**Palestine Polytechnic University**

**College of Information Technology and**

**Computer Engineering**

# Smart cars and streets


**Team:**

**Nirmeen Hawamdeh (161044)**

**Shahd Abu Dawood (161080)**

**Summer shroori(161083)**

**Supervisor:**

**Dr. Ayman wazwaz**


**Jun 2, 2021**

# Acknowledgment

All thanks and respect to Palestine Polytechnic University. Thanks, and appreciation to Computer systems Engineering College. A Special thanks and gratitude to our department “computer Engineering department”.

Departments, for helping us assemble this Project.

Thank you to our supervisor Eng. Ayman wazwaz, for providing guidance, feedback and overall insights throughout this project.

To

I dedicate this work to our dear parents, our families, and dears.

To our green land, for an olive tree that has uprooted.

To the farmer that his land has been usurped. To the toilers and farmers of our beloved land.

## الاهداء

اهديهذا**العمل**الىصاحبالسيرةالعطرة،والفكرالمُستنيرفلقدكانلهالفضلالأوَّلفيبلوغيالتعليمالعالي (والديالحبيب)

أطالاللهفيعُمره،إلىمنوضعتنيعلىطريقالحياةوجعلتنيرابطالجأش (أميالغالية)

أطالاللهفيعمرها،إلىإخوتيمنكانلهمبالغالأثرفيكثيرمنالعقباتوالصعاب،إلىجميعأساتذتيالكرام؛ممنلميتوانوافيمديدالعون لنا.

**Abstract:**

Year by year, the street problems increase linearly with the growth of people. Accidents, speed violation, street crimes, time waste to reach your goal through streets …etc.

Our problem speaks about the street status and how it can be solved; the solution to the street problem comes into two parts, either automatically or manually.

Accidents and speed violations are solved in an automatic way, using sensors to measure the accurate value and compare it, then produce an action depending on the output value the system can notify driver and the ambulance when the violation occurs and display the specific location on map.

# Contents


**Chapter 1** .......... **8**

Introduction .......... 9

Overview of the project ١.١ .......... 9

Motivation ١.٢ .......... 9

Importance ١.٣ .......... 9

Objective ١.٤ .......... 10

Description of the project ١.٥ .......... 10

problem statement ١.٦ .......... 11

List of requirements ١.٧ .......... 11

results Expected ١.٨ .......... 12

Overview of the rest of report ١.٩ .......... 12

**chapter 2** .......... **13**

Background .......... 13

Overview ١. ٢ .......... 13

Literature review ٢.٢ .......... 13

Theoretical background ٢.٣ .......... 14

re componentsHardwa ٢.٤ .......... 16

software ٢.٥ .......... 21

**Chapter 3** .......... **24**

System Design .......... 24

Overview ٣.١ .......... 24

Detailed system description ٣.٢ .......... 24

Block diagrams ٣.٣ .......... 26

Flowchart ٣.٤ .......... 28

pseudo code ٣.٥ .......... 30

Schematic diagram ٣.٧ .......... 31

**Chapter 4** .......... **32**

implementation Software and hardware .......... 32

Overview ٤.١ .......... 32

Software implementation ٤.٢ .......... 32

re implementationHardwa ٤.٣ .......... 38

Issues and challenges ٤.٤ .......... 39

Hardware Issues and challenges ٤.٤.١ .......... 39

Software Issues and challenges ٤.٤.٢ .......... 40

System Testing ٤.٥.٢ .......... 45

Implementation Results ٤.٦ ........ 46
Chapter 5 ........ 47
System analysis and Discussion ........ 47
erviewOv ٥.١ ........ 47
Analysis and discussion about the results ٥.٢ ........ 47
Chapter 6 ........ 50
Conclusion ........ 50
Challenges ٦.٢ ........ 50
:Recommendations and future action ٦.٣ ........ 51
Reference ........ 52

## Table of figure

Figure 2.1: wireless sensor network, source [8] ........ 15
Figure 2.2: MQTT Protocol, source [9]. ........ 15
Figure2.١١: IFTTT Web Server, source [16] ........ 23
Figure2.١٢: Webhook, source [17] ........ 23
Figure 3.2 Block of interfaces diagram and Connection symbols ........ 26
Figure 3.3 Block of IoT controller in car (1) with connected gadgets ........ 27
Figure 3.4 Block of IoT controller (2) with connected gadgets ........ 27
Figure 3.5 Block of IoT controller 3 with connected gadgets ........ 28
Figure 3.6 An aggregate diagram of the system ........ 28
Figure 3.6 represents the flowchart of Accident detection. ........ 28
Figure 3.8 represents the flowchart of street ........ 29
Figure 3.9 Schematic diagram through Block Diagram ........ 31
Figure 3.10 Schematic diagram (Street node) through Block Diagram ........ 31
Figure4.1: cayenne application ........ 32
Figure 4.2: cayenne log in ........ 33
Figure 4.3 devices in cayenne ........ 33

**Figure 4.4sensor's valuesof car1 ......... 33**

**Figure 4.6 create webhook _ 1 ......... 35**

**Figure 4.7 create webhook _2 ......... 35**

**Figure 4.8 create webhook _3 ......... 35**

**Figure 4.9 create webhook _4 ......... 36**

**Figure 4.10 create webhook _5 ......... 36**

**Figure 4.11: Trigger and Alerts button ......... 37**

**Figure 4.12, 4.13: Triggers ......... 37**

**Figure 4.14: cayenne notification ......... 40**

**Figure 4.16: Result of GPS ......... 41**

**Figure4. 17: Test vibration sensor ......... 41**

**Figure4.18: Result of vibration sensor ......... 42**

**Figure 4.19: Result of buzzer ......... 42**

**Figure4. 20: Test led ......... 42**

**Figure4.21: Result of led ......... 43**

**Figure4. 22: Test accident button ......... 43**

**Figure4.23: Result of accident button ......... 43**

**Figure 4. 25: Result of temperature sensor ......... 44**

**Figure 4.27: Test smoke sensor ......... 44**

**Figure 4.29 map contain location of car ......... 45**

**Figure 4.31: Test for all system ......... 46**

**Figure 5.1 :Testing ......... 47**

**Figure 5.2: Collision case ......... 48**

**Figure5.2: over speeding ......... 48**

**Figure 5.3: smoke in street ......... 49**

**Tables :**

**Table 2.1: Comparison between ESP8266and Arduino** ................................................ 16

**Table 2.2: Comparison between gps module and gps in phone** ..................................... 17

**Table 2.3 : Comparison between Piezo Buzzer and magnetic Buzzer** ............................ 18

**Table 2.4 : Comparison between limit switch and pushbutton** ...................................... 19

**Table 2.5 : Comparison between vibration and flex** ..................................................... 19

**Table 2.6 : Comparison between DHT22 Buzzer and DHT11** ....................................... 20

**Table 5.1: Test results for the system** .............................................................. 49

## Chapter 1

## Introduction

### ١.١ Overview of the project

In this project we built a system based on microcontrollers. Microcontroller is a small and low-cost microcomputer, which is designed to perform the specific tasks of embedded systems like displaying microwave's information, receiving remote signals, and controlling traffic etc. [1].

we worked in a system in which we placed the microcontroller in different places in the streets and cars, and an access point to connect the microcontroller to each other's and Cloud service model (Platform as a Service) that supports many of the things we were needed such as database, mobile application, GPS to discover location and various sensor devices.

### ١.2 Motivation

1. Traffic accidents in Palestine continue to increase and they cause death of tens of people every year.

2. Over speed on roads is the main reason for the increasing accidents

3. Frequent negligence and speed of violators cause many accidents.

### ١.٣ Importance

The importance of this project is in solving the problem of accidents that cause many negative effects on roads, Detecting the occurrence of an accident and notifying the competent authorities, giving a warning about speed and a violation when it is higher than the legal speed

## 1.4 Objective

1- The system is able to know the occurrence of the accident, determine its location, and notifies its location to the ambulance in order to attend the accident

2- When an accident occurs, the sensor value will be greater than threshold so the platform sends messages to the ambulance about it and to nearby cars to change their route.

3- At high speed, an electronic message is sent to the violator and a sound will be issued to alert the driver to avoid an accident.

## 1.5 Description of the project

1. We created a wireless network using a microcontroller by placing it in different cars and streets and connecting them to the access point.

2. Necessary Information about every microcontroller is stored in the database on the platform

3. Each microcontroller has a different ID in the platform, and a different dashboard.

**The system will provide some services:**

- **Accident detection:**

A microcontroller placed inside the car is connected to a group of sensors; it has a special ID stored in the platform and an interface that contains readings that are updated every minute inside the platform.In the event of an accident, the sensor value is greater than the threshold value, so the system sends messages to the ambulance warning it for an accident and informs the surrounded cars to change their routes if they are close to the danger. A microcontroller placed on a street; it is connected to a set of sensors to monitor street changes such as the occurrence of combustion.

- **Electronic violation message**

The speed is calculated from the distancethat the vehicle traveled during a period of time via the location tracking device, and when an increasing in the speed has been noticed from the threshold, an electronic violation is sent to the driver. So, the system runs an alarm to speed-down to slow down.

