as it might be.

Neha garg et al [17] devised a method for predicting when the bus will come. For data

collecting, researchers created a system based on two GPS devices. The first was the bus unit, which was an android app placed on the driver's phone that supplied bus coordinates every 6 seconds, and the second was the passenger unit, which received passenger coordinates and tracked the bus's whereabouts. The user is given information along with the bus number so that he may make an informed selection. The user will need to track the bus location easily, but will not get information about road traffic, the time the user will wait until the bus arrives appropriately, and the bus driver will needs to start the app every time he wants to make a trip .

Thura kyaw et al [18] used the machine to create a traffic congestion prediction model for the metropolitan road network. The model was created by collecting data from buses using GPS trackers, constructing a road network, developing a model to predict journey speed, and achieving average error rates ranging from 97 to 98 percent. The outcome was encouraging; passcodes shown on a computerized map of yangon depicting road segments would aid users in determining which route they may take.

Hassan al-mir [11] has taken a model approach to predict the travel time and traffic status of the car route chosen by the user in bashar city based on the deep neural network , where GPS data was collected through the development of an android application that collects GPS coordinates for those using public transport and their own systems.

2.3 Comparison table

works	Model		Application type		Collected data	
	ML	DL	Simple	mobile	Source	Volume
Obuhuma and Moturi 2012 [14]	√		√		manually	6371 km
Poo Kuan Hoong et al 2012[12]	√		√		manually	1700 cases
Mohamed Zaki et al 2015 [16]		√	√		manually	3090 sample
Abhijeet Tikar et al 2017 [13]	√			native	Kaggle	20K trips
Anil Pingale et al 2017 [15]				web	manually	null
Neha Garg et al 2017 [17]			√	web	manually	null
Thura Kyaw et al 2020 [18]	√		√	web	manually	4000 trips
Hassan Al-Mir 2021 [11]		√	√	web	manually	2220 KM
Our Approach		√		native	manually	3021 KM

Table 2.1: Comparison Table

In this research, we will provide an approach which estimates the travel time with traffic status consideration using a deep neural network. Our method focuses on GPS data application which collectes the data in adrar city taking into account the timeliness sites. after that, all data collected must be integrted for the processing phase through a native android application, which is faster than web applications, and provides full and easy access to the capabilities of the device.

2.4 Conclusion

Several approaches to the integration of intelligent transportation are presented in this chapter, particularly in the areas of time-of-flight and traffic forecasts based on machine learning.

Chapter 3

Proposed Approach

Chapter 3

Proposed Approach

3.1 Introduction

To implement the proposed idea, an organised conception is needed. In this chapter, a conception of the android application GPS adrar and wassalni application will be explained

3.2 Data collection

3.2.1 Conception of GPS adrar

An android application was required to track users permanently and without interruption in order to meet the study's goal. Due to Android constraints in background service and foreground service, which is an option to better economize the battery's life as much as possible, some issues were experienced.
Here in Figure 3.1, a description of the conception of the android application is given as follows:

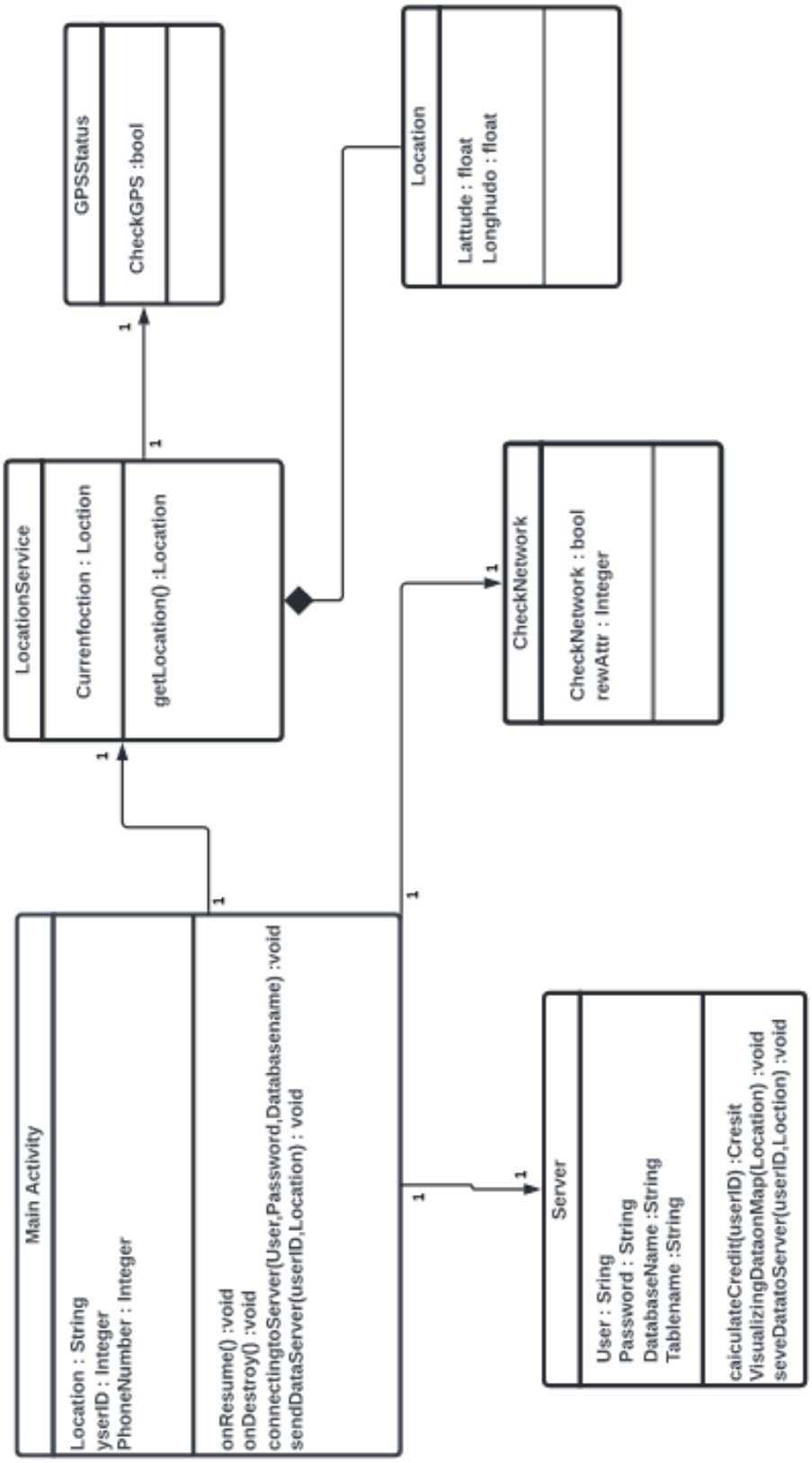


Figure 3.1: GPS Adrar class diagram

According to the class diagram Figure 3.1, the main activity is the interface of the application and has the role of informing the user of its ID and location. To get the user's location, the main activity calls the location service class. This class is with the help of a specific class in java which is called location manager and checking if GPS is available will determine the user's latitude and longitude and send it back to maina ctivity.

The communication between the main activity and the server is about saving collected GPS data to the server after checking the network availability

The following figure 3.2 will explain better the communication between the server and the app.

