A Project Report

on

# IOT BASED TRAFFIC MANAGEMENT SYSTEM

Submitted in partial fulfillment of the requirement for the award

of the degree of

# BACHELORS OF TECHNOLOGY IN COMPUTER SCIENCE ENGINEERING


Under The Supervision of Dr.T. Poongodi
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# CANDIDATE'S DECLARATION

I/We hereby certify that the work which is being presented in the thesis/project/dissertation, entitled **"IOT BASED TRAFFIC MANAGEMENT SYSTEM "** in partial fulfillment of the requirements for the award of the B.tech Computer Science submitted in the School of Computing Science and Engineering of Galgotias University, Greater Noida, is an original work carried out during the period of month, Year to Month and Year, under the supervision of Dr.T.Poongodi Associate Professor, Department of Computer Science and Engineering/Computer Application and Information and Science, of School of Computing Science and Engineering , Galgotias University, Greater Noida.

The matter presented in the thesis/project/dissertation has not been submitted by me/us for the award of any other degree of this or any other places.

Prajapati Yash

Adarsh Shukla

This is to certify that the above statement made by the candidates is correct to the best of my knowledge.

Dr.T.Poongodi

Associate Professor

# CERTIFICATE

The Final Thesis/Project/ Dissertation Viva-Voice examination of Adarsh Shukla, Prajapati Yash has been held on _____ and his/her work is recommended for the award of B.tech Computer Science

**Signature of Examiner(s)** **Signature of Supervisor(s)**

Date: November, 2021
Place: Greater Noida

# TABLE OF CONTENT

**TITLE**

# ABSTRACT

Over the years, there has been a sudden increase in the number of vehicles on the road. Traffic congestion is a growing problem everyone faces in their daily life. Manual control of traffic by traffic police has not proved to be efficient. Also the predefined set time for the signal at all circumstances (low and high traffic density) has not solved this problem. A model to effectively solve the above mentioned problems by using Internet of Things (IoT) is proposed. We use cloud for internet based computing, where different services such as server, storage and application are delivered for traffic management. A network of sensors is used to track the number of vehicles and the traffic congestion at the intersections on a road and rerouting will be done on the basis of the traffic density on the lanes of aroad. With growing populace and no of motors on road, the site visitors may be predicted to be excessive and control of that site visitors manually may be greater difficult. This task is to offer help to the site visitor's policemen through developing an interconnection among the motors primarily based totally on cloud connection in order that the site visitors may be monitored automatically. Additionally, automatic ignition primarily based totally at the biometrics permits simplest the customers with allowable license to drive. Violation and site visitor's offences are effortlessly captured and fined primarily based totally at the wide variety plate of the car and presently logged in user. In case of injuries or emergencies, nearest ambulance will acquire notification consisting of the closest clinic with all required information so the docs can take movement as required or create an alert to folks that set GPS on excessive congestion zones to deviate to a low congestion direction until truly necessary.

# ACKNOWLEDGEMENT

We would like to express our deepest appreciation to all those who provided us the possibility to complete this report. A special gratitude we give to our professor Dr. T.Poongodi , whose contribution in stimulating suggestions and encouragement, helped us to coordinate our project especially in writing this report. Furthermore, we would also like to acknowledge with much appreciation the crucial role of the staff of Galgotias University, who gave the permission to use all required equipment and the necessary materials to complete the task. We are thankful and fortunate enough to get constant support from our seniors and every teaching staff of B.tech Computer Science and engineering department which helped us successfully complete our project. We would also like to extend our regards to all the non-teaching staff of B.tech Computer Science and engineering department for their timely support. Special thanks go to my team mates, We have to appreciate the guidance given by other supervisor as well as the panels especially in our project presentation that has improved our presentation skills thanks to their comment and advices. Our thanks and appreciations also go to each and every one of our colleagues for their encouragement and support in developing the project.

## LIST OF TABLES

## LIST OF ABBREVIATIONS

| ACRONYM | | FULL FORM |
|---|---|---|
| SDLC | : | Software Development Life Cycle |
| SQL | : | Structured Query Language |
| HTML | : | Hyper Text Markup Language |
| UML | : | Unified Modeling Language |
| HOG | : | Histogram Of Oriented Gradient |
| ROI | : | Region Of Image |
| ERD | : | Entity Relationship Diagram |
| GUI | : | Graphics User Interface |

# CHAPTER- 1

# INTRODUCTION

## INTRODUCTION

Smart Traffic Management is a system where centrally-controlled traffic and accident and sensors keep track of the people who are violating the traffic rules. Installing camera on all the signal will help us to find the drivers who are not following traffic signals.

In “Traffic and accident Management software” each set of traffic lights will have communication equipment that can be used to transmit (anonymous) vehicle data, either from ANPR cameras or Bluetooth detectors, and CCTV feeds (where appropriate). When passing by the camera, ANRP get a photo of the vehicle’s number plate, registering it on an images database, with date, hour and camera information, allowing a lot of consults and a more effective traffic management.

After that the software will implement some deep learning on the images stored on the database and will generate its output. After that the officer who is appointed to look after the video, will generate report on behalf of the output of the software and will send it to the victims

“Traffic and Accident Management Software” is an electronic way of managing traffic via a desktop driven application and some camera. The advantage of smart Traffic over the traditional “traffic system” is that it will reduces human intervention in traffic signal, it will reduce accident leading to harsh driving of the bikers and other vehicles.

However, in order to adopt such automation solutions certain challenges, need to be addressed:

1) Real-time Implementation: Processing significant amount of information in a time constraint manner is a challenging task. As such applications involves task like segmentation, feature extraction, classification and tracking, in which a significant amount of information need to be processed in short duration to achieve the goal of real-time implementation.

2) Occlusion: In real life scenarios, the dynamic objects usually occlude each other due to which object of interest may only be partially visible.

3) Direction of Motion: - 3-dimensitional objects in general have different appearance from different angles. It is well known that accuracy of classifiers depends on angle to some extent.

4) Environment: Natural conditions might be affect the our system for further methodology.

## Hypothesis

A smart traffic management system utilizing sensor data, communication and auto- mated algorithms is to be developed to keep traffic flowing more smoothly. The aim is to optimally control the duration of green or red light for a specific traffic light at an intersection. The traffic signals should not flash the same stretch of green or red all the time, but should depend on the number of cars present. When traffic is heavy in one direction, the green lights should stay on longer; less traffic should mean the red lights should be on for longer time interval. This solution is expected to eliminate inefficiencies at intersections and minimize the cost of commuting and pollution.

## Motivation

In 2014, 54% of the total global population was urban residents. The prediction was a growth of nearly 2% each year until 2020 leading to more pressure on the trans- portation system of cities. Additionally, the high cost of accommodation in business districts lead to urban employees living far away from their place of work/education and therefore having to commute back and forth between their place of residence and their place of work. More vehicles moving need to be accommodated over a fixed number of roads and transportation infrastructure. Often, when dealing with increased traffic, the reaction is just widen the lanes or increase the road levels. However, cities should be making their streets run smarter instead of just making them bigger or building more roads. This leads to the proposed system which will use a micro controller and sensors for tracking the number of vehicles leading to time based monitoring of the system.

## ABOUT PROJECT

In the perception to make a traffic and accident system acute, we provide desktop application which can reduces the effort of traffic police and provide moreover functionality to them for catch the bikers easily who don‟t wear helmets.

Desktop application will automatically extract the images of bikers who don‟t wear helmets and it will save these images for further approach. Images will be extracts from the surveillance video on public road. Desktop application will provide features like visualization of data related to occurrence of vehicles on different attributes.