**1.6 problem statement**

1. Speed is a major risk factor for road accidents all around the world. If a car collides at a speed of 50 kilometers per hour, then the probability of death is estimated to be twenty percent, but if its speed is eighty kilometers per hour, the percentage increases to 60%.[2]

2. Continuing of breaking traffic laws and non-compliance with them lead to fatal accidents and deaths.

**1.7 List of requirements**

- Functional requirements:

● The system's ability to detect an accident and change the route of nearby cars

● The system must send the violations to the correct vehicle at the exact time.

● Availability of a permanent internet connection

- Non functional

● Data about cars must be secure

● Communication is available all the time

● Services are available to everyone

● That the road should be rehabilitated when any alternative roads are available.

## 1.8 Expected results

We expect this project to be able to:

- Detect the occurrence of an accident and inform the competent authorities
- Given a warning when increasing of the speed is exists.
- Violation a driver when he/ she increases the speed
- Change the route of nearby cars by providing them with the location

## 1.9 Overview of the rest of report

The outline of the report is as follows:

Next chapter, “background”, contains the theoretical background, Literature review, options (design options for hardware components and design options for software components) and design constraints. Third chapter “design”, includes a detailed conceptual description of the system (Hardware and Software), detailed design, schematic diagrams, block diagrams, structural diagrams, and any necessary information about the design.

# chapter 2

# Background

## 2 .1 Overview

This chapter introduces the theoretical background of our project, a short description of design options that are used in the system, design specifications, constraints and some additional information about the system.

## 2.2 Literature review

1) **digital roads:**

   This project works to detect violations of drivers in case of violation, speed limit violation, traffic light violation, and traffic accidents. A database has been built on the server that includes important information that preserves all information about cars and their drivers there and some other information about ambulances, firefighting and locations of police stations And their contact numbers. In this project, the central system was programmed using C# language and SQL database used to monitor traffic violations, calculate traffic, monitor accidents, track any vehicle within our network coverage and control traffic lights if necessary. Some information is transmitted to a center Police or to the driver or policemen on their mobile devices via the GSM network, and this information is displayed as a map on the Android device with the driver of the car, patrol policeman or ambulance.[3]

**2)Accelerometer:**

It is a project that built an Arduino based vehicle accident alert system using GPS, GSM and accelerometer. The accelerometer detects the sudden change in the vehicle axes and the GSM module sends the alert message to your mobile phone with the location of the accident, and the location of the accident is sent as a Google Map link, which is derived from the latitude and longitude of the GPS module.[4]

**3) Traffic Light Monitoring System based on NodeMCU using Internet of Things:**

In this system, sensors will send information to a NodeMCU]. Then NodeMCU will receive that information and transfers to the android device via the internet. Android device will send all the collected information to the server over the web server and store it in the database. According to the traffic signals from the sensors will be managed dynamically to avoid a traffic jam. When a user needs a real-time traffic data or condition the routes, the user can log in to the Android application, the application will request to the web server for the user requirement and the server will get results from requirement and user will see the traffic data and traffic condition.[5]

## 2.3Theoretical background

The Internet of Things (IOT) is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer direct interaction. The idea behind IOT is creating a system that stores all the data on the cloud without having the need of human efforts in collecting them. It is believed that the impact of IOT on the world will be immense in the upcoming years. And, given the current trends, its effect on human life is increasing exponentially and will only continue to rise with the concept of smart cities, cars and streets [6].

We used this concept in our system by building a wireless sensor network, for its ability to transfer data over a network without the need of human-to-human interaction or human-to-computer interaction.

**Wireless sensor network (WSN)** "refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. WSNs measure environmental conditions like temperature, sound, pollution levels, humidity, wind, and so on "[7].

In our project we used the concept of a sensor by connecting a group of sensors in a microcontroller supporting the Internet to read some of the variables that occur on the street.

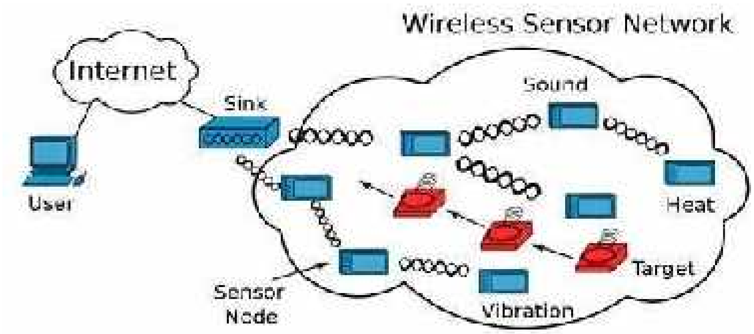



**Figure 2.1: wireless sensor network, source [8]**

**MQTT**: is a publish/subscribe protocol that allows the edge-of-network devices to publish to a broker, Clients connect to this broker, which then mediates communication between the two devices. Each device can subscribe, or register, to particular topics. MQTT is an OASIS standard messaging protocol for the Internet of Things (IOT).

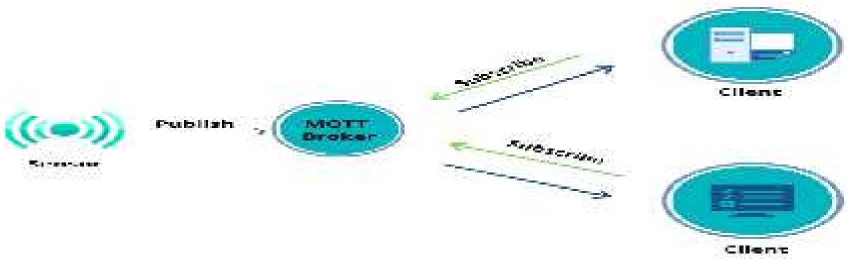



**Figure 2.2: MQTT Protocol**, **source [9].**

**GPS**

GPS stands for Global Positioning System and can be used to determine exact position, time, and speed if you're travelling.

## 2.4 Hardware components

- **Microcontroller**

There are many types of microcontrollers that can be used in our project, the comparison is shown in the table2.1.

| Type<br>Comparison | ESP8266 | Arduino |
|---|---|---|
| Operating Voltage | 3.3 v or 5v | 5v |
| Flash Memory | 4 MB | 32 KB |
| Clock Speed | 80 MHz | 16 MHz |
| WIFI | Yes | No |
| Digital I/O Pins | 16 | 14 |
| Digital I/O Pins with PWM | 16 | 6 |
| The shape |  |   |

**Table 2.1: Comparison between ESP8266and Arduino**

**Chosen Design**

Weused ESP8266 because data is allowed to be transferred using wi-fi protocol.

- **GPS:**

There are many thingsto get location, the comparison is shown in the table2.2

| Type / Comparison | GPS module | GPS in phone |
|---|---|---|
| Complex | Not complex | Complex |
| Price | Less expensive | more expensive |
| Need to mobile | No | Yes |
| Link with esp8266 | Yes | No |

**Table 2.2: Comparison between gps module and gps in phone**

**Chosen Design:**

We chose gps module because:

1. it will be linked directly with the node
2. in the case of GPS in mobile it will be linked through the AGPS app
3. AGPS location isn't as precise as a true GPS location will be, but it's a good start, and the micro-adjustments that can be made with true GPS data when it refreshes makes up for most discrepancies.

- **Buzzer:**

There are many types of buzzer that can be used in our project to drivers alarm; the comparison is shown in the table2.3.

| Type / Comparison | Piezo Buzzer | Magnetic Buzzer |
|---|---|---|
| Start method | Piezo - electric effect | Electromagnetic effect |
| Size | Big (10-50mm) | Small (6-25mm) |
| Resonant Frequency | High (2-6KHz) | low (1-3KHz) |
| Operating voltage | High (9-24V) | Low (1.5-12V) |
| Sound level | Louder (85-120dB) | Lower (70-95dB) |
| Current consumption | Low (5-20mA) | high(35-60mA) |

**Table2.3: Comparison between Piezo Buzzer and magnetic Buzzer**

We chose Piezo Buzzer because it is available in various types and sizes to suit the requirements

- **Switch**

There are many types of switches that can be used in our project to detect accident; the comparison is shown in the table2.4

| Type / Comparison | **Limit switch** | **Pushbutton** |
|---|---|---|
| Size | Middle | Small |
| Efficiency | High | Low |
| The shape |  |  |

**Table2.4: Comparison between limit switch and pushbutton**

**Chosen Design:**

We chose limit switch, its more practical from pushbutton

- **Sensors to Detect accident**

There are many types of sensors that can be used in our project to detect accident; the comparison is shown in the table2.5

| Type / Comparison | **Vibration sensor** | **Flex sensor** |
|---|---|---|
| Cost | It is available for low cost. | It is expensive |
| How is work | The shock sensor was used to report the accident when value is zero | flex sensor depends on the angles of torsion |
| The shape |  |  |

**Table2.5: Comparison between vibration andflex**

**Chosen Design:**

We chose vibration sensor because it contains a  Potentiometer through which the calibration is Carrie

- **Temperature**

There are many types of temperature sensor that can be used in our project to sense the temperature in the event of an accident that causes fires, and it is used to alert passing cars. The comparison can be shown in table 2.6

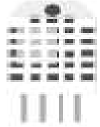
| Type / Comparison | DHT22 | DHT11 |
|---|---|---|
| temperature measuring range | -40 to 80°C / ± 0.5°C | 0-50°C / ± 2°C |
| sampling rate | 0.5 Hz (reading every 2 seconds) | 1 Hz (reading every second) |
| The ship |  |  |

**Table2.6: Comparison between DHT22 Buzzer and DHT11**

**Chosen Design:**

We chose DHT11,itis less expensive, smaller in size and has higher sampling rate. The sampling rate of the DHT11 is 1Hz.