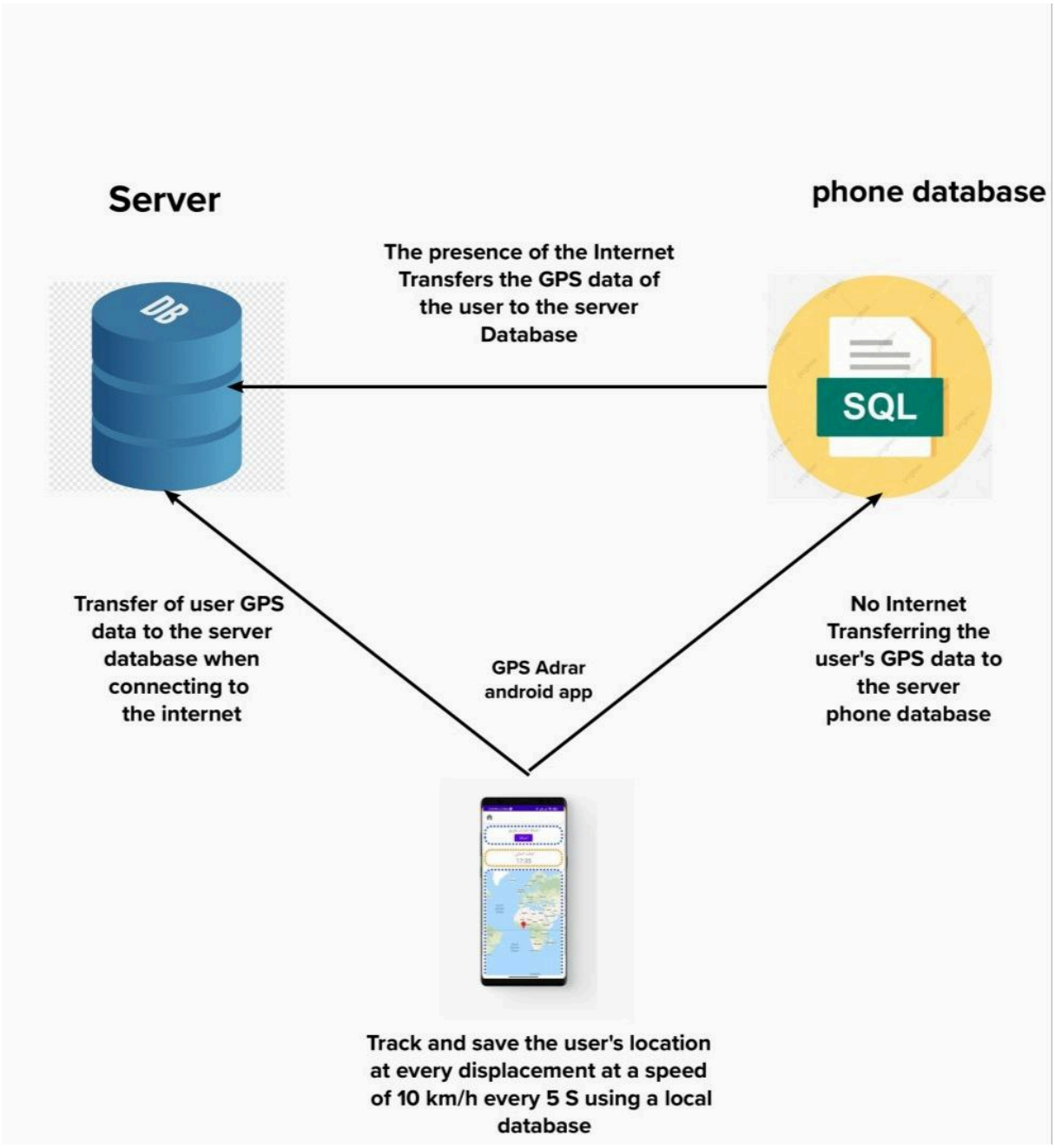


Figure 3.2: Architecture of application GPS Adrar

The collected GPS data was structured as follows:

- **Starting Point (sp):** At the beginning of the journey point coordinates are taken when meeting previous requirements, and data is renewed by taking the end point as a starting point
- **End Point (ep) :** Represent the new coordinates after 5 seconds.
- **Traveled Distance :** Represent the distance between the starting point and the end point.
- **Day :** The days of the week in which the trip occurred were arranged, as of monday, it is number 1.
- **Period :**The time where the travel was occurred which is divided in 3 periods.
  - The **value A** is given from **7:00** to **16:00** .
  - The **value B** is given from **16:00** to **21:00** .
  - The **value C** is given from **21:00** to **7:00** .
- **Traffic state:** which is determined by the speed of the traveler passing the segment
  - **Very slowly (Value A) :**if the user was moving in the speed of **10 km** or less .
    - Obstacles are positioned and given an (Value A) very slowly, such as bumps
  - **Tardy (Value B) :** if the speed was between **30** and **10 km** per hour.
  - **Natural (Value C) :** if the speed was between **50** and **30 km** per hour .
  - **Quick (Value D) :** if the speed was **50 km** per hour or greater .

The data is collected by **69 users** in different places and at different times. it is important to note that the data collection phase is activated all the time. That is, even the 'wassalni' app collects the data.

3.3 Data processing

The training of the learning model was made using artificial intelligence which has the concept of neural networks.

The model training was done using the deep neural multilayer perceptron which is a type of artificial neural network constituted of : input layer, hidden layer, output layer. it is used to do basic deep learning modelling.

In the model training, 5 hidden layers are modeled with each layer containing the following number of neurons (256,128,64,32,16). Considering the input and output layers, the training was done with a total of 7 layers , the number of iterations 400 , learning rate 0.001 and activation function tanh

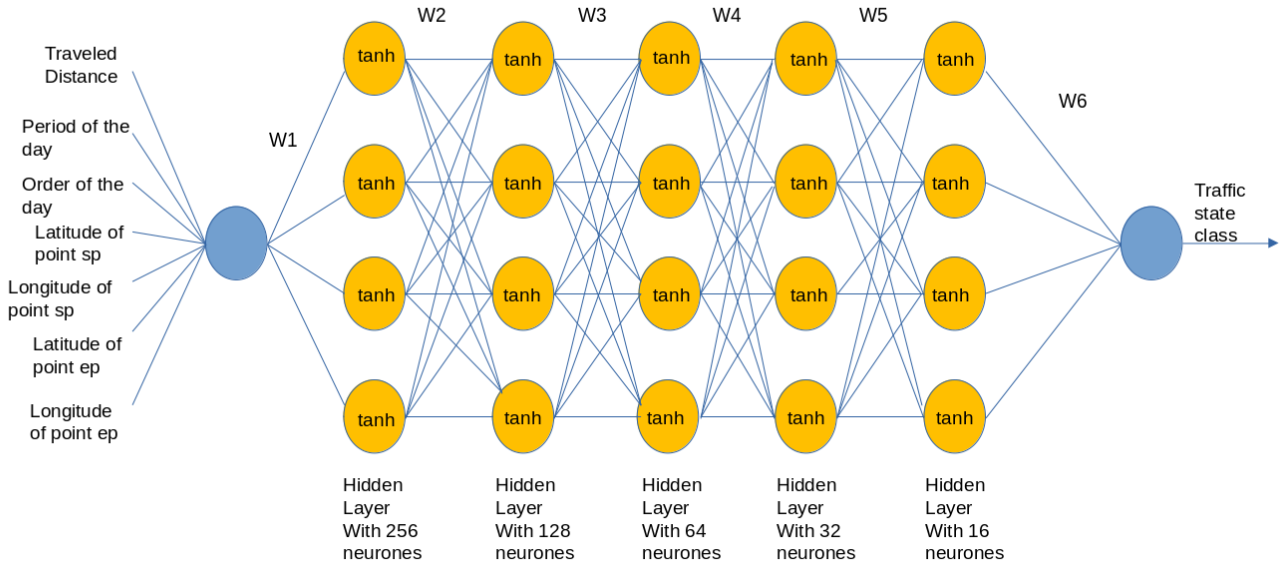


Figure 3.3: architecture of the neural networks used

3.4 'Wassalni' App Architecture :

Understanding the problem and collecting enough data to realize it was not everything in this project. a good conception is necessary. but since there is the neural network model which is resulted from the phase of training from adrar traffic data that would be easier.

So the idea is to give the user the ability to choose his way, and this is what hassan el-mir did [11], but this was not enough for the user, in addition to this work, we developed the "wassalni" application that chooses the best way for user like google map and then makes a hash for this the route sends every part of it to the neural network model that predicts traffic conditions and provides an estimated travel time. then all the parts will be added to calculate the travel time for the entire route. This is how "wassalni" works in a nutshell.

In addition to this work, the application also collects gps data from the trips that the user makes, a search that saves the inputs to the machine learning model and the outputs and uploads them to the database. So, the "wassalni" application performs the stage of collecting and processing data at the same time, and this feature was not present in the previous works.

The training of the deep learning model was also relied upon on the website of traffic obstacles such as bumps, and this addition is not present in the previous works.