## PROJECT OBJECTIVE

Our main objectives to develop this project are as follows:

- Reduce accident due to violation of traffic rules.
- Easy to identify driver without helmet.
- It maintains all historical data related to traffic.
- Helps in traffic management.
- Helps in increasing or reducing police of a particular area.
- IOT based traffic management
- Easy penalize traffic violators and help officials identify unauthorized drivers.
- Reroute the ambulance to the low congestion roads tohelp get medical care at the earliest.

# PYTHON_TKINTER

Python offers multiple options for developing GUI (Graphical User Interface). Out of all the GUI methods, tkinter is most commonly used method. It is a standard Python interface to the Tk GUI toolkit shipped with Python. Python with tkinter outputs the fastest and easiest way to create the GUI applications. Creating a GUI using tkinter is an easy task.
To create a tkinter:
Creating a GUI application using Tkinter is an easy task. All you need to do is perform the following steps −

- Import the Tkinter module.
- Create the GUI application main window.
- Add one or more of the above-mentioned widgets to the GUI application.
- Enter the main event loop to take action against each event triggered by the user.

## Python History and Versions

- Python laid its foundation in the late 1980s.
- The implementation of Python was started in the December 1989 by **Guido Van Rossum** at CWI in Netherland.
- In February 1991, van Rossum published the code (labeled version 0.9.0) to alt.sources.
- In 1994, Python 1.0 was released with new features like: lambda, map, filter, and reduce.
- Python 2.0 added new features like: list comprehensions, garbage collection system.
- On December 3, 2008, Python 3.0 (also called "Py3K") was released. It was designed to rectify fundamental flaw of the language.
- *ABC* programming language is said to be the predecessor of Python language which was capable of Exception Handling and interfacing with Amoeba Operating System.
- Python is influenced by following programming languages:
    - ABC language.
    - Modula-3

## BACK END

The backend [2] to a website is pretty much everything the user can't see. Generally, this means the programming that generates pages that the user views, creating the "servside" content of the site.

This could be scripts, directives, databases, and other automated functions the server performs.

## MySQL

- MYSQL is the most popular Open Source Relational SQL database management system. MYSQL is one of the best RDBMS being used for developing web-based software applications.
- A database is a separate application that stores a collection of data. Each database has one or more distinct APIs for creating, accessing, managing, searching and replicating the data it holds.
- Relational Database Management System (RDBMS) is a software that:
- Enables you to implement a database with tables, columns and indexes.

Guarantees the Referential Integrity between rows of various tables.

- Updates the indexes automatically.
- Interprets an SQL query and combines information from various table.
- MYSQL uses a standard form of the well-known SQL data language.
- MYSQL works on many operating systems and with many languages including PHP, PERL, C, C++, JAVA, etc.
- MYSQL works very quickly and works well even with large data sets.

# CHAPTER- 2
# SOFTWARE AND HARDWARE REQUIREMENT

## SOFTWARE: -

Software: - Software used for Coding, Hosting and Database are given below:

For Developing:

- Anaconda: This is World Most popular Python/R Data Science Platform
- Python 3.7.2

For Database:

- MYSQL

## HARDWARE: -

1. Processor : 2.8 GHZ or above
2. RAM : 4 GB or above
3. HDD : 512 GB or above

## EXISTING SYSTEM

Traffic congestion mainly focuses on the signals failure, reduced law enforcement and improper traffic management. Because the existing foundation cannot be expanded further, the only option is to improve traffic management. As a result, the window of opportunity to effectively address traffic congestion has passed. Many ways have been developed to manage traffic and reduce congestion. Infrared sensor, inductive loop detection, video data analysis, wireless sensor network, and other are used to somewhat solve the congestion in the traffic and to manage the traffic smartly.

# CHAPTER-3
# PROBLEM DESCRIPTION

## PROBLEM

In India more than 37 million people are using two motorcycles. Since usage is high, accident percentage of two wheelers are also high compared to four wheelers. The impacts of these accidents are more dangerous when the driver involves in a high speed accident without wearing helmet. Government has made it a punishable offense to ride a bike without helmet and have adopted manual strategies to catch the violators. But, sometimes bikers without helmet not caught by officers.

## EXISTING SOLUTION

Traffic police catch the bikers who don‟t wear the helmet manually using surveillance video. Number of cameras attached on different location in particular city. They identify the location of footage by unique number of camera assigned to it. Firstly, traffic police see the bikers who violate the rules than after zooming towards the number plate they extract the unique number of bike and send e-challan to owner of associated vehicle number with help of RTO.

## PROBLEMS WITH EXISITING SOLUTION

- At a time, user can only extract number of single bike so there might be the circumstance that they skip another vehicle that doesn‟t follow the rules. So, task would become tedious and time consumption for them.
- More human intervention
- Manual detection of bikes are expensive because of monthly salary to each and every user who surveillance live footage.

## SOLUTION OF ABOVE PROBLEMS

The automation helmet detection project aims to provide total safety for bike riders. In this project we create desktop application which automatically detects and extract the image of bikers who don‟t wear the helmet on public roads and count the number of bikers with and without helmet and other vehicles. The video footage capture by camera of specific location. Desktop application interface provides the traffic police to visualize the data of specific time slot. The Traffic police will only need to send the E-challan to owner of bikers by just sees number of bike from saved images. Further, because of automated detection single officer can concentrate on multiple

locations and save more time.

# CHAPTER-4
# LITERATURE SURVEY

## INTRODUCTION

A literature survey or a literature review in a project report is that section which shows the various analyses and research made in the field of your interest and the results already published, taking into account the various parameters of the project and the extent of the project. All computer scientists who have done work in or are interested in traffic management found it very difficult because India is a country with the second largest road network in the world. Out of the total stretch of 5.4 million km of road network, almost 97,991 km is covered by national highways.

Traffic and accident management system requires lots of investment. In 2017, Miami-Dade has invested $130 million for the second phase of the project, to expand the cameras to most of the 3,000 intersections in the county over five years. The project is funded by a half-percent sales tax for transportation that voters approved in a 2002 referendum.

The main aim is to line up the sequence of green lights on U.S. 1 so that rush-hour commuters can drive through a maximum number of intersections without causing excessive waits at cross streets. "You want cars to get the green, start moving, start approaching that intersection and have the green pop up so you don"t have to stop," said Frank Aira, chief of Miami-Dade"s Traffic Signals Division. "You get a platoon of cars, and you want to move them as far as you can before it"s necessary for them to stop."

Cameras and other sensors calculate vehicle speed and car counts at intersections, and that data helps the computer decide whether the current timing schedule looks ideal. If not, the computer will tweak the schedule for the next cycle of red lights and green lights running through the intersection. With "adaptive" signals, an intersection can experience four or five adjustments in a minute.

Aira said the current county system only gives computers the option to change the durations of green and red lights, not their order in an intersection"s traditional cycle.

There"s also the issue of cross-street waits. The computer system"s prime directive is to speed travel time where there"s the most demand for crossing the intersection — that is, the busiest direction for traffic. Every time a light stays green for northbound traffic on U.S. 1 in the

morning, another light needs to remain red. That could lead to longer than usual backups on side streets that cross U.S. 1 in an effort to move as many vehicles as possible during peak times.

Installing the first wave of equipment throughout the year led to concerns of new red-light cameras, enforcement devices banned by Miami-Dade, Miami and other cities. While the county‟s police command center can take over the traffic cameras for surveillance during emergencies, they're not used for any ticketing purposes, Aira said. Even so, the electronic eye has motorists taking notice.

“There is a psychological effect to seeing it,” Aira said, saying the lights with cameras are seeing fewer vehicles “blocking the box” by getting stuck in intersections when traffic doesn‟t move after a light turns red. “People behave better.”