- **MQ2 Gas sensor**

A **MQ_2 Gas** sensor using a simple voltage divider network, concentrations of gas can be detected. MQ2 Gas sensor works on 5V DC and draws around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 10000ppm.

It is used to sense smoke in the event of an accident-causing fires, and it is used to alert passing cars.

**Figure2.3: MQ_2 gas sensor, source [10]**

**Led**

LED Stands for "Light-Emitting Diode." An LED is an electronic device that emits light when an electrical current is passed through it. LEDs are commonly used for indicator lights (such as power on/off lights) on electronic devices.

**Chosen design:** In the event of an accident, the light was be lit to warn

**Figure2.4: led, source [11]**

## 2.5 software

A cloud server is a virtual server (rather than a physical server) running in a cloud computing environment. It is built, hosted and delivered via a cloud computing platform via the internet, and can be accessed remotely. They are also known as virtual servers. Cloud servers have all the software they require to run and can function as independent units [12].

Platform as a service (PaaS) platform-based service is a category of cloud computing services that provides a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app

Types of platforms that we can use and we will choose one:

- Blynk
  Blynk is a Platform with IOS and Android apps to control Arduino, Raspberry Pi and likes over the Internet. It's a digital dashboard where you can build a graphic interface for your project by simply dragging and dropping widgets. It's really simple to set everything up and you'll start tinkering in less than 5 mins. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choice. Whether your Arduino or Raspberry Pi is linked to the Internet over Wi-Fi, Ethernet or this new ESP8266 chip, Blynk will get you online and ready for the Internet of Your Things [13]

- Cayenne
  Cayenne is the world's first drag and drop IoT project builder that empowers developers, designers and engineers to quickly prototype and share their connected device projects. Cayenne was designed to help users create Internet of Things prototypes and then bring them to production.

  There are several major components in the platform:
  ● Cayenne Mobile Apps – Remotely monitor and control your IoT projects from the Android or iOS Apps.
  ● Cayenne Online Dashboard – Use customizable widgets to visualize data, set up rule.
- **Cayenne vs Blynk:**

1. Blynk is more complicated and suitable for those who want to write code for functions whereas Cayenne is simple to use and no need for programming or writing codes.

2. User interface is small in Blynk and difficult sometimes, whereas Cayenne has a good user interface and is easily configurable.

3. Cayenne provides a very easy triggers / rules engine whereas Blynk does not provide a simple way to create triggers

4. Cayenne provides scheduling whereas Blynk doesn't

5. Cayenne is more suitable for beginners whereas Blynk can be extensively used for high end IoT projects using writing your own code.

What is IFTTT?

IFTTT derives its name from the programming conditional statement “if this, then that.” What the company provides is a software platform that connects apps, devices and services from different developers in order to trigger one or more automations involving those apps, devices and services and you can connect all your "services" together so that tasks are automatically triggered and completed. There are numerous ways you can connect all your services - and the resulting combinations are called "Applets".[14]

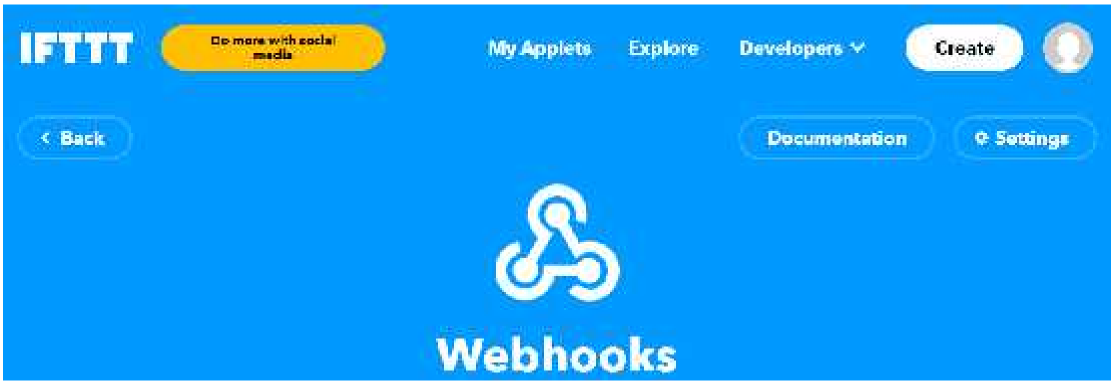



**Figure2.5: IFTTT Web Server, source [15]**

**Webhooks**

Webhook is a simple and flexible way to send data from your Particle devices to other apps and services around the Internet. Webhooks bridge the gap between the physical and the digital world, helping you get your data where you need it to be.

You could use a webhook to save valuable information in a database, visualize data being read from a sensor, send the latest weather report to your device, trigger a payment, send a text message, and so much more!.[16]

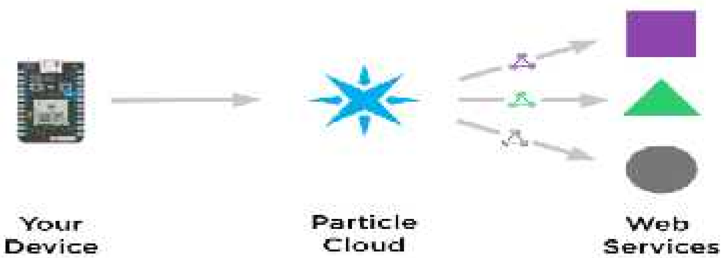



**Figure2.6: Webhook, source [16]**

# Chapter 3

## System Design

### 3.1 Overview

This chapter discusses the conceptual design of the system, it shows the system requirements, a block diagram of the system, pseudo code, flow chart, detailed design, schematic diagrams.

### 3.2 Detailed system description

Initially, we designed a network consisting of a set of Nodes / MCUs connected together through the access point. We put one node / MCU on the street and two in the cars. The first node in car 1 is connected to some sensors: vibration sensor if the shock value is greater than the threshold, so an accident has occurred. It is also connected to the Global Positioning System (GPS) that determines the location and speed. pushbuttonto detect accident when the value became one, and buzzer will sound if the speed is excessive. The second node in car 2, it is receiving SMS to change route if nearby to accident location.

the third node is on the street it is connected to DHT and smoke sensors, it used when fire on the street noticed because of an accident or other reason, and buzzer to alarm for the danger on this street and sends SMS to car1 and 2 in order to change their routes if they are nearby thisdanger.

So, our system provides some services such accident detection, changing routes, alarming drivers to decrease speed, electronic violation when they over speeding and detect fire.

**Normal behavior in the system**

1. Cars move in the street normally, the sensors connected to the nodes are reading every second.

2. Nodes are on the way to provide the Internet.

3. The readings are sent to the platform for storage.

4. The system continues reading and updating the information and comparing the current reading with the previous one to check the system's status.

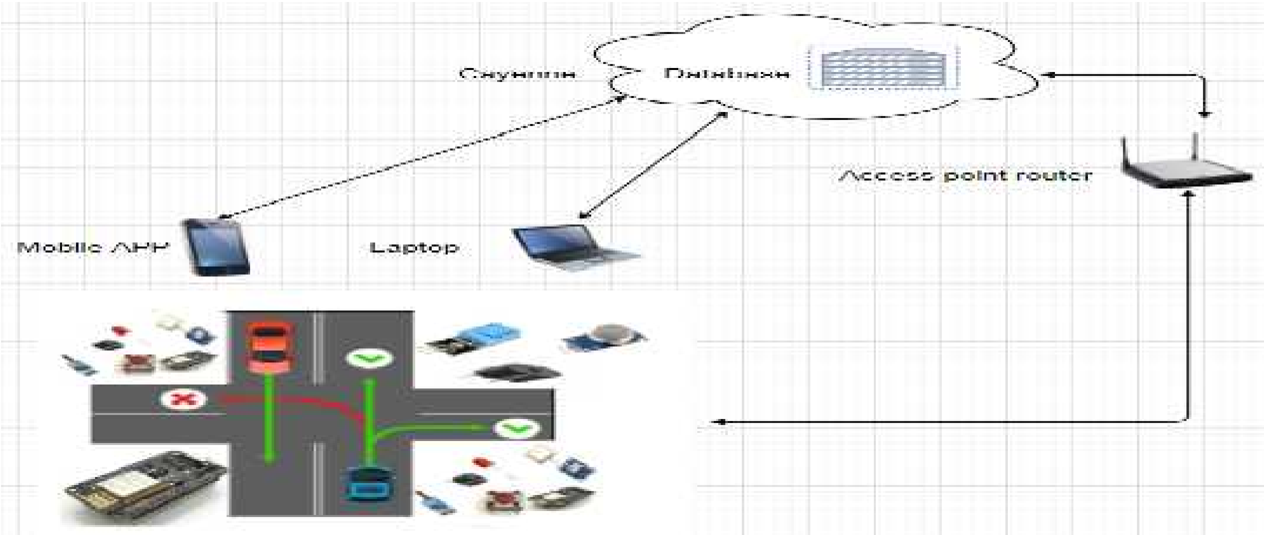



**Figure 3.1system description**

**Abnormal scenarios in situation:**

Cars moving on the street, and while they are moving, they are exposed to some events such accident, over speed:

**1. In the accident case**

While the car is walking on the road it collides with another car, the state of shockchanges, at this moment the system detects the accident through this step:

- The readings are stored in the cayenne database.
- The system compares values
- If the states of shock ·or pushbutton 1 it sends a message or:
  - To ambulance about the accident with the exact location.
  - To the nearby cars to change the route.