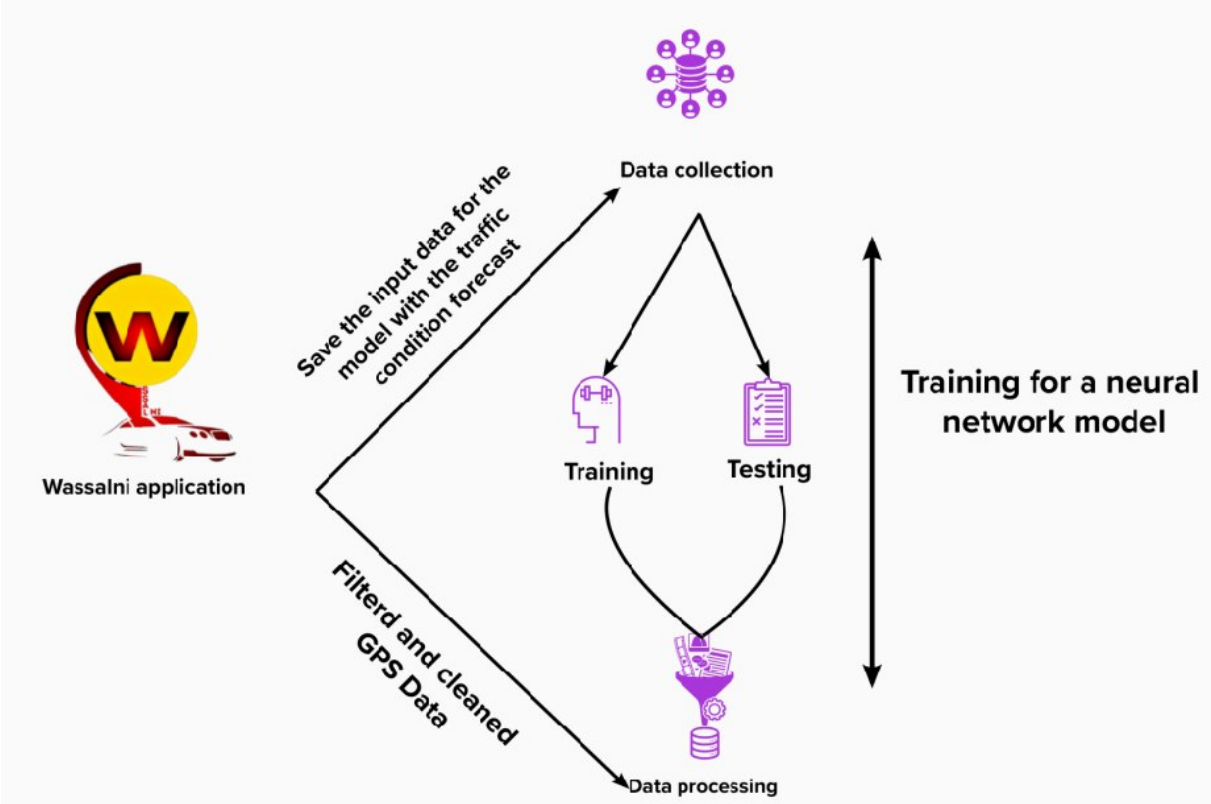


Figure 3.4: 'Wassalni' app architecture

3.4.1 Wassalni application's purpose :

This name has now been chosen. Almost all algerians from any region know the meaning this is the algerian word, which means "show me the way". The purpose of this project is to show the user the optimal path from the point of origin to the desired destination point. In addition, the application provides traffic cases on the road at the time of travel and also provides an experience of choosing the connection to the nearest chosen landmark in the city, such as a mosque or a hotel, a gas station

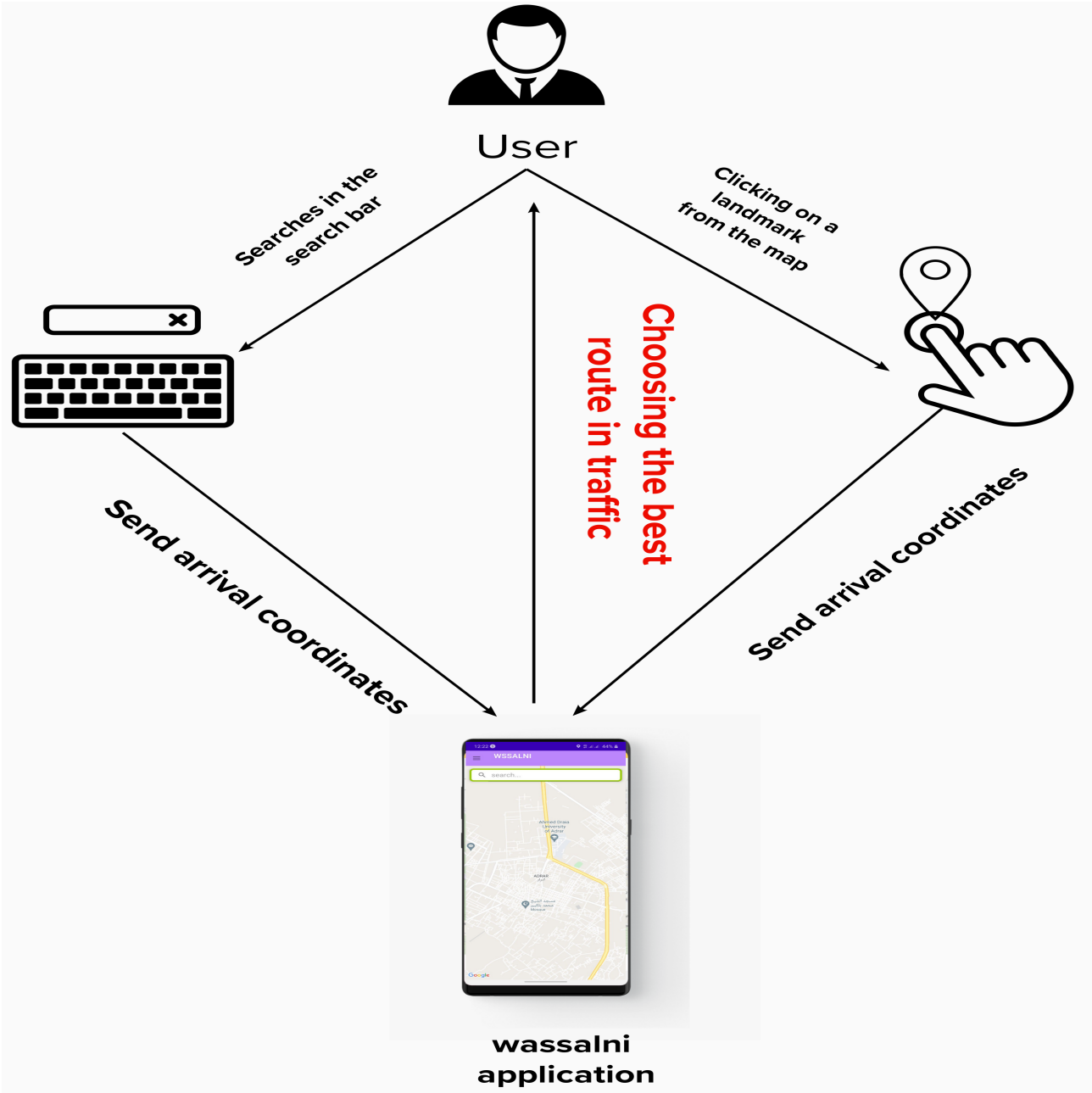


Figure 3.5: Wassalni application's purpose

3.5 Conclusion

In this chapter, a full description of the concept of the proposed idea is given. Talking about the details in the adroid " GPS adrar " application and the stage of data collection and processing.

Chapter 4

Implementation and Experiments

Chapter 4

Implementation and Experiments

4.1 Introduction

The proposed idea required a well-organized plan to better collect data and apply it subsequently in the development of the prediction model. This chapter is divided into four parts:

- The presentation of GPS android application, which collects data from adrar residents and stores it in a remote database. to create the android application, this stage took a long time
- Presentation of how the model was built using the python programming language and the scikit-learn ML library.
- After creating a deep learning module, the linking phase comes with the Wassalni application
- After completing the "Wassalni" application, evaluation and measurement of accuracy are necessary and important steps.

4.2 Tools Used

4.2.1 Java

The name of the programming language to write computer and mobile software is what we used in our apps "GPS adrar" and "Wassalni" because there are many useful libraries to facilitate the process.

4.2.2 MySQL

The name of the programming language for creating database tables. User information, personal information, starting points and access points of the saved information can be saved and linked between one or more tables with relationships, and this helped us a lot in our applications "GPS adrar" and "Wassalni". [18]

4.2.3 Google earth pro

Google earth pro is the most complete set of geospatial data available in a public manera and includes high-resolution images, 3D havens of cities, detailed road maps, street panoramas, historical images, and points of interest. Many functions in order to visualize the collected data on the map and filter it in the data visualization stage. [19]

4.2.4 Scikit-learn

It is a free machine learning library that supports supervised and unsupervised learning. It also includes a number of tools for model synthesis, data pre-processing, model selection and evaluation, as well as a number of other features. [20]

4.2.5 Python

Python is a high-level, general-purpose programming language. organized python data in a manner appropriate to the training phase, the python command package was used to create a neural network model.

4.2.6 Hypertext Preprocessor (PHP)

It is a text programming language that has been used in both apps "GPS adrar" for data collection and "wassalni" final application and has been used to link the app to external server using mysql and php commands.

4.2.7 eXtendable Markup Language (XML)

It is a special purpose coding language as well as expandable coding language and can also transfer and store data and design used in our apps GPS adrar and wassalni to create user interface.

4.3 Phase I: Data collection process

To develop and realize a model that can overcome the different problems of traffic congestion in an effective way, sufficient data about adrar traffic is required to obtain an optimal model with high accuracy. For this purpose, a new android application named GPS adrar was developed for the data collection phase :

- GPS adrar is an android application that tracks its user's location at every displacement at a speed of 10 km/h or more every 5 seconds with the help of android GPS phone service that provides the coordinates of the user's location using satellites.
- The GPS adrar android application also allows collecting the locations of the bumps and adjusting the traffic situation in (Value D).
- The GPS adrar application also allows determining the locations of the main landmark in the area that the user needs, such as mosques, hospital, gas station, hotels.

About 69 residents from different parts of adrar will participate in this phase. where more than 3021 KM so the total data was about 329436 GPS locations. To inform the user of the purpose of the application and give him a better explanation of why needed for help.

4.3.1 Relation of GPS adrar

A lot of java resources were used to create the GPS adrar program figure 4.1 :

- **Manager of locations:** After obtaining authorization, user coordinates can be obtained.

- **Request for location:** After confirming the basic parameters, the user's coordinates can be taken to reach the real location. Every 5 seconds at a speed of 10 km/h or higher.

- **Manager of telephony :** After obtaining permission to use the device's resources from the user, the user can enter personal information such as name and phone number, and each user is assigned a unique ID to preserve the coordinates contributed by the program.