## About IoT

The Internet of Things (IoT), also sometimes referred to as the Internet of Ev- erything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sen- sors,processors and communication hardware. These devices, often called ”con- nected” or ”smart” devices, can sometimes talk to other related devices, a process called machine-to-machine(M2M) communication, and act on the information they get from one another. Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that are available these days, as well as the always-online nature of our home and business networks. Connected devices also generate massive amounts of Internet traffic, including loads of data that can be used to make the devices useful, but can also be mined for other purposes. All this new data, and the Internet-accessible nature of the devices, raises both privacy and security con- cerns.

## Advantages and Disadvantages of IoT

### *Advantages*

**Communication:** IoT encourages the communication between devices, also fa- mously known as Machine-to-Machine (M2M) communication. Because of this,the physical devices are able to stay connected and hence the total transparency is available with lesser inefficiencies and greater quality.

**Automation and Control:** Due to physical objects getting connected and con- trolled digitally and centrally with wireless infrastructure, there is a large amount of automation and control in the workings. Without human intervention, the machines are able to communicate with each other leading to faster and timely output.

**Information:** It is obvious that having more information helps making better de- cisions. Whether it is mundane decisions as needing to know what to buy at the grocery store or if your company has enough widgets and supplies, knowledge is power and more knowledge is better.

**Monitor:** The second most obvious advantage of IoT is monitoring. Knowing the exact quantity of supplies or the air quality in your home, can further provide more information that could not have previously been collected easily. For instance, knowing that you are low on milk or printer ink could save you another trip to the store in the near future. Furthermore, monitoring the expiration of products can and will improve safety.

**Time:** As hinted in the previous examples, the amount of time saved because of IoT could be quite large. And in today's modern life, we all could use more time.

**Money:** The biggest advantage of IoT is saving money. If the price of the tagging and monitoring equipment is less than the amount of money saved, then the Internet of Things will be very widely adopted. IoT fundamentally proves to be very helpful

### *Disadvantages*

**Compatibility:** Currently, there is no international standard of compatibility for the tagging and monitoring equipment. I believe this disadvantage is the most easy to overcome. The manufacturing companies of these equipment just need to agree to a standard, such as Bluetooth, USB, etc. This is nothing new or innovative needed.

**Complexity:** As with all complex systems, there are more opportunities of failure. With the Internet of Things, failures could sky rocket. For instance, let's say that both you and your spouse each get a message saying that your milk has expired, and both of you stop at a store on your way home, and you both purchase milk.

**Privacy/Security:** With all of this IoT data being transmitted, the risk of los- ing privacy increases. For instance, how well encrypted will the data be kept and transmitted with? Do you want your neighbors or employers to know what medica- tions that you are taking or your financial situation? Safety: As all the household appliances, industrial machinery, public sector services like water supply and trans- port, and many other devices all are connected to the Internet, a lot of information

## IoT in Traffic Management

Traffic management is one of the biggest infrastructure hurdles faced by developing countries today. Developed countries and smart cities are already using IoT and to their advantage to minimize issues related to traffic. The culture of the car has been cultivated speedily among people in all types of nations. In most cities, it is common for people to prefer riding their own vehicles no matter how good or bad the public transportation is or considering how much time and money is it going to take for them to reach their destination.

## Data management and Big data Issues

Traffic and Accident management system need to handle a huge amount of data. Therefore, standardization in data representation needs to be employed, once many problems may arise if each source employ an independent measurement and formatting. Moreover, many sources may report its data asynchronously; thus, a big challenge is how to manage such issue. Furthermore, data correlation is another challenge due to non-integration among different systems and sources, in which the same source may provide data in different systems. In other words, as different systems are independent, the data accounting can incur in false positives. However, the challenge is how to correlate such data to a common source. In addition, TMSs need to provide sophisticated mechanisms to fuse, aggregate, and exploit data to deal with different data types provided from heterogeneous sources. However, the major challenge is how to exploit these big data issues in a vehicular environment, once the current models and algorithms used in big data are physically and logically decentralized, but virtually centralized.

# CHAPTER-5
# SOFTWARE REQUIREMENTS SPECIFICATION

## 5.1 FUNCTIONAL REQUIREMENTS

- Discusses the functionalities required by the users from the system.
- Should clearly describe each function which the system would support along with the corresponding input and output data set.
- Identify the high-level functions of the system.
- A high-level function is one using which the user can get some useful piece of work done.
- The user invokes the services of each high-level requirement.
- Each high-level requirement typically involves accepting some data from the user, transforming it to the required response, and then output the system response to the user.
- The generated system response can be in several forms, e.g. display on the terminal, a print-out, some data transferred to the other systems etc.
- Except for very simple high-level functions, it may not be the case that the function reads the data before the start of the function and the output is produced at the completion of the function.
- In fact, a high-level function usually involves a series of interactions between the system and one or more users.
- Even for the same high-level function, there can be different interaction sequences or scenarios due to users selecting different options or entering different data items.

**How to identify the functional requirements.**

There can be many types of users of a system and their requirements from the system may be very different.

First identify different type of users who might use the system.

Then try to identify the different services expected from the software by different types of users.

**How to document the functional requirements**

- A function (requirement) can be documented by identifying the state at which the data is to be input to the system, its input data domain, the output data domain, and the type of processing to be carried on the input data to obtain the output data.

- The user interaction sequences may vary from one invocation to the another depending on some conditions.
- These different interaction sequences capture the different scenarios.
- To accurately describe a functional requirement, all the different scenarios that may occur must be accurately described.

**LOGIN:**

Description:

The login function first check the username and password if both are correct then the output is redirect to the home page, otherwise it generate errors.

Input:

- Username
- Password

Output: login successfully

**UPDATE USER INFORMATION:**

Description:

The update user information function updates take the input username and match username with file data if it matches then system generate random password and update the username, password and send the username and password to the given email.

Input:

- Old Username

Output: Username and password update successfully.

**DISPLAY DATA**

Description:

The display data function display the data day wise, date wise in the table.

Input: user selection.

Output: Total vehicles count, bike without helmet, bike with helmet.

**GRAPH PLOT**

Description:

The graph plot function plot the graph according to the user selection option.

Input: user selection.

Output: plot the graph between bike with helmet and without helmet.

## 5.2 NON FUNCTIONAL REQUIREMENTS

**N.1: DATABASE:**

A data base management system that is available free of cost in the public domain should be used.

**N.2: PLATFORM:**

Both Windows and UNIX versions of the software need to be developed.

**N.3: SAFETY AND SECURITY:**

No loss or minimum loss, Privacy and Security of data is major concerned which can be achieved by regular backup of database and by applying concept of OOPs (such as Encapsulation, Abstraction and Inheritance).

# CHAPTER-6

# SOFTWARE DESIGN

## USE CASE DIAGRAM

### INTRODUCTION

- The use case model for any system consists of a set of use cases.
- The use cases represent the different ways in which a system can be used by the users.
- The use cases correspond to the high-level functional requirements.
- The use cases partition the system behavior into transactions, such that each transaction performs some useful action from the user‟s point of view. Each transaction to complete, may involve multiple message exchanges between the user and the system.

A simple way to find all the use cases of a system is to ask the question "What all can the user do by using the system?"

### REPRESENTATION OF USE CASES

- A use case model is documented by drawing a use case diagram and writing an accompanying text elaborating the drawing.
- Use case diagram
- Each use case is represented by an ellipse.
- The name of the use case is written inside the ellipse.
- The use cases should be named from the users‟ perspective.
- All the ellipses (i.e. use cases) of a system are enclosed within a rectangle which represents the system boundary.
- The name of the system being modeled appears inside the rectangle.
- Actor: An actor is a role played by a user with respect to the system use.