**2. In case of speed excessing**

- The GPS calculates speed and stores it in a cayenne database.
- Compare it to the legal speed of the street.
- If it is larger than legal speed.
- It alarms the driver to decrease speed through on buzzer and send electronic violations (SMS).

**3. In case of burning**

- The readings are stored in the cayenne database.
- The system compares values
- If notice the value is greater than threshold it sends a message.
- To the nearby cars to change the route.
- Running buzzer

### 3.3 Block diagrams

The First block figure 3.2

That consists of the main bond of the process that is an interface diagram containing the database and smartphones and interfacing devices connected to the Cayenne server.

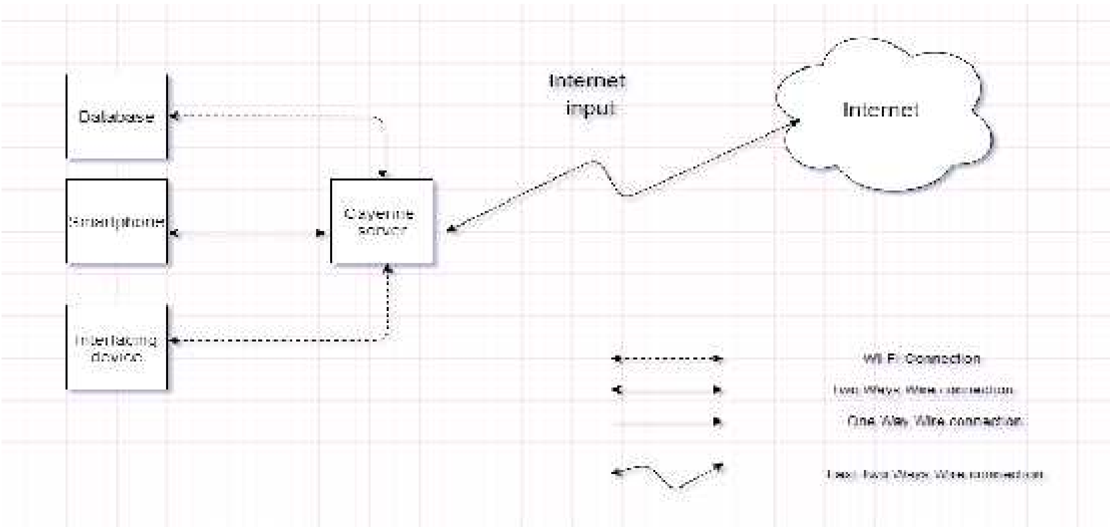



**Figure 3.2 Block of interfaces diagram and Connection symbols**

The Second block figure 3.3:

Contains an IoT controller 1 as ESP8266 on WeMos D1 module with connected gadgets:Buzzer, GPS,Led ,accident button and vibration sensor, and shows the processing unit in the controller that will manage all signals.

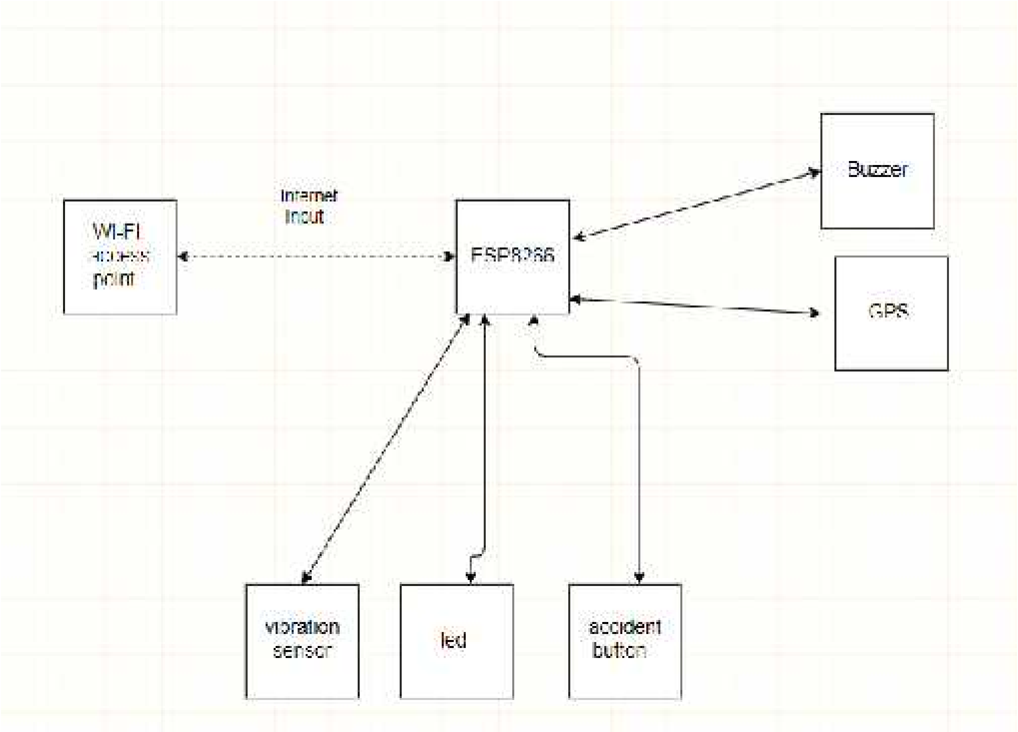



**Figure 3.3 Block of IoT controller in car (1) with connected gadgets**

The third block figure 3.4:

ContainsIOT controller 2 as ESP8266.

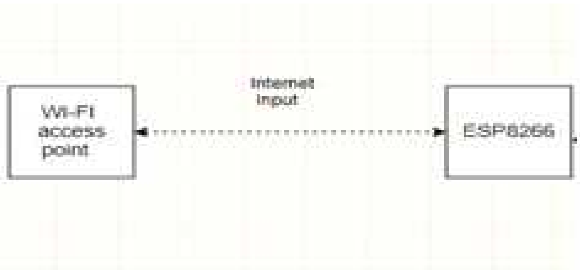



**Figure 3.4 Block of IoT controller (2) with connected gadgets**

The Fourth block figure 3.5:

Contains IoT controller (3) as ESP8266 with connected gadgets that control outputs: temperature sensor (DH11) and smoke sensor (MQ_2).

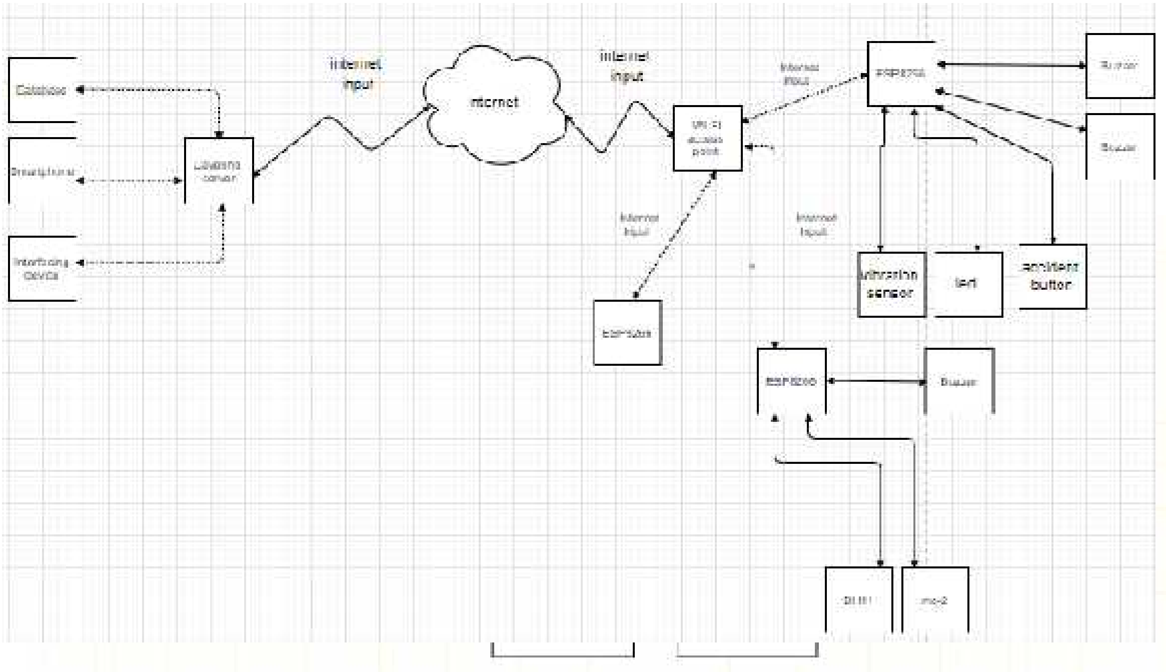



**Figure 3.5 Block of IoT controller 3 with connected gadgets**

**Figure 3.6 An aggregate diagram of the system**

**Notice:**

-The first car on the road (IOT controller1)