- **manager of batteries :** The program will cease collecting data if the battery ratio falls below 15% .

- **Manager of connectivity :** After gathering site data, we'll need to connect to the internet in order to upload coordinates to the server. If there is no internet connection, the device's coordinates will be kept until the link is established. The server will get the coordinates.

- **Volley :** we wish to upload the coordinates to the server after collecting the site coordinates and if internet connectivity is available, thus we'll need to contact the server using Volley library .

These are the primary categories that enabled app development and made data collecting feasible, as well as a web server to store the acquired data. The programming languages **PHP, JAVA, SQL, and XML** were used to create it.

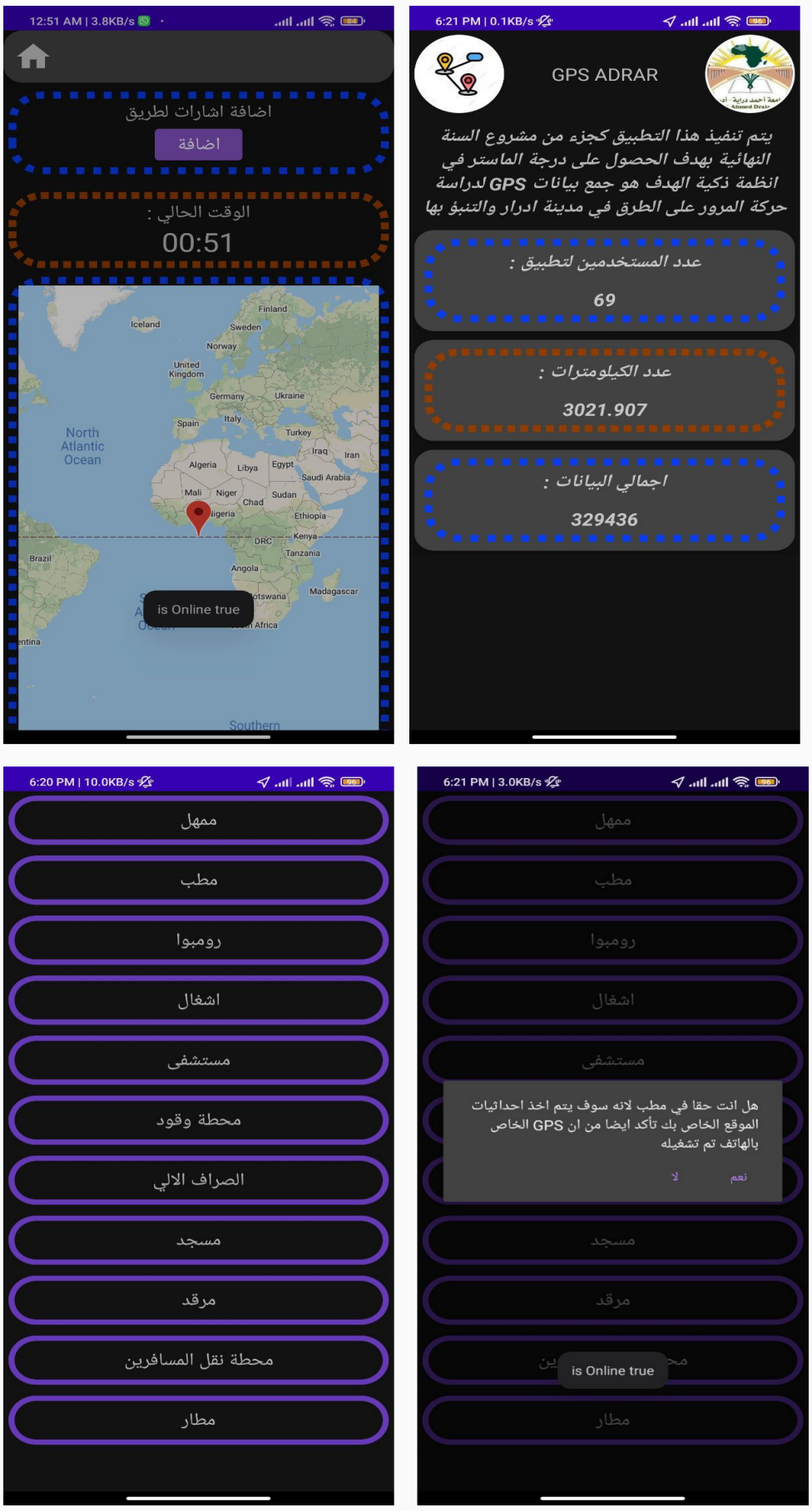


Figure 4.1: The user interface of GPS adrar

4.3.2 Filter the collected GPS data and build the model

After the data collection stage, the stage of filtering and cleaning came to preserve the collected data on the main road of adrar city because the purpose of the project is to deal with the traffic problem for this purpose the data was represented with the help of google earth pro figure 4.2

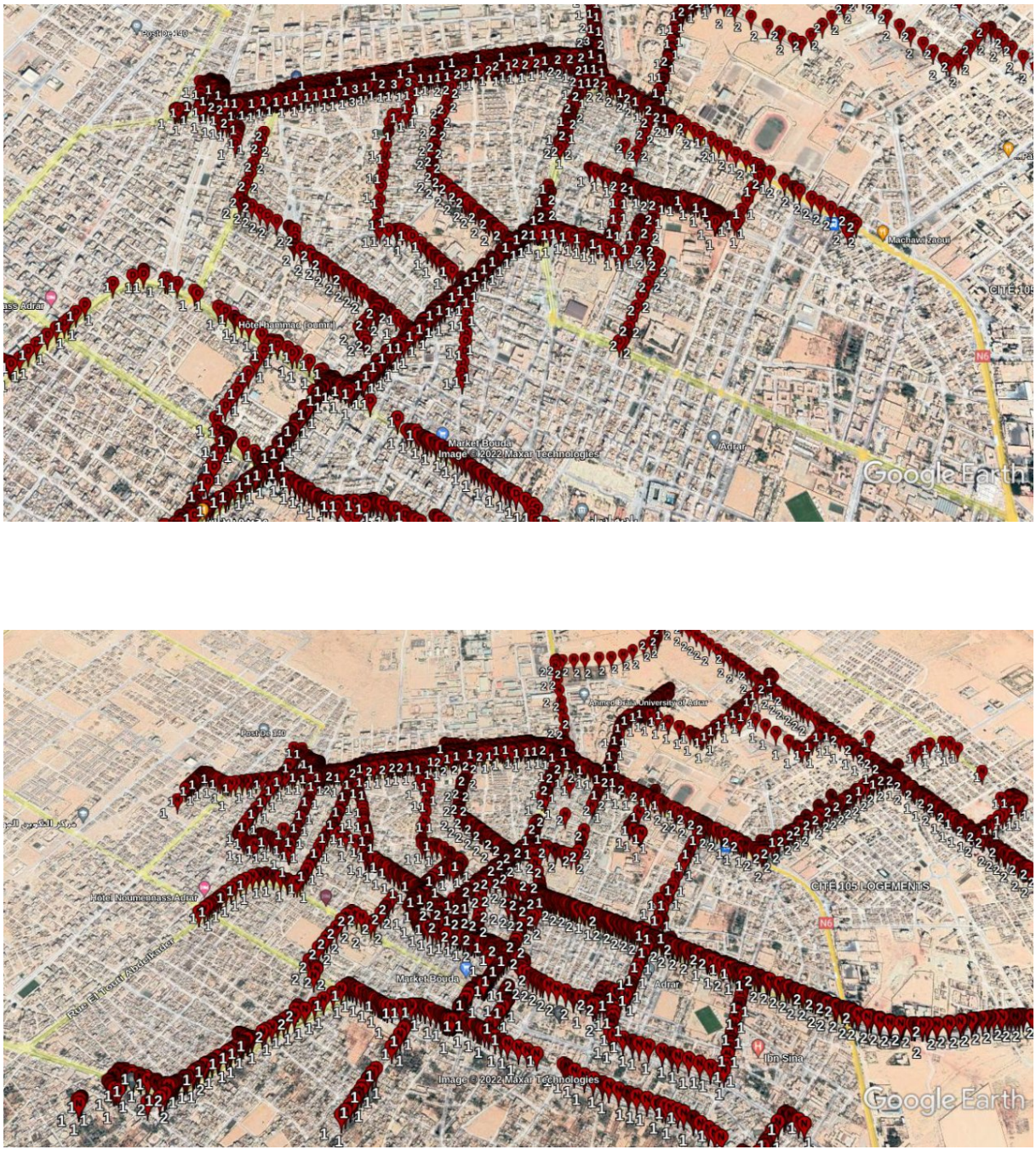


Figure 4.2: The visualization of the 10000 last collected GPS points

After this phase, a CSV file will be obtained containing all the required GPS data cleaned and ready for the training process. The amount of data was about 329436 segments figure 4.3 .