Actors are represented by using stick person icons.

### 6.1.1 TRAFFIC MANAGEMENT USE CASE DIAGRAM

As shown in the given (fig 6.1.1) use case diagram, Traffic Management has following functionalities.

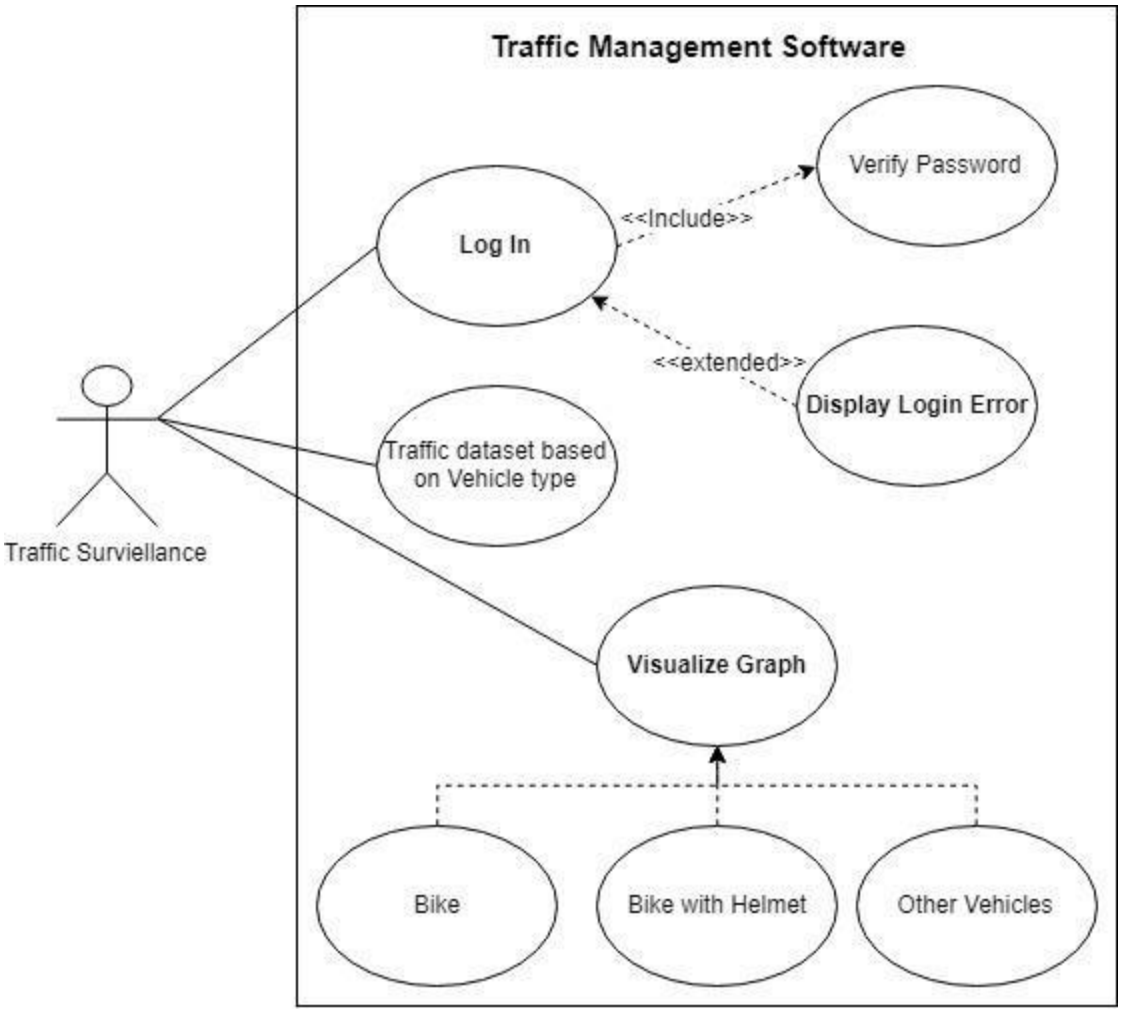



**Figure 6.1.1: Use Case Model of Traffic Management**

## TABLE STRUCTURE

Table structure transforms ER diagram into a table which is intersection of rows and columns. Here each column is a depicted form of an attribute and entity into table name. Here database" Traffic and management system" is used in which two table user, surveillance record.

**USER**

| Field | Type | Null | Key | Default | Extra |
|---|---|---|---|---|---|
| Username | varchar(40) | No | | NULL | |
| Passwd | varchar(20) | No | | NULL | |

**Table 6.2.1: User table**

**SURVEILLANCE RECORD**

| Field | Type | Null | Key | Default | Extra |
|---|---|---|---|---|---|
| date | datetime | NO | PRI | NULL | |
| bike_with_helmet | bigint(8) | YES | | NULL | |
| bike_without_helmet | bigint(8) | YES | | NULL | |
| total_vehicle | varchar(20) | YES | | NULL | |

**Table 6.2.2: Surveillance Record Table**

## ER DIAGRAM

The entity Relationship Diagram (ERD) depicts the relationship between the data objects.

- The ERD is the notation that is used to conduct the date modeling activity the attributes of each data
- Object noted is the ERD can be described resign a data object descriptions.
- The set of primary components that are identified by the ERD are
- Data object
- Relationships
- Attributes
- Various types of indicators.

The primary purpose of the ERD is to represent data objects and their relationships.