-The second car on the road (IOT Controller2) Street (IOT controller3)

### 3.4 Flowchart

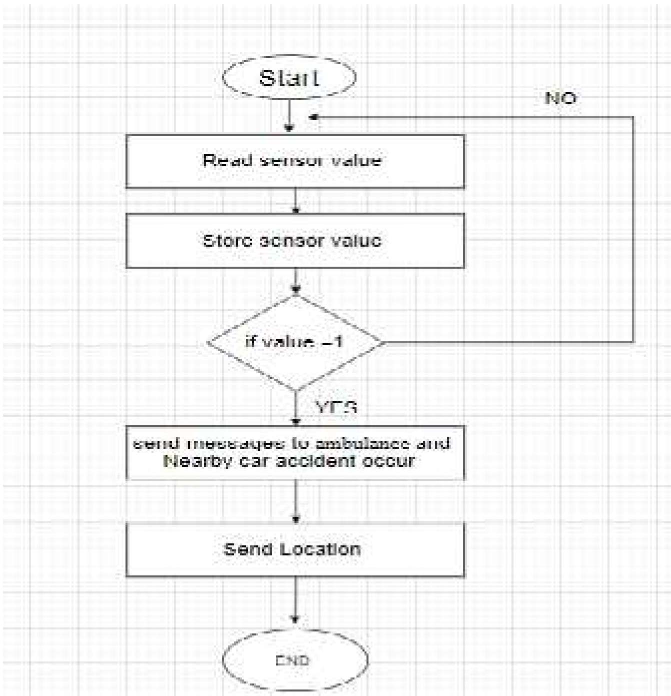



**Figure 3.6 represents the flowchart of Accident detection.**

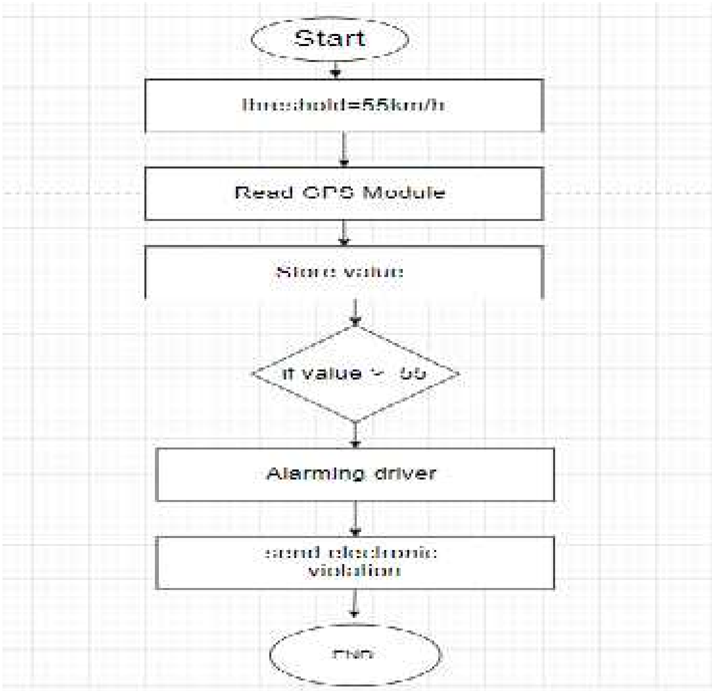



**Figure 3.7 represents the flowchart of electronic violation when speed excessing**

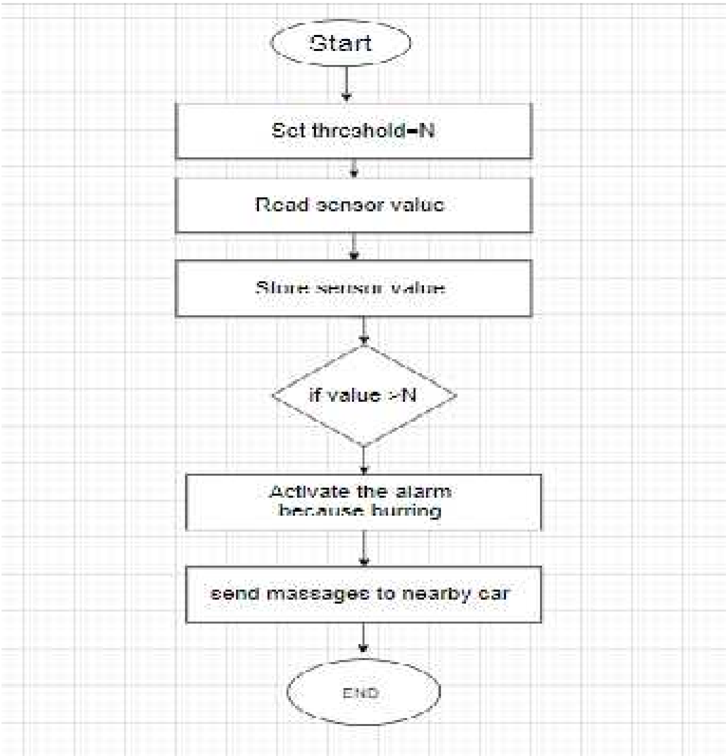



**Figure 3.8 represents the flowchart of street**

### 3.5 pseudo code

- **Accident detection**

Read sensors value

Store sensors value

If (value of push button == 1 or value of vibration == 0)

THEN

Send a message to the ambulance

Send a message to the nearby car

Send location

Else

Read sensors

ENDIF

- **Accident detection (by using smoke sensor and temperatures sensor (burning sensor)**

Initialize threshold = N // depend in the area

Read sensor value

Store value

If (value >=threshold)

THEN

Run buzzer

Send messages to nearby cars

ELSE

Read sensor

ENDIF

**Detailed information**

***Speed = distance / traveled time***

***In Speed Exceeding case***

- Getting the speed by using TinyGPS++ library. This library makes it simple to get information on location and speed in a format that is useful and easy to understand. We while use this function to get speed (gps. speed. Value ());
- Threshold It represents the maximum speed within cities according to the Ministry of Transport and Communications in accident case

## 3.7 Schematic diagram

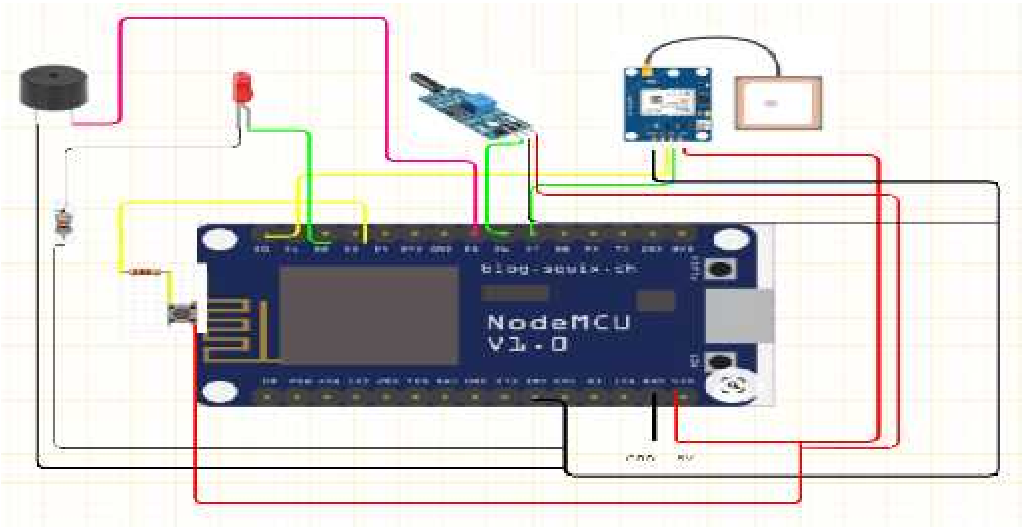



**Figure 3.9 Schematic diagram through Block Diagram**

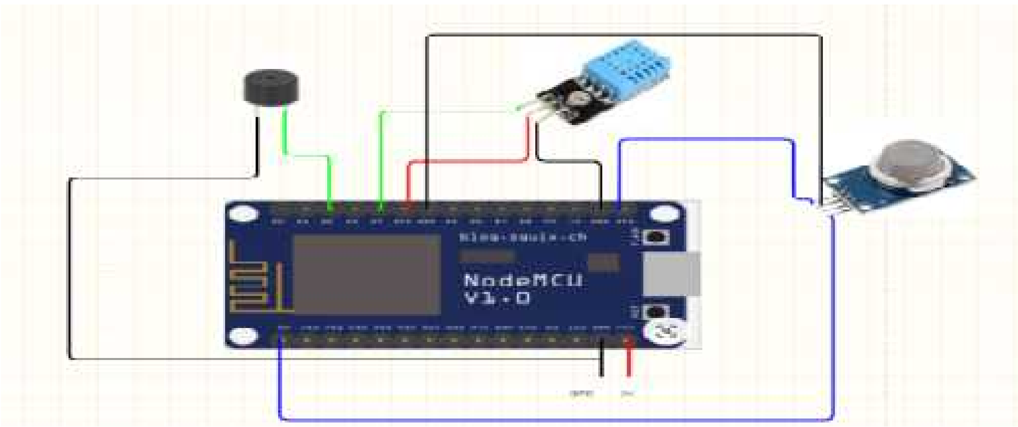



**Figure 3.10 Schematic diagram (Street node) through Block Diagram**

## Chapter 4
## Software and hardware implementation

### 4.1 Overview

This chapter describes the project software and hardware implementation as well the different components and tools used to build our project smart cars and streets.