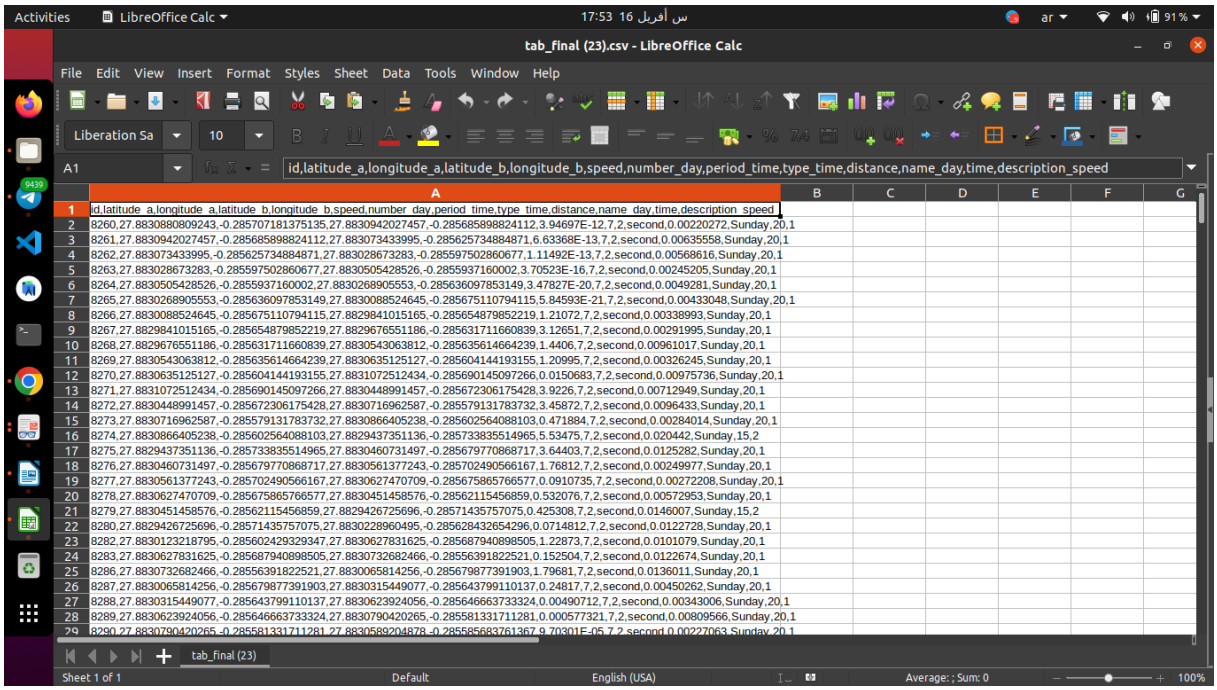


Figure 4.3: The cleaned and filtered CSV file containing the collected GPS data

The timed locations were also collected by the android adrar app, each timed location was repeated on all days up to 420 locations as shown in the figure 4.4.

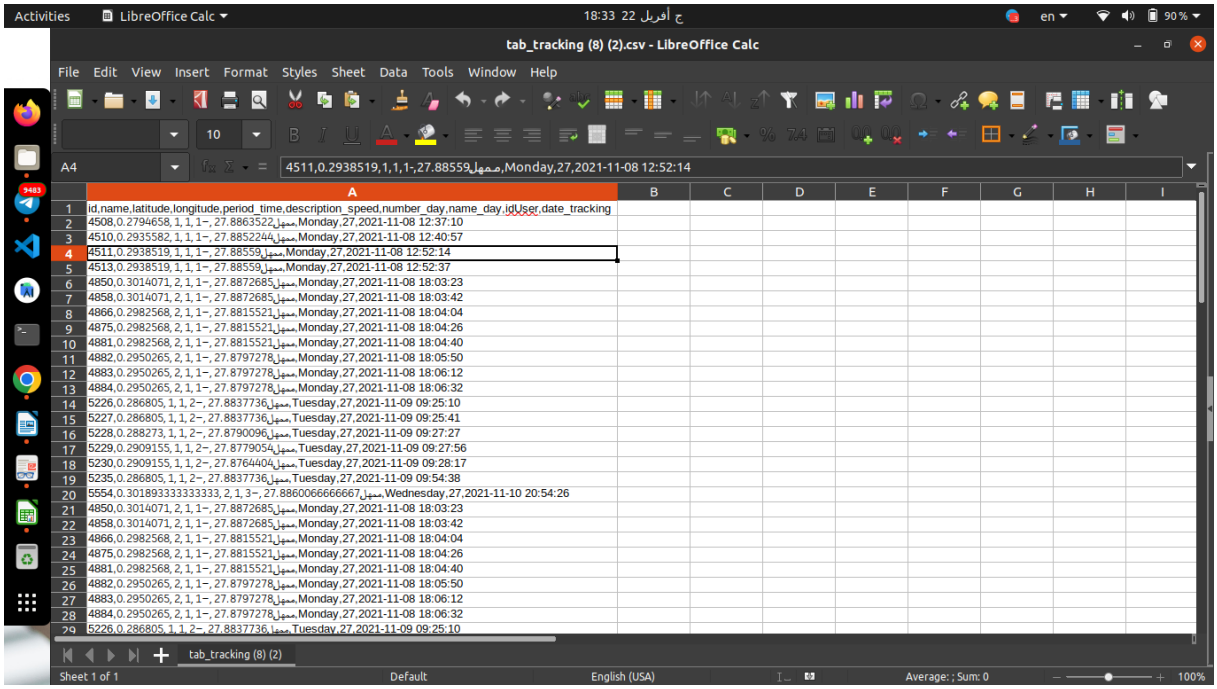


Figure 4.4: CSV file containing collected time-out locations

4.4 Data processing phase

- The GPS data of the users and the obstacle data were combined as pits, pits, and the total GPS data reached 329,676.
- In the training phase, the data is divided into 80% (329436) for training purpose and 20% (65887) for the purpose of testing.
- The activation function used is tanh and it takes the function any real value as input and output values in the range -1 to 1. The higher the input (more positive), the closer the output value is to 1.0, the smaller the input (more negative), the closer the output will be -1.0 figure 4.5.

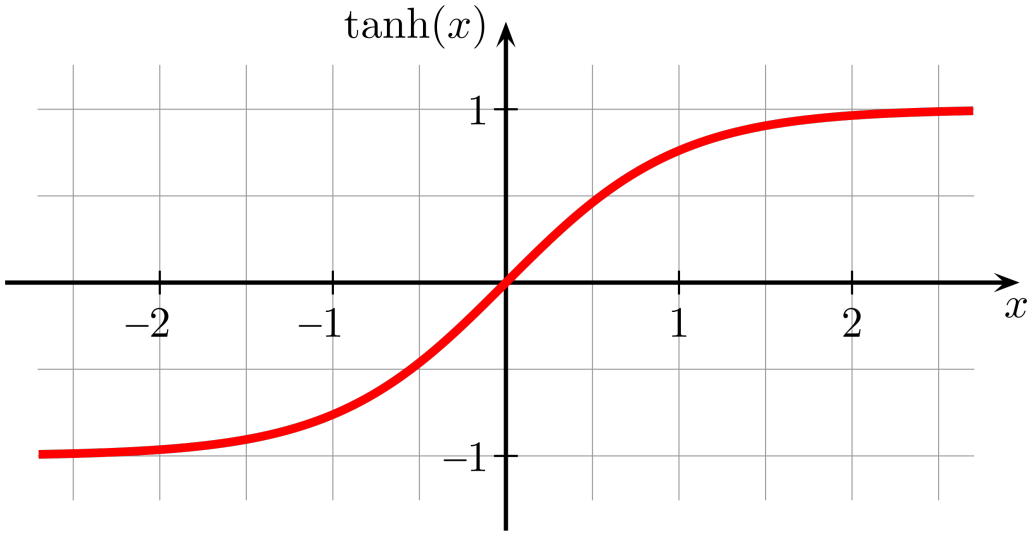


Figure 4.5: Plot of inputs vs. outputs for the tanh activation function.

- A max number of iterations was defined to be 400 iterations
- And after that the model was trained with 80% of the data. The rest 20% was used to make predictions of traffic states and comparing them to real values.

$$\textbf{Model accuracy} = \frac{\textbf{number of right predicted values}}{\textbf{total number of real values}} * \textbf{100}. \tag{4.1}$$

A comparison was made between the expected values and the real values of the traffic conditions using the algorithm, and the accuracy of the model was calculated, which amounted to about 99.56, which is excellent for the neural network model.

The confusion matrix is a tool for measuring the accuracy of the machine learning model by checking which point its predictions are accurate compared to the real experience in the form above where it compares the traffic conditions expected from the ML model and the actual traffic conditions. For this case, the results of the testing phase were excellent figure 4.6 .