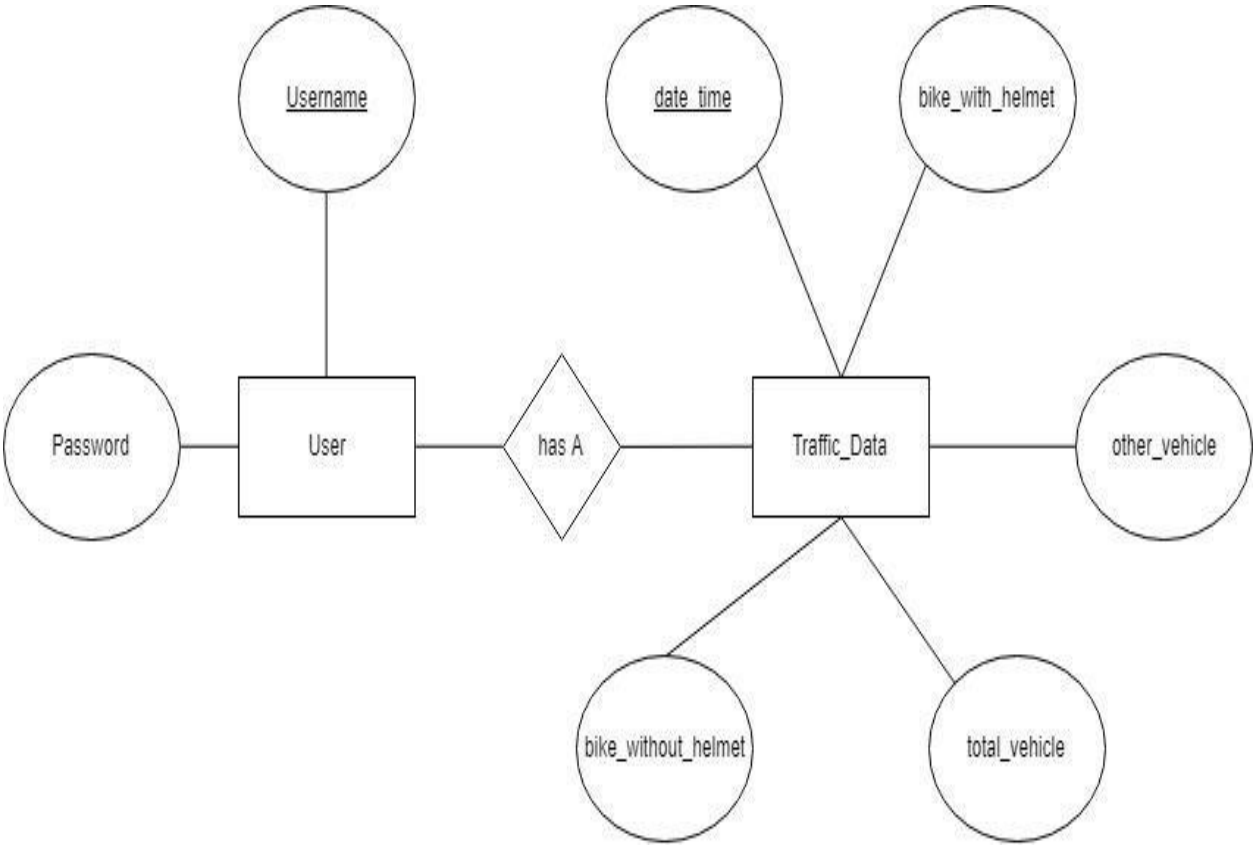



**Figure 6.3.1: ER Diagram**

# CHAPTER-7

# TESTING

## INTRODUCTION

Testing is the process of detecting errors. Testing performs a very critical role for quality assurance and for ensuring the reliability of software. The results of testing are used later on during maintenance also.

## PSYCHOLOGY OF TESTING

The aim of testing is often to demonstrate that a program works by showing that it has no errors. The basic purpose of testing phase is to detect the errors that may be present in the program. Hence one should not start testing with the intent of showing that a program works, but the intent should be to show that a program doesn‟t work. Testing is the process of executing a program with the intent of finding errors.

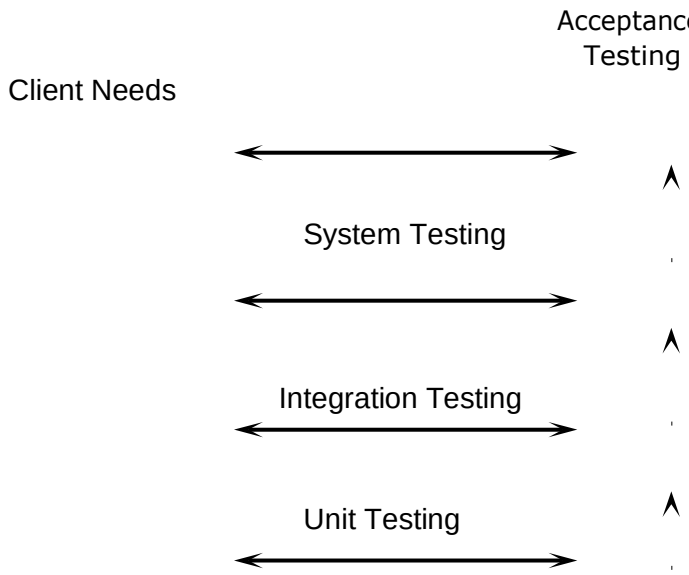
## TESTING OBJECTIVES

The main objective of testing is to uncover a host of errors, systematically and with minimum effort and time. Stating formally, we can say,

- Testing is a process of executing a program with the intent of finding an error.
- A successful test is one that uncovers an as yet undiscovered error.
- A good test case is one that has a high probability of finding error, if it exists.
- The tests are inadequate to detect possibly present errors.
- The software more or less confirms to the quality and reliable standards.

## LEVELS OF TESTING

In order to uncover the errors present in different phases we have the concept of levels of testing. The basic levels of testing are as shown below.




**SYSTEM TESTING:**

The philosophy behind testing is to find errors. Test cases are devised with this in mind. A strategy employed for system testing is code testing.

**CODE TESTING:**

This strategy examines the logic of the program. To follow this method, we developed some test data that resulted in executing every instruction in the program and module i.e. every path is tested. Systems are not designed as entire nor are they tested as single systems. To ensure that the coding is perfect two types of testing is performed or for that matter is performed or that matter is performed or for that matter is performed on all systems.

**UNIT TESTING**

Unit testing focuses verification effort on the smallest unit of software i.e. the module. Using the detailed design and the process specifications testing is done to uncover errors within the boundary of the module. All modules must be successful in the unit test before the start of the integration testing begins.

In this project each service can be thought of a module. There are so many modules like Login, HW Admin, Master Admin, Normal User, and Manager. Giving different sets of inputs has tested each module. When developing the module as well as finishing the development so that each module works without any error. The inputs are validated when accepting from the user.

In this application developer tests the programs up as system. Software units in a system are the

modules and routines that are assembled and integrated to form a specific function. Unit testing

is first done on modules, independent of one another to locate errors. This enables to detect errors. Through this error resulting from interaction between modules initially avoided.

### LINK TESTING

Link testing does not test software but rather the integration of each module in system. The primary concern is the compatibility of each module. The Programmer tests where modules are designed with different parameters, length, type etc.

### INTEGRATION TESTING

After the unit testing we have to perform integration testing. The goal here is to see if modules can be integrated properly, the emphasis being on testing interfaces between modules. This testing activity can be considered as testing the design and hence the emphasis on testing module interactions.

In this project integrating all the modules forms the main system. When integrating all the modules I have checked whether the integration effects working of any of the services by giving different combinations of inputs with which the two services run perfectly before Integration.

### SYSTEM TESTING

Here the entire software system is tested. The reference document for this process is the requirements document, and the goal us to see if software meets its requirements.

### ACCEPTANCE TESTING

Acceptance Test is performed with realistic data of the client to demonstrate that the software is working satisfactorily. Testing here is focused on external behavior of the system; the internal logic of program is not emphasized.

In this project „Network Management of Database System" I have collected some data and tested whether project is working correctly or not.

Test cases should be selected so that the largest number of attributes of an equivalence class is exercised at once. The testing phase is an important part of software development. It is the process of finding errors and missing operations and also a complete verification to determine whether the objectives are met and the user requirements are satisfied.

### WHITE BOX TESTING

This is a unit testing method where a unit will be taken at a time and tested thoroughly at a statement level to find the maximum possible errors. I tested step wise every piece of code, taking care that every statement in the code is executed at least once. The white box testing is also called Glass Box Testing.

I have generated a list of test cases, sample data which is used to check all possible combinations of execution paths through the code at every module level.

### BLACK BOX TESTING

This testing method considers a module as a single unit and checks the unit at interface and communication with other modules rather getting into details at statement level. Here the module will be treated as a block box that will take some input and generate output. Output for a given set of input combinations are forwarded to other modules.

## CRITERIA SATISFIED BY TEST CASES

Test cases that reduced by a count that is greater than one, the number of additional test cases that much be designed to achieve reasonable testing.

Test cases that tell us something about the presence or absence of classes of errors, rather than an error associated only with the specific test at hand.