### 4.2 Software implementation

**- Esp8266Software (Arduino IDE)**

Installing ESP8266 Board in Arduino IDE. The code of all sensors interfaces is written through many functions and libraries in Arduino IDE. We need to download Tiny++Gps and Software Serial for Gps in order to detect location**.**

**-Cayenne platform**

Cayenne is the Main platform that runs the system. It supports any browser application, Android system, and IOS Apple mobile smartphone system. **Figure4.1**

**Figure4.1: cayenne application**

**To start to cayenne, we need to log in, This Web site to login: Start | my Devices Cayenne . after clicking enter username and password. figure 4.2**


**Figure 4.2: cayenne log in**

The Menu Bar shows the devices list figures and each connected widget. Figure 4.3.


**Figure 4.3 devices in cayenne**

First tap Monitor the car1 that contains allsensor's values Figure 4.4


**Figure 4.4sensor's valuesof car1**

Second tap car 2 **Figure 4.5**

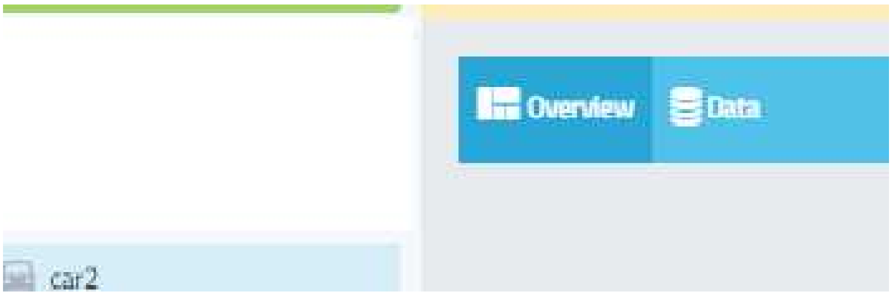



**Figure 4.5 car2**

Third tap Monitor Street that contains all sensor's values **Figure 4.6**

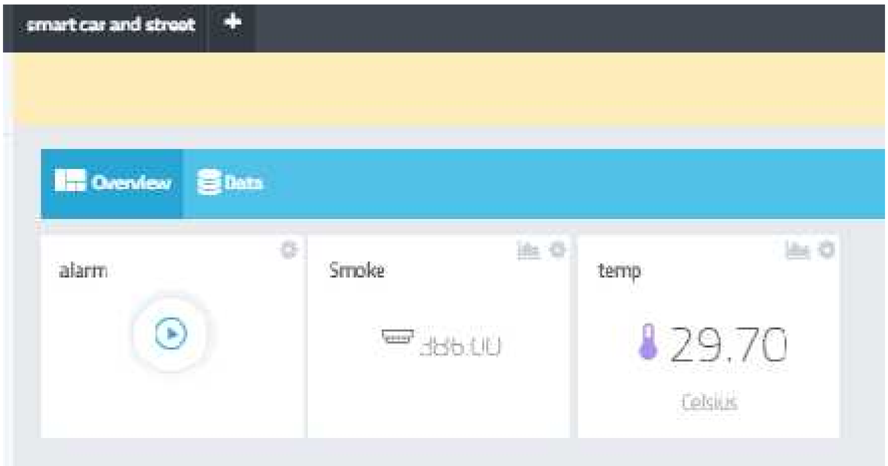



**Figure 4.6sensor's valuesof car1**

**Cayenne webhook**

UsingCayenne webhook trigger feature, we will send a custom a message notification to the mobile, we will be also using IFTTT for this

-Steps to create webhook:


Figure 4.6 create webhook _ 1

Figure 4.7 create webhook _2

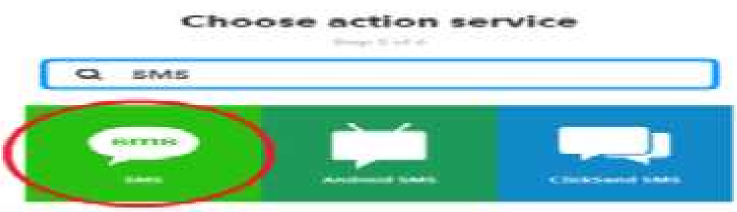




Figure 4.8 create webhook _3


Figure 4.9 create webhook _4


Figure 4.10 create webhook _5

The Cayenne application allows creating triggered actions on and between your sensorsbased upon the state devices, simply put if a trigger event happens, then a resultingaction happens, as the If statements in programing language algorithms,to show triggers and alerts, press on the Trigger and Alerts button. Figure 4.11.

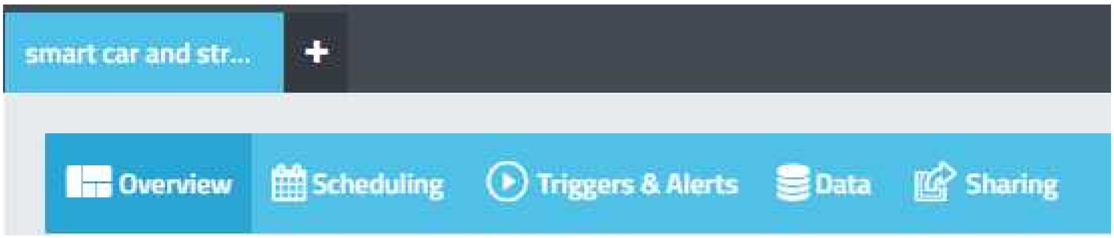



**Figure 4.11: Trigger and Alerts button**

Triggers List shows up with all the events that were made, and it is available to deactivate,check or edit. Figures 4.12, 4.13.

**Figure 4.12, 4.13: Triggers**

**The Triggers where listed are:**

If accident occurs then sends a webhook message

If accident occurs then lights a led

If over speeding then sends a webhook message

If over speeding then runs a buzzer

If there is a fire then sends a webhook message

If there is a fire then runs a buzzer

### 4.3 Hardware implementation

- **The first microcontroller is WeMos D1 (car1)**: We connect the other system components well as follows:

1.**Vibration sensor**: We connect the WeMos D1 with the vibration sensor inside the first car and install it

**Result:**

The vibration values of this sensor are updated with the stored value. If the value equals zero an accident occurs, so send messages to ambulances and to nearest cars changing the route.

2.**Buzzer:** We connect the WeMos with the buzzer in the first car and install it inside the car

**Result:** When the vehicle speed increases above the appropriate speed, a buzzer sounds in order to warn the driver to reduce the speed.

3.**GPS:**We connected the WeMos with a GPSto the first car and installed it inside

**Result:** using gps, we get the location of the car and speed.

4.**pushbutton:** We connected the WMOS with two pushbuttons placed at the front of the car from the left and right.

**Result:**

The Accident button, if the value equals one an accident occurs, so send messages to ambulances and to nearest cars changing the route.

**Led:** We connected the WeMos with the light in the first car and fixed the led at the top of the car.

**Result:** If accident occurs, led will light.

- **The second microcontroller is WeMos D1 (car 2)**

It's not connected with any hardware components,it put to test changing the route when accident occurs.

- **The third microcontroller is WeMos D1 (street): We** connect the other system components well as follow:

  1. **Temperature sensor:** We connected the third WeMos D1 with the temperature sensor on the road

**Result:**

It is used to detect a fire resulting from an accident or any other reason. When the temperature rises above the threshold (there is a fire), a message is sent to cars to change route and avoid danger**.**

  2. **Smoke sensor:** We connected the second WeMos with the gas sensor in order to detect any smoke in the street**.**

**Result:**

It is used to detect a fire resulting from an accident or any other reason. When the smoke rises above the threshold (there is a fire), a message is sent to cars to change route and avoid danger.

3**. Buzzer:** We connected the second WeMos with the buzzer on the way.

**Result:** When a fire breaks out, an alarm is given.

### 4.4 Issues and challenges

#### 4.4.1 Hardware Issues and challenges

During the implementation of the project, we encountered many obstacles, and problems, these problems were as follows:

**1.GPS:** One of the most important problems was lack of quality of the gps chip and the large number of defects in them. We bought many chips that were not usable and the signal inside the house was weak.