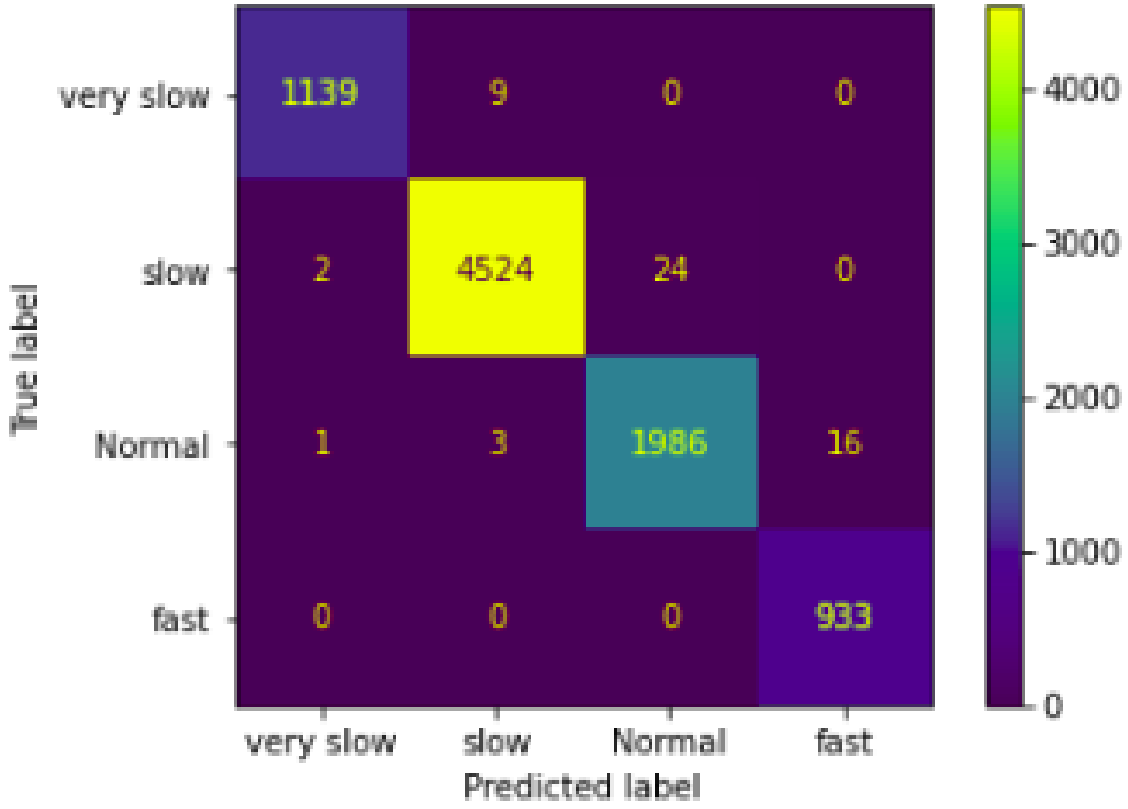


Figure 4.6: Confusion matrix adrar dataset's

4.4.1 Development of wassalni

The app was developed using java, php, xml, python programming languages and was fully focused on them :

- A login form interface has been constructed, which includes a login button, a place to input the phone number, and a place to type the personal name. XML was used to construct this interface.
- The present location of a gadget built in the java language requires an accessibility permission.
- Created using XML: a place to write destination search
- By clicking on a location on the accompanying map, user may choose your intended destination. The java programming language was used to construct the interface.
- Access shortcuts to the nearest hospital or post office are shown on the side. XML was used to design the interface.
- When a destination is chosen, google maps is consulted to get the route's coordinates. The written in the java programming language.
- The neural network model receives road divides with the current number day and speed. java is used to create the transmission code.

- To compute journey time, a neural network model was constructed. Python was used to write the code.
- When the data is received by the neural network model, it is analyzed and the time necessary for a journey is calculated. The JSON data has been received. The program is used to examine the data. java is used to program the data analysis code.
- The flight route is split down by a distinct color once the data is analyzed, reflecting the probable speed of the passenger programmed in java.
- Wassalni colors the chosen route based on traffic flow, and the map is drawn using the google maps service (value 1: red represents heavy traffic, value 2: orange signifies traffic). Green indicates low traffic, whereas number 4 indicates no traffic). Java programming
- ach class of traffic states has an anticipated mean speed (a : 10 km/h, B : 20 km/h, C : 30 km/h, D : 60 km/h), and each segment distance will be split by the expected class's speed , programmed in java .
- Finally, the route will be displayed with traffic status and flight time in the application

4.4.2 Connect an android application wassalni with a model

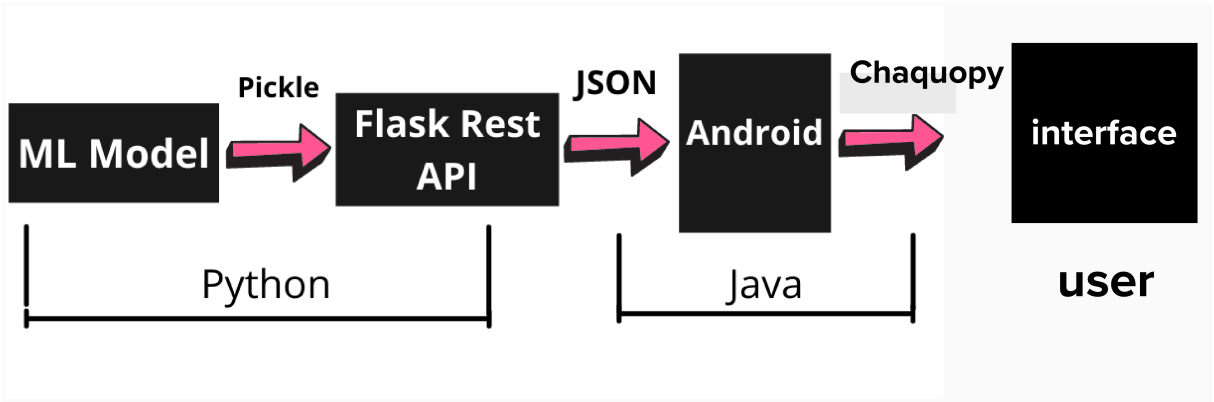


Figure 4.7: Workflow of machine learning project on android

After creating a deep learning module and training the module on GPS data, the stage of saving the trained module comes through the pickle library, which allows this to be used in the android studio environment.

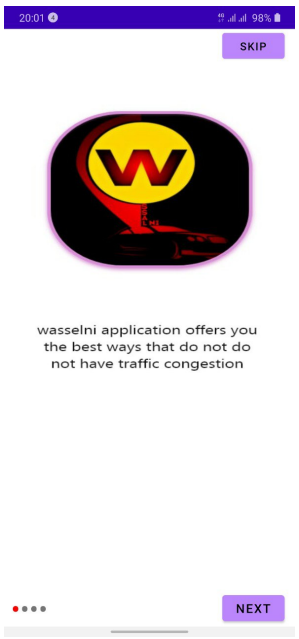
Chaquopy

It is a free library that allows user to associate an android application with python files and it has been such a sensitive role as after the destination is chosen by the user, we collect the existing paths, then split each path, and enter each part of the path into

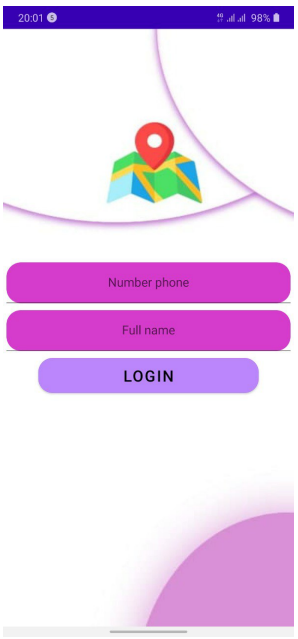
the deep learning model using the chaquopy library, which returns data on the state of the traffic in JSON type of the model, and the flight time is calculated for each path and then choose the best path

4.4.3 How to make use of a application Wassalni

- user will be provided with an interface that describes how the software works, its features, and its purposes when user first launch it, and user can opt to cancel it following figure 4.8a .



(a) about application wassalni

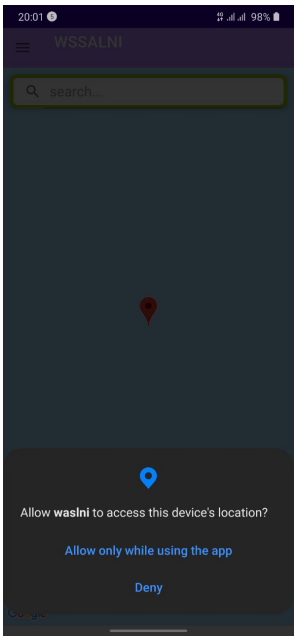


(b) login application wassalni

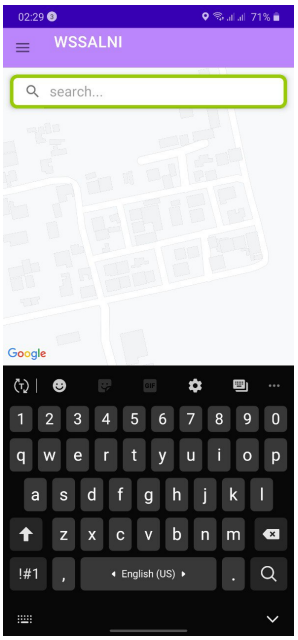
Figure 4.8: Wassalni application from the user's perspective

- The program needs a direct login the first time it is used by providing the phone number, personal name. The user is instantly registered in the database and the application is logged in if the phone number is new. The application gets logged in if the phone number has been previously registered following figure 4.8b .