# CHAPTER-8

# PRINCIPLE

## Existing System

The exiting traffic system is generally controlled by the traffic police. The main drawback of this system controlled by the traffic police is that the system is not smart enough to deal with the traffic congestion. The traffic police official can either block a road for more amount of time or let the vehicles on another road pass by i.e. the decision making may not be smart enough and it entirely depends on the official's decision. Moreover, even if traffic lights are used the time interval for which the vehicles will be showed green or red signal is fixed. Therefore, it may not be able to solve the problem of traffic congestion. In India, it has been seen that even after the presence of traffic lights, traffic police officials are on duty, which means that in this system more manpower is required and it is not economical in nature.(Viswanathan and Santhanam, 2013)

### *Disadvantages of Existing System*

i) Traffic congestion
ii) No means to detect traffic congestion
iii) Number of accidents are more
iv) It cannot be remotely controlled
v) It requires more manpower
vi) It is less economical

## Proposed System

The first and primary element of this system is the wireless sensor nodes consist- ing of sensors. The sensors interact with the physical environment means vehicles presence or absence while the local server sends the sensors data to the central mi- crocontroller. This system involves the 4*2 array of sensor nodes in each way. This signifies 4 levels of Traffic and 2 lanes in each way. The sensors are ultrasonic sensors which transmits status based on presence of vehicle near it. The sensor nodes transmit at specified time intervals to the central microcontroller placed at every intersection. The Microcontroller receives the signal and computes which road and which lane has to be chosen based on the density of Traffic. The computed data from Microcontroller is then transmitted to the local server through Wi-Fi connectivity. The controller makes use of the collected data to perform the Intelligent Traffic rout- ing. In this system, the primary aim is to gather the information of moving vehicles based on WSN to provide them a clear path till their destinations and traffic signals should switch automatically to give a clear way for these vehicles.(Dave,2018)

### *Advantages of Proposed System*

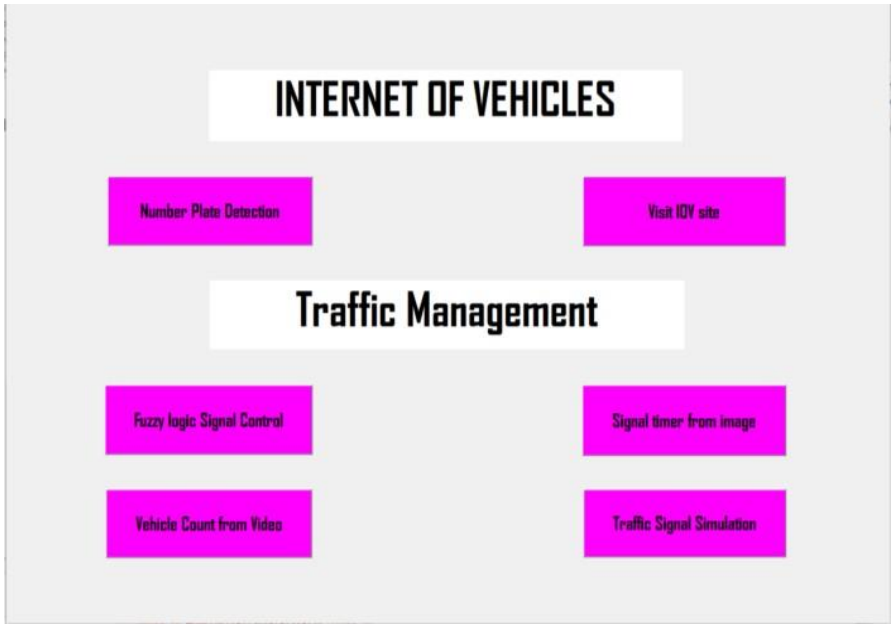
i) Minimizes number of accidents.
ii) Reduces fuel cost and saves time.
iii) Low budget.
iv) Easy implementation and maintenance.
v) Remotely controllable.
vi) Minimizes hassle and cost of commuting.

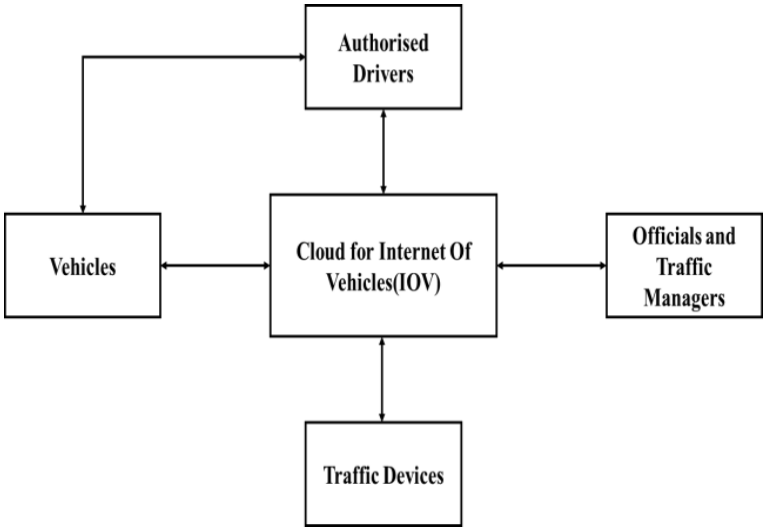
## Method

In this proposed system, the traffic lights are LEDs and the car counting sensor is an ultrasonic sensor. Both blocks are connected to a Microcontroller usingphysical wires. The Microcontroller is the traffic light controller which receives the collected sensor data and manages the traffic lights by switching between green, yellow and red. The Microcontroller computes the number of cars in the street of the inter-section it is monitoring based on the distances measured by the ultrasonic sensor and the timing between those measurements. The Microcontroller then sends the number of cars every minute to the local server. This communication is doneusing the Microcontroller serial port. The local server exchanges the data received with the cloud server in order to better predict the changes in timings of the traffic light. This communication is done using Wi-Fi. More specifically, the cloud server uses an equation that takes the data received (number of cars) as input then determines the time interval of LEDs needed for a smooth traffic flow. This calculated time is then compared to the current actual time of the LEDs (this data is saved in a database on the cloud server). The server then comes up with a decision. If the current actual green time is less than the calculated time, the decision is to increase the green time, else to decrease the green time.(Chandana K K, 2013)

# METHODOLOGY

The cloud contains all the information in the database which has information like users, vehicles, Traffic offences, Safe limit for each Road, Locations of each vehicles and roads etc. The network of these Vehicles is stored to identify and authorize and also track their features like conditions, driving range, max speed, safety measures etc. The officials are given premium benefits to monitor the vehicle registrations, available users, incoming applications, traffic violence and offence, and traffic flow. These officials can access and modify the blockage of routes in case of a VIP patrol or any other unavoidable closures in the road and the users can choose an alternate route. The alert is used to notify all possible commutes near the blocked road and hence congestion can be avoided. Traffic offences- like riding without a helmet, speeding over the safe limit etc. can be captured through the devices which identifies the number plate of the vehicle and the currently logged user is penalized based on the governance fines. Other traffic devices include signal lights, Digital Speed meter Boards etc. These can be modified based on traffic status in the road under consideration or route under commute. A rerouting algorithm is crafted to deviate ambulances to low congestion position based on network of sensors and vehicles employed in the IOT module.


INTERNET OF VEHICLES
Number Plate Detection
Visit IOV site
Traffic Management
Fuzzy logic Signal Control
Signal timer from image
Vehicle Count from Video
Traffic Signal Simulation


Authorised Drivers
Vehicles
Cloud for Internet Of Vehicles(IOV)
Officials and Traffic Managers
Traffic Devices

# Matlab

MATLAB is a proprietary multi-paradigm programming language and numeric computing environment developed by Math Works. MATLAB supports matrix manipulations, plotting of functions, implementation of algorithms, creation of user interfaces, and allying with programs written in other languages. MATLAB is used in many technical fields for data analysis, problem solving, and for experimentation and algorithm development. The gateway is the GUI of the project which gives access to the individual objective codes in MATLAB. The GUI is designed based on the GUIDE library in the software tool. The various accessories from the GUI takes through the appropriate codes as mentioned.