**Solution:** We have purchased a more accurate and quality piece

**2.pushbutton:** difficult to press.

**solution:** buy another kind of chip, easy to press.

### 4.4.2 Software Issues and challenges

- **Cayenne notification**: Messages are unclear, do not serve the project, and cannot change content of message figure 4.9.


**Figure 4.14: cayenne notification**

**Solution:**

Using the cayenne webhook trigger feature, we sent a custom message notification to the mobile. we also used IFTTT for this**.**

### 4.5 testing

### 4.5.1 Hardware testing

- GPS test:

Initially, we tested the GPS and connected it directly to the ESP8266 as shown in Figure 4.15, to make sure that it is working and the coordinates appear on cayenne.

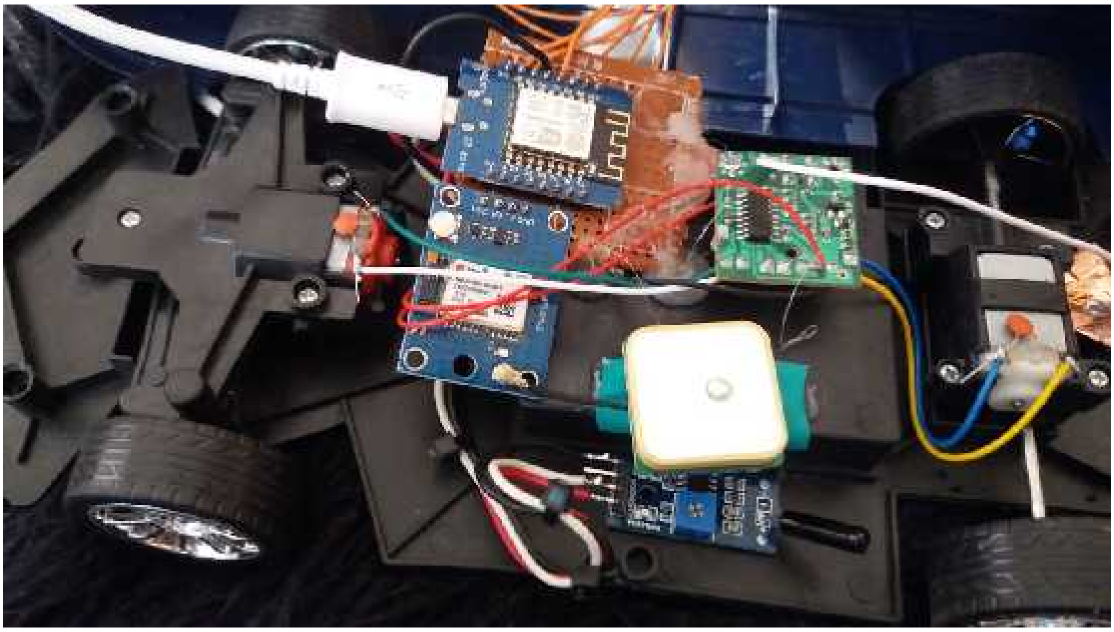


**Figure4. 15: Test of GPS**


**Figure 4.16: Result of GPS**

- **Vibration sensor test:**

At the beginning, we tested the vibration sensor and connected it directly to the ESP8266 as shown in the figure 4.17, when one of its lights (not shocked), the value is one. when two lights (shocked), the value is zero shown in the figure4.18.

**Figure4. 17: Test vibration**


**Figure4.18: Result of vibration sensor**

- **Buzzer testing:**

At the beginning, we tested the buzzer and connected it directly to the ESP8266 as shown in the figure. To make sure it works and activates it on the platform as shown in the figure 4.19.


**Figure 4.19: Result of buzzer**

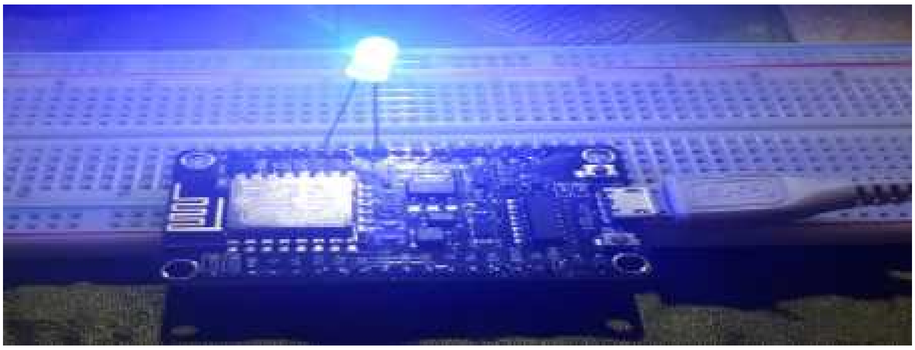


**Figure4. 20: Test led**

- **Led Testing:**

At the beginning, we tested the led and connected it directly to the ESP8266 as shown in the figure 4.20, To make sure it works and activates it on the platform as shown in the figure 4.21.


**Figure4.21: Result of led**

- **accident button testing:**

At the beginning, we tested the accident button and connected it directly to the ESP8266 as shown in the figure, and activated it on the platform as shown in the figure 4.22.

**Figure4. 22: Test accident button**


**Figure4.23: Result of accident button**

- **Temperature sensor testing**: At the beginning, we tested the temperature sensor and connected it directly to the ESP8266 as shown in the figure 4.24, The appearance of the temperature value on the cayenne pad is shown in the figure 4.25

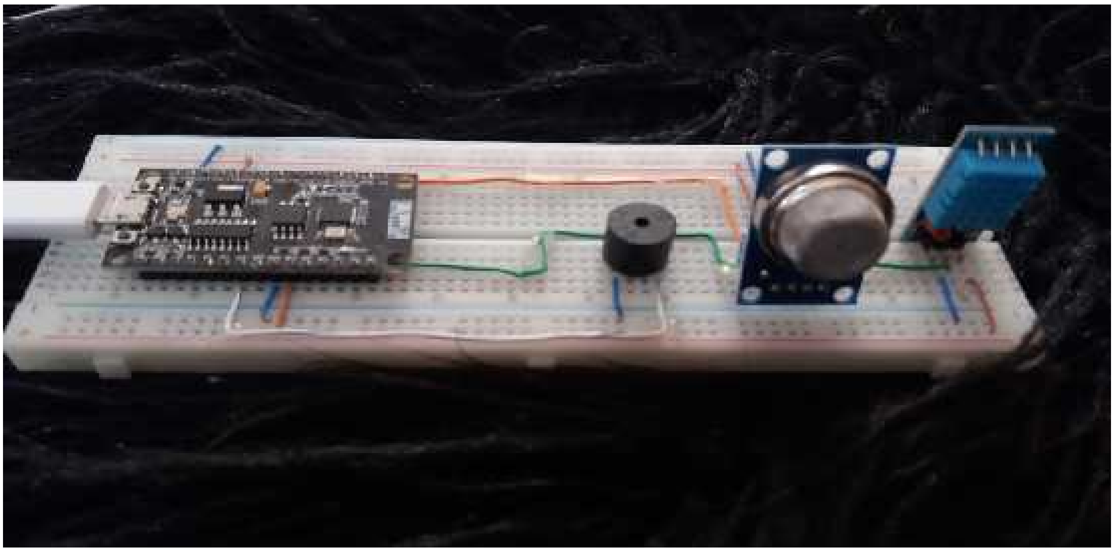


**Figure4. 24: Test temperature sensor**


**Figure4. 25: Result of temperature sensor**

- **Smoke sensor testing:**

At the beginning, we tested the smoke sensor and connected it directly to the ESP8266, the appearance of the smoke value on the cayenne platform is shown in figure 4.27


**Figure 4.26: Test smoke sensor**

### 4.5.2 System Testing

**A. Accident detection Test:**

To check the Accident detection, we installed the sensor on the car vibration sensor and gps inside the car and pushbutton (accident button) on the front of the car left and right, so when the reading of vibration becomes zero and reading of push button becomes one, sends messages to police and nearby cars.

**Results:**

The system responds to changing reading, so it sends messages to police and nearby cars, containing (number of cars, time, and Ip address to get on map when clicking it).

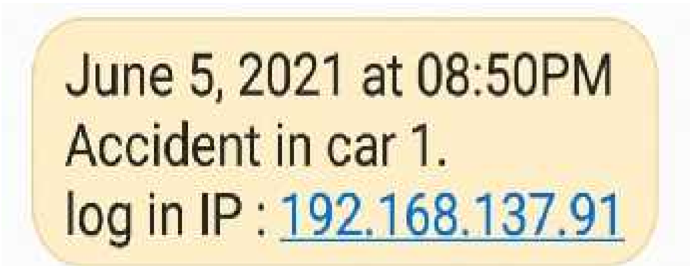



**Figure 4.27 massage of accident detection**

**Figure 4.28 map contain location of car**

**B. speed testing**

To check the over speeding, we installed the gps inside the car and buzzer, when the reading of speed is greater than 55 the buzzer runs and sends electronic violation to the driver

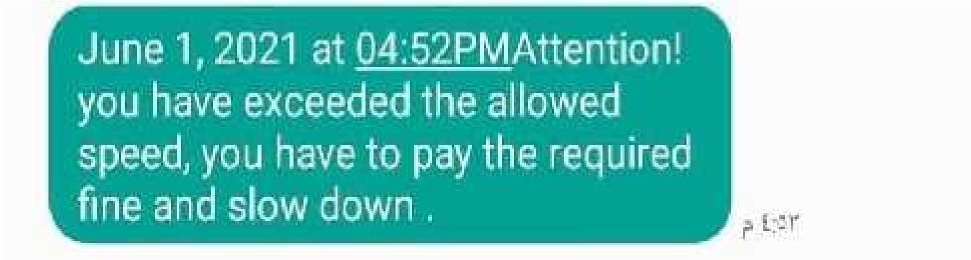



**Figure 4.29 massage of over speeding**

**C. detect fire testing**

To check the firing, we installed the DH11 sensor and smoke inside the street and, when the reading of temperature is greater than 55, or smoke is greater than 600 sends a message to nearby cars to change route.