- After logging in, user must acquire the user's physical location with their consent following figure 4.9a .



(a) permission GPS information



(b) Destination Search Experience

Figure 4.9: Wassalni application from the user's perspective

- The user may find the destination by typing it into the search field. following figure 4.9b .
- In the side menu, user can quickly reach hospitals, gas stations, ATMs, mosques, nurseries, road transport stations, and airports. When user press any shortcut, user will be directed to the best road with the least amount of traffic, allowing user to quickly reach your destination and transition to a colorful road based on your driving speed following figure 4.10 .

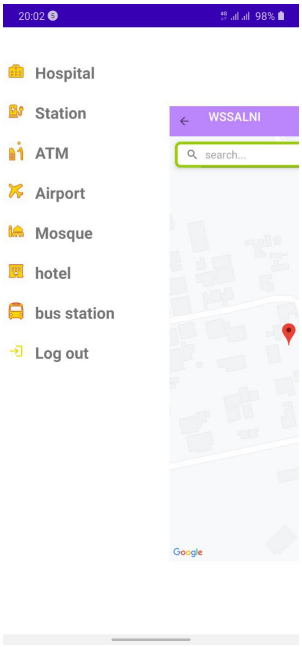
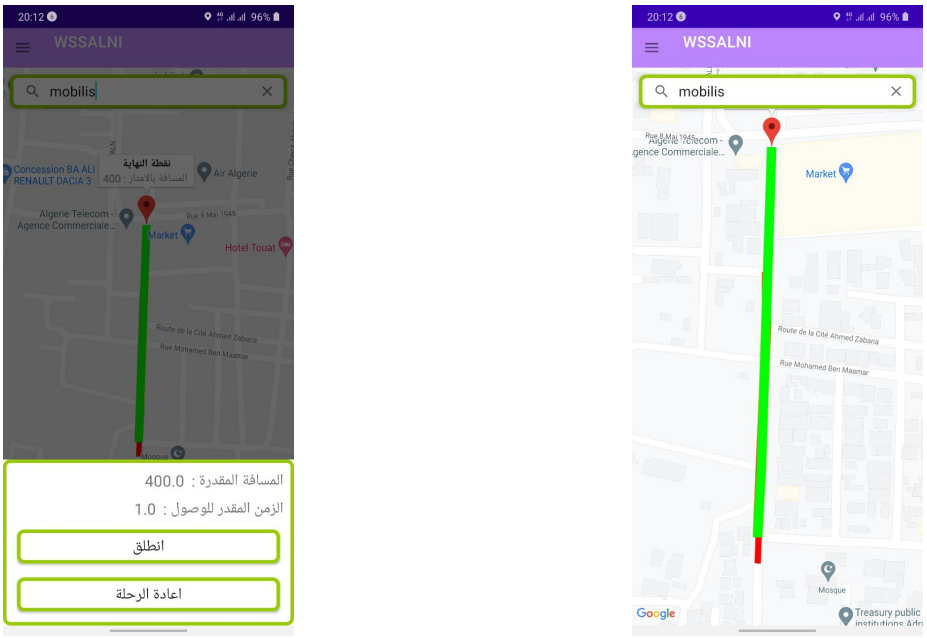


Figure 4.10: Shortcuts help user choose your destination

- user may now get on the road that has no traffic congestion after picking your destination.

- Between the starting location and the destination, a multi-colored line will be created, along with the estimated travel time and distance following figure 4.11a and figure 4.11b .



(a) (b)

Figure 4.11: How to take use of it's application Wassalni

- The application can estimate how long the travel will take following figure 4.11a .

- This application is an addition to the city of adrar and its residents because google maps are inaccurate and to learn more about traffic in a city that helps people and accessions, especially delivery companies and emergency services in hospitals .

4.5 Phase IV :Results and discussion

The results of waslani application were promising with a average error 0.19 seconds in 11 approximation experiments in most cases gave a better estimation time than google maps on the other hand. The results were not as good as trial no. 7. The reason why the GPS data collection time of adrar state was roads in a city under refurbishment was in some experiments at the testing stage after maintenance the roads were high.

At the testing stage, experiments were not taken into account when the expected time was equal in both google map and the application of wassalni.

N	Origin	Destination	Distance (km)	Google time (min)	Wasslni time (min)	Real Time (min)	Google error (min)	Wasslni error (min)
1	Ahmed Deraya University adrar	Saperte Boulhares	1.1	2	3	3,15	-1,15	+0,15
2	National Manuscript Center	Post do 140	2,24	5	7	6,14	-1,14	+0.86
3	Post do 140	Hotel Al-Fath	1.2	4	5	4,33	-0,33	+0,67
4	Hotel Al-Fath	Hotel Takialt	1.9	5	6	7,20	-2.2	-1,2
5	Hotel Takialt	Hotel Touat	2.5	3	4	4,12	-1.12	-0.12
6	Hotel Touat	Mosquée Cheikh Bin Lakbir	0. 807	3	4	3,57	-0,57	−0.43
7	Hôpital Al-Qasab	Scandory Khalid bin walid	1.2	4	5	4,35	-0,35	+0.7
8	Scandory Khalid bin walid	Scandory ibn Sina	2.5	7	9	8,2	-1,2	+0.8
9	Laboratoire médical Moubarak	Station de transfert de passagers	2.3	5	6	6,20	-1.2	+0.2
10	Station de transfert de passagers	Hôpital 240 lits	3,3	8	9	9,10	-1.10	-0.10
11	Hôpital 240 lits	Ahmed Deraya University Adrar	4,2	9	12	11,43	-2.43	+0.57
					Average Error =		1.09	0.19

Table 4.1: test result

$$\textbf{Average Error} = \frac{\sum|\ \textbf{Error in the experiment}\ |}{\textbf{Total number of experiments}}. \tag{4.2}$$

According to these results, the objective of the study was achieved, where travel time and an estimate of the traffic status of the selected route were better than the google map,

but the results could be improved by adding new data to the city of adrar .

Where the results were good through the curves of the figure 4.12. On the seventh flight, we notice that the google curve and the real curve agree, due to the quality of the road, as it was under maintenance.

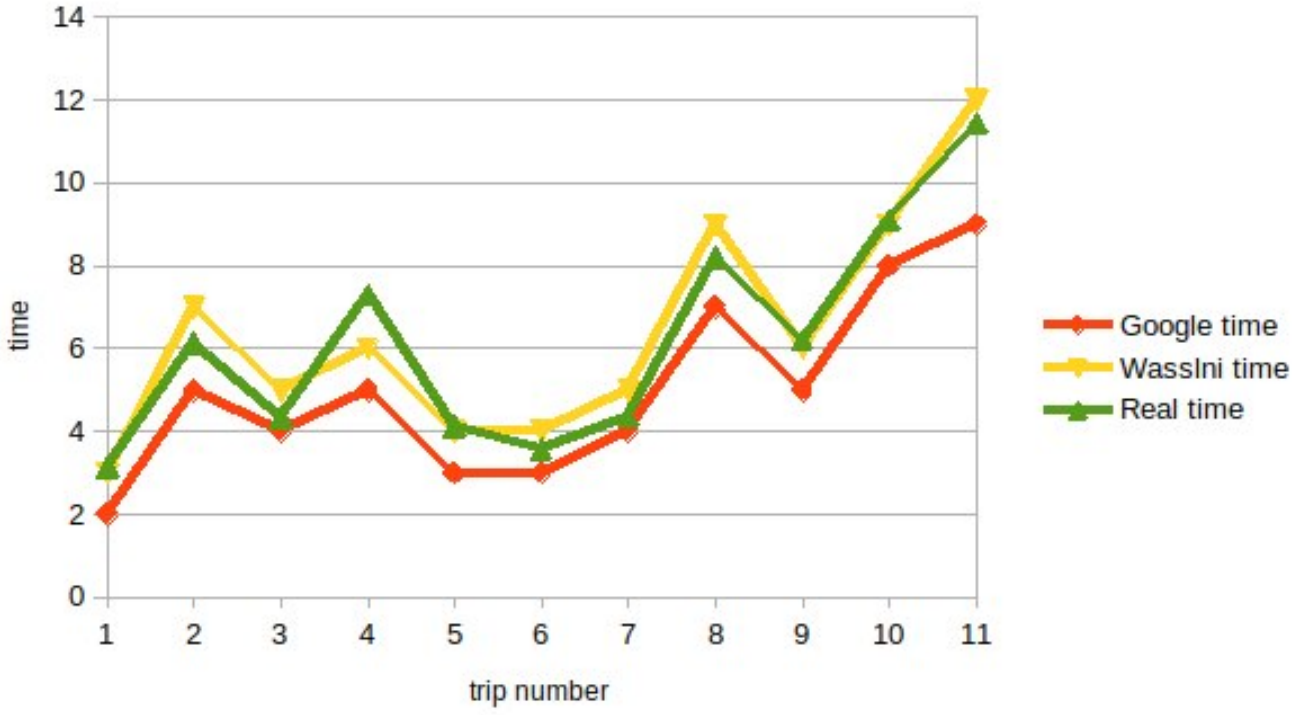


Figure 4.12: trip number VS time prediction

- These results also support the effect of distance on the expected travel time by the waslni app figure 4.13.