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

- Math and computation
- Algorithm development
- Modeling, simulation, and prototyping
- Data analysis, exploration, and visualization
- Scientific and engineering graphics
- Application development, including Graphical User Interface building
- MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar noninteractive language such as C or Fortran.
- The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation.
- MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

The MATLAB System

The MATLAB system consists of five main parts:

- ***The MATLAB language.***

  This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

- ***The MATLAB working environment.***

  This is the set of tools and facilities that you work with as the MATLAB user or programmer. It includes facilities for managing the variables in your workspace and importing and exporting

data. It also includes tools for developing, managing, debugging, and profiling M-files, MATLAB's applications.

- ***Handle Graphics.***

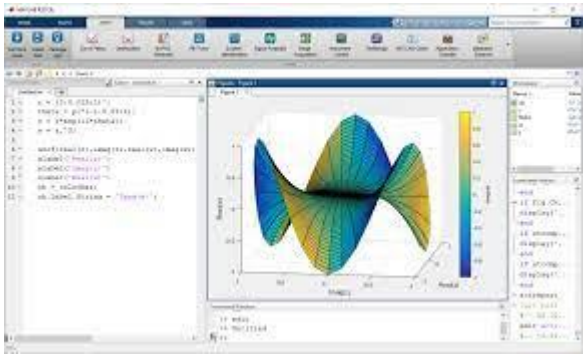
  This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

- ***The MATLAB mathematical function library.***

  This is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix eigenvalues, Bessel functions, and fast Fourier transforms.

- ***The MATLAB Application Program Interface (API).***

  This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.



# TINKERCAD

Tinkercad is a free 3D modeling program known for its ease of use. It's 100% web-based, making it available to anyone with an internet connection.

Kids, educators, and hobbyists use it to design anything imaginable. Utilizing 3D printing, laser cutting, or building blocks can bring Tinkercad projects into real life.

Many Schools use it as a way to teach projects with 3D Design, Electronics, and Visual Code Blocks.

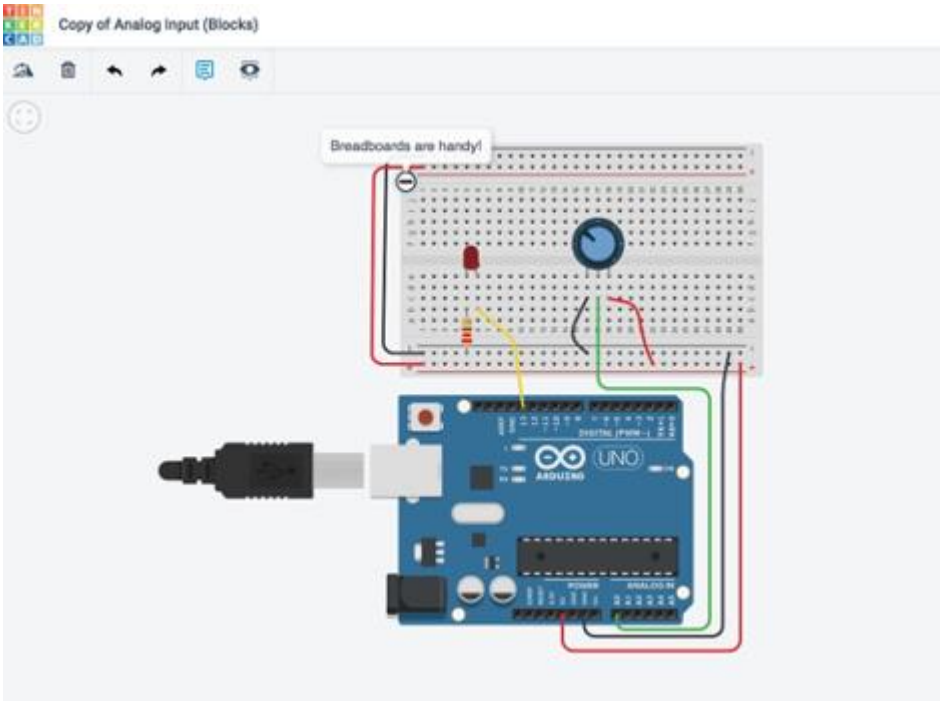

Let's explore these three core areas of Tinkercad.

## 3D Design

Tinkercad launched in 2011 to make 3D designs available to the general public. Designing in Tinkercad is a great way to learn the foundation of solid modeling.

Solid modeling is the practice of building objects with primitive shapes. Users can drag and drop premade shapes into the workspace to create solids. By combining premade shapes, users can create their unique designs.

Virtual-circuits can be designed and built in Tinkercad before created in real life. Source: Tinkercad blog




*Virtual-circuits can be designed and built in Tinkercad before created in real life. Source: Tinkercad blog*

## Electronics

Unique designs can also utilize motion and light by using Tinkercard's built-in circuit features. Users can begin with a starter circuit or build their own by using premade wire components. Virtual-circuits are a great way to learn and tinker before making it in real life. Built-in Code blocks or custom C++ can run circuit components. Users can tweak and further define them until they achieve their desired result.

## Visual Code Blocks

Drag and drop premade code blocks together to make custom shapes. Code blocks allow the creation of 3D designs using visual programming. Reordering, the code blocks can refine the details of shapes. For example, a cylinder code block cut out from a box code block makes a hole. To save time, Tinkercard includes several example code blocks. The "Starters" section groups all of the samples that are ready to use.

# ARCHITECTURE OF INTERNET OF THINGS

Architecture of internet Of Things contains basically 4 layers:

- Application Layer
- Gateway and the network layer
- Management Service layer
- Sensor layer

**APPLICATION LAYER:**

- Lowest Abstraction Layer
- With sensors we are creating digital nervous system.
- Incorporated to measure physical quantities
- Interconnects the physical and digital world
- Collects and process the real time information

**GATEWAY AND THE NETWORK LAYER:**

- Robust and High performance network infrastructure
- Supports the communication requirements for latency, bandwidth or security
- Allows multiple organizations to share and use the same network independently

**MANAGEMENT LAYER:**

- Capturing of periodic sensory data
- Data Analytics (Extracts relevant information from massive amount of raw data)
- Streaming Analytics (Process real time data)
- Ensures security and privacy of data.

**SENSOR LAYER:**

- Provides a user interface for using IoT.
- Different applications for various sectors like Transportation, Healthcare, Agriculture, Supply chains, Government, Retail etc.

# CHAPTER-9

# MISCELLANEOUS

## Future Scope

For future directions, different priority levels for multiple incidents and scenarios can be considered. The main issue with IoT is that the security of the entire sys- tem have to be concentrated on and not a particular IoT layer, device or software. Hence, integrating the entire traffic management system with multiple layer secu- rity for various data generated from various sources can be another subject of future scope. Along with that an emergency signal for an emergency vehicle (such as an Ambulance) can also be included in order to serve them better.

## Related Works

In the field of IoT, many systems are proposed in order to control, manage the traffic system effectively. Each of the systems use different types of technologies, components for managing Traffic congestion like IR Sensors, RFID's, Zigbee, Traffic warning systems, Big Data, Bluetooth etc. The following are some the works that are related to our project. In the past ten years, the Internet of Things evolution has been unprecedented. Recently, various driver assistance systems have been actively developed that use both information communication technology and on-board sensors. Invisibility of traffic signal caused by huge vehicles blocking the view, prevent traffic congestion at toll gates and give advanced collision warning to the drivers. A microcontroller with a RF module will be installed and is programmed to connect to each automobile passing by. Later it displays signal status on the traffic signal status display system installed inside the automobile. This system installed in the vehicle is also capable of giving collision warnings to the driver.

IoT links the objects of the real world to the virtual world. It constitutes to a world where physical objects and living beings, as well as virtual data and environments, interact with each other. Urban IoT system that is used to build intelligent trans- portation system (ITS) has been developed. IoT based intelligent transportation systems are designed to support the Smart City vision, which aims at employing the advanced and powerful communication technologies for the administration of the city and the citizens. ITS uses technologies like near field communication (NFC) and wireless sensor network (WSN).