**4.6 Implementation Results**

At the end of the implementation process, we combined all the components together to get the final look of the project. We connected some sensors with esp8266 (vibration sensor, buzzer, led, gps, and pushbutton) in car 1.

In the street we connected some sensors with esp8266 (DH11, MQ smoke, andbuzzer).

The final connection of the system is shown in Fig.4.12

**Figure 4.30: Test for all system**

## Chapter 5
## System analysis and Discussion

### 5.1 Overview

This chapter introduces analysis and discussion about the results and error rate of the systemanalysis.

The system read   storing and updating sensors in the database, and displays reads in user interface to monitor the cars and street. using trigger to deal with issues happened in car or street like accident occur or over speed**.**


**Figure 5.1 :Testing**

### ٥.٢ Analysis and discussion about the results

#### 5.2.١Accident reporting test

The car moving in street, When the car collides with car or wall shock value became zero and if collision right side or left on front car the value of push button becomes one, so in this case accident happened we will be receiving messages about it shown in figure The performance was tested several times in the specified test environment and the result was recorded in thetable5.1

**Figure 5.2: Collision case**

### 5.2.2 over speeding result

As a result of over speeding

Car moving using remote control in the street, store speed in a database when driver increase speed, run a buzzer to reduce speed because over speeding causes accidents, and send electronic violations. The performance was tested several times in a specified environment and the result was recorded in the table5.1

**Figure5.2: over speeding**

### 5.2.3Combustion result

In the street we tested burning through a fire in a safe area, and if the value was greater than threshold, messages were sent to nearby cars, as shown in the figure 5.3, and run a bazaar. The performance was tested several times in a specific environment. The test was recorded and the result was recorded in table 5.1.

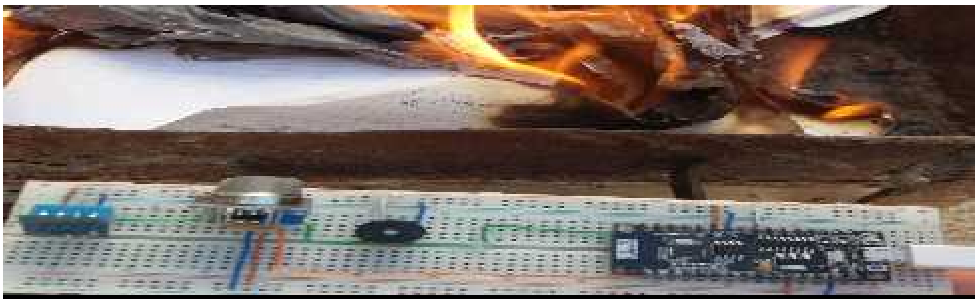


**Figure 5.3: smoke in street**

**Table 5.1: Test results for the system**

| | **1st Test** | **2nd Test** | **3rd Test** | **4th Test** | **5th Test** | **6th Test** |
|---|---|---|---|---|---|---|
| **Detect accident** | Fail | Success | Success | Success | Success | Fail |
| **Over speeding** | Success | Fail | Success | Success | Success | Success |
| **Combustion** | Success | Success | Success | Success | Success | Success |
| **All cases** | Success | Success | Success | Fail | Fail | Success |

According to the records in the table, we calculated the success rate of the system. First, the success rate in detect accidentwas 80%. Second, we calculated the overseedingsuccess rate. It was 90%. Then we calculated the test success rate for combustion, and it was 100%. Finally, we calculated the success rate of the entire system when it was working in accident reporting, burning reporting, over speeding, etc., and it was 90%. Therefore, the total pass rate for all of the system was 80% and the overall error rate was 20%.

**Success Rate = summation of success rate / number of experiment times.**

**Error Rate = summation of Error rate / number of experiment times**

Why is the Fail?

in the event of a collision, there was a failure in certain cases because the intensity of the vibration was not high, as was calibrated using the potentiometer.

in the event of exceeding the speed, the speed was not high enough to give a result, and there are cut wires and disconnected electric

## Chapter 6

## Conclusion

### 6.1 Overview

This project is to design and produce smart cars and streets using some sensors and switches. At this level, hardware components, software tools and design are explainedMovement of the car in the street. Are tested and results are discussedDespite the implementation issues. System detects an accident, over speeding, combustion and sends a message to alert them and turn on a buzzer and led.

**According to the goals of our system, we achieve these results:**

1- The system is able to detect the accident.

2- The system is able to report the accident.

3 The system is able to warn the driver when they are speeding and tell nearby cars to change their route to reduce the danger.

4- The system turns on a car's light when an accident occurs.

5- The system is able to detect fires through smoke and heat, and send a message to nearby cars to move away from the area.

### 6.2 Challenges

We faced many challenges that impeded the progress of our project and prevented us from performing it as its best.**<u>These are the main ones:</u>**

- Difficulty in finding a sensor capable of detecting the accident, many sensors were tested and examined to ensure that they could detect the accident, this step was the biggest obstacle for us.
- The accident buttons were not an effective solution to be a successful evidence of an accident, so we had to use a vibration sensor, the vibration sensor doesn’t support the analog.

### 6.3 Recommendations and future action:

Since our project is a model, it can be checked using the car's remote control to manually increase its speed and make it hit another car or a wall to see the results. We hope that the project will be implemented on the ground by making subscription fees for the driver, to take advantage of the services we also hope that the new students will develop the project and treat as many cases as possible.

1-We recommend using Wi-Fi because the project is based on the use of Wi-Fi, we would like to support it when doing the experiment, it is better to use cars that run on electricity to quickly touch the different speeds to cover all possibilities to get the results that are apparent to them.

2- It is recommended not to specify a specific area or a specific meter for experimenting, but rather with unlimited distances and for indefinite distances to facilitate the behavior of alternative paths in the case of our collision in the model Energy must be supplied by the battery to operate the nodes (ESP8266).

3- It is recommended to fix the parts by welding and not just on the board; because when testing the accident, it may slip away Beware of improper use of all parts especially parts of the locator (GPS).

## Reference

**[1] Introduction to Microcontrollers (2018), Available at: [What is a Microcontroller? A Look Inside a Microcontroller | Arrow.com | Arrow.com], Accessed [8/9/2020]**

**[2] Legal Status in Palestine (2018), Available at: [http://lawcenter.birzeit.edu/], Accessed [8/9/2020]**

**[3] Digital Roads ," Digital Roads – Observation and Serving", PPU, Y . Aljuneidi, S.Alqadi, H.Manasrah (2014).**

**[4] Accident Detection and Alert System using Arduino(2017), Available at: [Engineering Projects], Accessed [15/9/2020]**

**[5] Traffic Light Monitoring System based on NodeMCU using Internet of Things," IOP Conference Series Materials Science and Engineering ", July 2018, DOI:10.1088/1757-899X/384/1/012024**

**[6] Internet of things (IoT)(2020),Available at [ https://internetofthingsagenda.techtarget.com ], Accessed[10/11/2020]**

**[7] Wireless Sensor Networks," Overview of Wireless Sensor Network ", INTECH, (pp.1-22), Mohammad A. Matin, September 2012**

**[8] Wireless Sensor Networks (2020), Availableat: [ "https://www.bing.com/images/search "], Accessed [10/11/2020]**

**[9] MQTT (2020), Available at: [ "https://www.bing.com/images/search "], Accessed [14/11/2020]**

**[10]MQ_2 gas sensor (2019), Available at [" https://www.google.com/search"], [ Online; accessed ٤/٢/202١].**

**[11] led (2019), Available at [" https://www.google.com/search"], [ Online; accessed 6/1٢/2020].**

**[12] cloud server (2018), Available at [" https://www.probrand.co.uk/"], [Online; accessed 20/11/2020]**

**[13] Blynk (2021), Available at ["Blynk IoT platform: for businesses and developers"], [Online; accessed 20/11/2020]**

**[14] IFTTT APP (2021), Available at [ " https://www.computerworld.com/"], [Online; accessed 12/3/2021]**

**[15] IFTTT (2021), Available at [" https://www.google.com/search"], [ Online; accessed 12/3/2021].**

**[16] WEBHOOK (2021), Available at ["https://docs.particle.io/tutorials/device-cloud/webhooks/]", [Online; accessed 7/3/2021]sss**