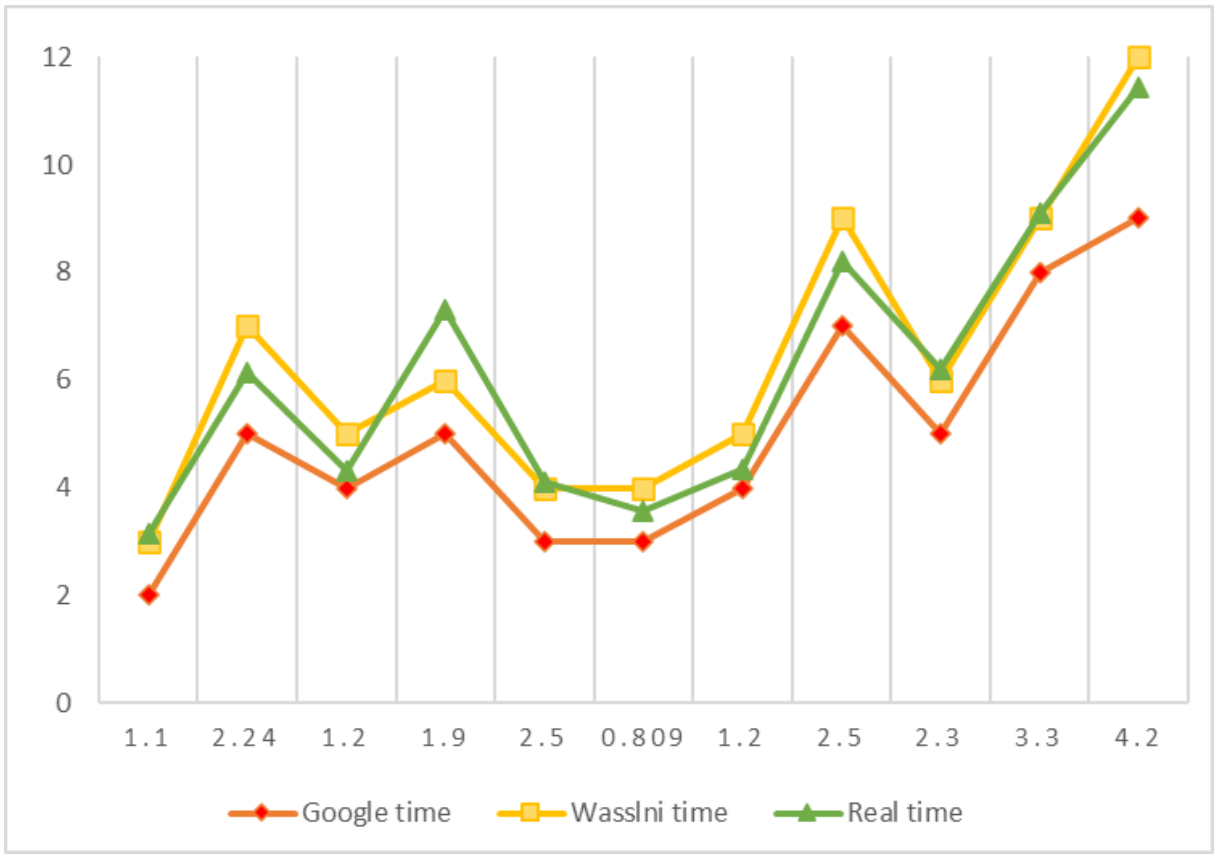


Figure 4.13: time prediction VS distance

4.6 Conclusion

In this chapter, we focused on establishing the implementation and realization of the field of study. This chapter is divided into three main parts:

- The first part explains the creation of the implementation of GPS adrar
- The second part explains the stages of creating an implementation of data processing
- The third part presents a comparison of the results with an explanation

General Conclusion

General Conclusion

General Conclusion

The main focus of the study was on predicting travel time in different roads in the Adrar city. Since a Google map doesn't offer time prediction with traffic as an effect factor in the city of Adrar, the proposed approach is to provide this service by building a new deep learning model.

Our model is built based on a set of data collected via an android application called GPS Adrar. The purpose of this application is to collect GPS coordinates from Adrar's citizens, particularly people who use public transport or their own cars.

The various collected data are used for the learning model using a neural network in order to predict road traffic in the city. Next, the obtained model is integrated with an application android called Wassalni. So that, the final product in this work, is an application android that offers the user a better prediction of road traffic among a set of available destinations.

The experimental results show that the proposed model offers high accuracy than Google Maps in most of the tested routes but not identical in the others ways. This issue is due to the time where the data is collected, so that, there are some roads that were under maintenance, which led to prediction errors.

Having a mobile application that can predict traffic time in an accurate way can help different organizations, such as civil protection, to carry out their missions with minimum cost. This research can be extended by developing a mobile application that will be released for users using IOS systems

Bibliography

[1] [Online] https://ar.zhujiworld.com/dz/1382736-adrar/ [04/04/2020]

[2] Tanya Tiwari, Tanuj Tiwari, Sanjay Tiwari. How Artificial Intelligence, Machine Learning and Deep Learning are Radically Different? International Journals of Advanced Research in Computer Science and Software Engineering. 2018.

[3] CHOLLET, FRANÇOIS. Deep Learning with Python. s.l. : Manning Publications, 2018.3 . Lee, Wei-Meng. Python Machine Learning. s.l. : WILEY, 2019.

[4] CHOLLET, FRANÇOIS. Deep Learning with Python. s.l. : Manning Publications, 2018.3 . Lee, Wei-Meng. Python Machine Learning. s.l. : WILEY, 2019.

[5] Yann LeCun, Yoshua Bengio, Geoffrey Hinton. Deep learning. Nature. 2015

[6] https://flatironschool.com/blog/deep-learning-vs-machine-learning/ 09/04/2022

[7] Neha Garg, Prateeksha V. Gawande, Payal P. Kurekar Deepika B. Kharat. Bus Tracking using GPS an Real Time Prediction. International Research Journal of Engineering and Technology (IRJET). APRIL 2017

[8] Azzedine Boukerche, Yanjie Tao, Peng Sun .Artificial intelligence-based vehicular traffic flow prediction methods for supporting intelligent transportation systems Computer Networks (2020)

[9] Tanzina Afrin, Nita Yodo. A Survey of Road Traffic Congestion Measures towards a Sustainable and Resilient Transportation System. Sustainability. 2020

[10] ABDO, Joseph. La solution à la congestion du trafic ? s.l. : Centre d'information sur le ciment et ses applications, 2011.

[11] Hassan Al-Mir ,Dr. Youssef Elmir of Bashar University . Theme Réalisation d'un Système de Prédiction du Trafic Routier Année universitaire 2020/2021.

[12] Hoong, Poo Kuan, Ian K. T. Tan, Ong Kok Chien, Choo-Yee Ting. Road traffic prediction using Bayesian Networks. Faculty of Computing and Informatics, Multimedia University, Cyverjaya, Malaysia. 2012

[13] Abhijeet Tikar, Niranjan Joshi, Manmat Hotalappa, Kajal Gadade. Travel time estimation for taxi trips using GPS sequence. International Education and Research (IERJ). MAY 2017

[14] Obuhuma, J. I. and Moturi, C. A. Use of GPS With Road Mapping For Traffic Analysis., INTERNATIONAL JOURNAL OF SCIENTIFIC TECHNOLOGY VOLUME 1, ISSUE 10. NOVEMBER 2012

[15] Prof A N Kaulage, Anil Pingale, Pooja Bhoite , Vijaylaxami Mankar , Pradip Yadav. Bus tracking and Bus arrival time, location prediction system. International Research Journal of Engineering and Technology (IRJET). MAY 2017

[16] Mohamed Zaki, Alaa Hamouda, Basma Hisham. Travel Time Prediction under Egypt Heterogeneous Traffic Conditions using Neural Network and Data Fusion. Egyptian Computer Science Journal. MAY 2015

[17] Neha Garg, Prateeksha V. Gawande, Payal P. Kurekar Deepika B. Kharat. Bus Tracking using GPS an Real Time Prediction. International Research Journal of Engineering and Technology (IRJET). APRIL 2017

[18] Thura Kyaw, Nyein Nyein Oo, Win Zaw. Predicting On-road Traffic Congestion from Public Transport GPS Data., International Journal of Advances in Scientific Research and Engineering (IJASRE). MARCH 2020

[19] Wikipedia. [Online] [Cited: 04 23, 2022.] https://en.wikipedia.org/wiki/MySQL

[20] Wikipedia. [Online] [23/4/2022] https://fr.wikipedia.org/wiki/Google_Earth

[21] Scikit learn. [Online] [Cited: 25/ 4/ 2022.]
https://scikit-learn.org/stable/getting_started.html.