Automation combined with the increasing market penetration of on-line commu- nication, navigation, and advanced driver assistance systems will ultimately result in intelligent vehicle highway systems (IVHS) that distribute intelligence between roadside infrastructure and vehicles and in particular on the longer term, are one of the most promising solutions to the traffic congestion problem. The simulation and evaluation of a traffic congestion detection system which combines inter-vehicular communications, fixed roadside infrastructure and infrastructure-to-infrastructure connectivity and big data. To simulate and evaluate, a big data cluster was devel- oped based on Cassandra. Big data cluster is coupled with discreet event network simulator with the SUMO (Simulation of Urban Mobility) traffic simulator and the Veins vehicular network framework. The results validate the efficiency of the traffic detection system and its positive impact in detecting, reporting and rerouting traffic when traffic events occur. In order to avoid incidents like jams, accidents and to reduce huge menace concepts like Zigbee, RFID, Bluetooth, GSM-GPS technologies were developed.(Yucheng Huang, 2018)

# Conclusion

Smart Traffic Management System has been developed by using multiple features of hardware components in IoT. Traffic optimization is achieved using IoT platform for efficient utilizing allocating varying time to all traffic signal according to available vehicles count in road path. Smart Traffic Management System is implemented to deal efficiently with problem of congestion and perform re-routing at intersections on a road.

This research presents an effective solution for rapid growth of traffic flow partic- ularly in big cities which is increasing day by day and traditional systems have some limitations as they fail to manage current traffic effectively. Keeping in view the state of the art approach for traffic management systems, a smart traffic man- agement system is proposed to control road traffic situations more efficiently and effectively. It changes the signal timing intelligently according to traffic density on the particular roadside and regulates traffic flow by communicating with local server more effectively than ever before. The decentralized approach makes it optimized and effective as the system works even if a local server or centralized server has crashed. The system also provides useful information to higher authorities that can be used in road planning which helps in optimal usage of resources. (Sabeen Javaid, 2018).

This conclusion presents some closing thoughts on the concepts covered in the preceding chapters of this book. The book discusses the centrality of data at the foundation of Internet of Things (IoT) ecosystems. IoT initiatives involve solutions that rely on sensor deployments and associated datasets. With the ever-increasing number of IoT deployments, there is a danger of fragmentation. Fragmentation can be reduced when interoperability allows the exchange of data and/or services. Turning to the future of the IoT, the book explores the emergence of what are referred to as cyber-physical systems (CPS), wherein physical and software components are deeply intertwined: virtual systems and physical systems directly interact, and embedded computers monitor and control physical processes with feedback loops where physical processes affect computations and vice versa. Exploiting advances in artificial intelligence technology, CPS will embed a far greater degree of automated reasoning and action than current IoT systems.

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# APPENDIX-1 GLOSSARY OF TERMS

## A

**Accuracy** Percentage of correct predictions made by the model.

**Algorithm** A method, function, or series of instructions used to generate a machine learning model. Examples include linear regression, decision trees, support vector machines, and neural networks.

**AUC** An evaluation metric that considers all possible classification thresholds**.**

The Area Under the ROC curve is the probability that a classifier will be more confident that a randomly chosen positive example is actually positive than that a randomly chosen negative example is positive.

## B

**Bar Chart** Bar charts are a type of graph that are used to display and compare the numbers, frequency or other measures (e.g. mean) for different discrete categories of data. They are used for categorical variables.

**Binary Variable** Binary variables are those variables which can have only two unique values. For example, a variable "Smoking Habit" can contain only two values like "Yes" and "No".

## C

**Classification** Predicting a categorical output (e.g. yes or no?, blue, green or red?).

**Classification Threshold** The lowest probability value at which we‟re comfortable asserting a positive classification. For example, if the predicted probability of being diabetic is > 50%, return True, otherwise return False.

**Computer Vision**

Computer Vision is a field of computer science that deals with enabling computers to visualize process and identify images/videos in the same way that a human vision does. In the recent times, the major driving forces behind Computer Vision has been the emergence of deep learning, rise in computational power and a huge amount of image data. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. Some of the key applications of Computer Vision are:

- Pedestrians, cars, road detection in smart (self-driving) cars
- Object recognition
- Object tracking

**Correlation**

Correlation is the ratio of covariance of two variables to a product of variance (of the variables). It takes a value between +1 and -1. An extreme value on both the side means they are strongly correlated with each other. A value of zero indicates a NIL correlation but not a non-dependence. You‟ll understand this clearly in one of the following answers.
The most widely used correlation coefficient is Pearson Coefficient. Here is the mathematical formula to derive Pearson Coefficient.

$$r = \frac{\sum_i (x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_i (x_i - \overline{x})^2} \sqrt{\sum_i (y_i - \overline{y})^2}}$$

**Cross Validation**

Cross Validation is a technique which involves reserving a particular sample of a dataset which is not used to train the model. Later, the model is tested on this sample to evaluate the performance. There are various methods of performing cross validation such as:

- Leave one out cross validation (LOOCV)
- k-fold cross validation
- Stratified k-fold cross validation
- Adversarial validation

# D

**Database**

Database (abbreviated as DB) is an structured collection of data. The collected information is organized in a way such that it is easily accessible by the computer. Databases are built and managed by using database programming languages. The most common database language is SQL.

**DataFrame**

DataFrame is a 2-dimensional labeled data structure with columns of potentially different types. You can think of it like a spreadsheet or SQL table, or a dict of Series objects. DataFrame accepts many different kinds of input:

- Dict of 1D ndarrays, lists, dicts, or Series
- 2-D numpy.ndarray
- Structured or record ndarray
- A series
- Another DataFrame

**Dataset**

Dashboard is an information management tool which is used to visually track, analyze and display key performance indicators, metrics and key data points. Dashboards can be customised to fulfil the requirements of a project.

It can be used to connect files, attachments, services and APIs which is displayed in the form of tables, line charts, bar charts and gauges.

# E

**Evaluation Metrics**

The purpose of evaluation metric is to measure the quality of the statistical / machine learning model. For example, below are a few evaluation metrics

1. AUC
2. ROC score
3. F-Score
4. Log-Loss

# F

**False Negative**

Points which are actually true but are incorrectly predicted as false. For example, if the problem is to predict the loan status. (Y-loan approved, N- loan not approved). False negative in this case will be the samples for which loan was approved but the model predicted the status as not approved.

**False Positive**

Points which are actually false but are incorrectly predicted as true. For example, if the problem is to predict the loan status. (Y-loan approved, N- loan not approved). False positive in this case will be the samples for which loan was not approved but the model predicted the status as approved.

**F-Score**

F-score evaluation metric combines both precision and recall as a measure of effectiveness of classification. It is calculated in terms of ratio of weighted importance on either recall or precision as determined by β coefficient.
F measure = 2 x (Recall × Precision) / ( $\beta^2$ × Recall + Precision )

# N

**Normalization**

Normalization is the process of rescaling your data so that they have the same scale. Normalization is used when the attributes in our data have varying scales.

**Numpy**

NumPy is the fundamental package for scientific computing with Python

# P

**Pandas**

Pandas is an open source, high-performance, easy-to-use data structure and data analysis library for the Python programming language.

| | |
|---|---|
| **Pattern Recognition** | Pattern recognition is a branch of machine learning that focuses on the recognition of patterns and regularities in data. Classification is an example of pattern recognition wherein each input value is assigned one of a given set of classes.<br>In computer vision, supervised pattern recognition techniques are used for optical character recognition (OCR), face detection, face recognition, object detection, and object classification. |