Palestine Polytechnic University

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Graduation project

security and safety system for car

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اهداء

نقف احيانا على تلك المفترقات ، تلك النهايات البدايات، نقف لنأخذ استراحة مما فات وشحذ الهمم لما هو أتٍ ، نقف ونأخذ نفساً عميقاً مُعلنين اننا طوينا صفحة كتبنا فيها الحرف الأخير ، وها نحن على وشك ان نبدأ صفحة جديده لنخط فيها الحرف الأول .

ولكن أليس لصاحب القلم المُتعب دقيقة يتأمل فيها ما كتب ، دقيقة يعيد القراءة من البداية ليمر بكل ما كان وحدث ، ليبتسم على كل موقف ، لترتسم في عينيه نظره احترام لكل دمعة ، ليتذكر اؤلئك الذين لا يعلم بعد كيف يقابل ما صنعوه له ومن أجله، فيكتفي بكلمة شكر يتمتمها بهدوء خجلاً من ضألتها في مواجهة ما اعطوه وله قدموه.

كم انا متعبة ومرهقة من كل ما مضى ، ولكن لكم على حق لن يوفيه الحبر الجاف على الأوراق .

والداي العزيزان ،خلافاتنا كان كثيره فقد علمتماني ان اكون مختلفة ، ولكن لم ينهاكما ذلك عن دفعي للأمام ، ولم يوقفكما اختلافنا عن حبي المطلق بلا شروط او احكام ، اليوم انهي حلماً كان لكما النصيب الأكبر فيه ، فاسمحا لي ان أُصرح لكما بأن اياً من هذا ما كان لولاكما.

معلميني الكرام ، واقصد كل من مر علي يوماً وعلمني لأكون كما أنا اليوم ، أقصد اؤلئك الذين حركتهم ضمائرهم ليبذلوا كل ما أوتوا لأجلي وأجل الاخرين ، كلمة الشكر والعرفان لا تجزيكم حقكم ، ولكن لكم عند ربكم أضعاف مضاعفة مما نحمله لكم من حب واحترام، رجائي كونوا دائماً كما عهدناكم فالدنيا ليست كما الدنيا لولاكم.

صديقاتي. يا سكر حياتي يا من كنا كالأخوات بالأتراح قبل الأفراح ،لا املك لكنَّ الا دعوة صادقة بأن تَرينَ فرحة بمقدار الفرحة التي خلقتها بداخلي بل وأكثر.

شريكي الآن وبكل ما هو قادم ، ليس في الكلام ما قد يُقال فما زال الطريق امامنا طويل وما زال لدينا الكثير لنشارك به ، واملي أن تكون كما كنت دائماً .

اخيراً وليس آخراً الى من لا يسعفي المقام ان اذكرهم بالأسماء ، الى الذين كانوا كالجنود المجهولين في حياتي ، لكم مني خالص المحبة والاحترام ، وعرفان ليس كمثله عرفان ، على كل ما قدمتم وكل ما منكم كان.

منار عمرو

ABSTRACT

Ther increasing number of cars every year causes many problems, which affects the life of people everywhere, and increase the need of more and bigger parks, and more time is needed to find a place for a car to park.

Our project is proposed to find solutions to decrease the effect of this problem in our society. The idea of our project is to make Automatic Parking System (APS) for drivers to book the suitable place for their cars before they arrive, which save time, money and effort. Our system is based on sensors to detect the available space, microcntrollers to manage park slots, and gates, and a Zigbee network to connect with a server. The server is connected with a modem to communicate with mobile devices and billing service.

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Chapter 1

introduction

1.1 overview

This chapter is the introduction for the project, which describes the general idea of the project; it also contains the project motivations and project scope.

1.2 Project Idea Description

Nowadays, the number of stolen vehicles in the world are increased, either because of inefficient alarms used in the vehicles, or because of increasing skills of car thieves that can beat the vehicle alarm and securing systems. Because of this, and in order to keep our cars safe we need a security system using technology tool such as mobile security system for vehicle to save vehicles, so by using this technology we can keep our vehicle safe .

Our project depends on face recognition in order to identify the person who drive the vehicle ,we will build a hardware controlling system using Microcontroller which will communicate with sensors in the vehicle and a laptop all this component will be connected with each other in an appropriate way.

1.3 Motivation

This project mainly aims to improve safety and security systems for the vehicle using mobile, in order to reduce the number of stolen vehicles in the world.

There are several benefits from the project:

- Control the safety of the car .

- Improving safety in vehicles and automobiles, especially in case where children are lifted alone.This is important because of what has happened in the sad accident in Tarqumya before few months ,four girls were strangled inside a closed vehicles.
- Improvement of vehicle securing by using the image processing for the vehicle owner to enable or disable the engine .

1.4 Project scope

- **Context:**
  Our project is an integrated system with vehicle components and systems.
- **Input and output information:** The input will be a motion, whether around the car or inside the vehicle.
  The output will be:

  1. Quick response by sending a message to the car's owner .
  2. The unauthorized driver's face image using face recognition technology, to disable the engine.
  3. Operate a ventilation motor in the vehicle .
  4. Activate the braking system.

- Functions:

  1. Disable vehicle engine or enable in case of a risk.
     (a) By using image processing for vehicle driver if it does not match his face the engine will not start.
  2. Activate brakes in case there is no driver inside the vehicle (the vehicle in the parking).
     (a) When the driver is outside the vehicle the load cell strain gage will give a signal that the driver is not on the driver seat, so the brake actuator will be activated to activate the brakes.
  3. Take a picture for the driver.
     (a) Take a picture for the driver.
     (b) Compare it with the number of images stored on the laptop.
     (c) If that image was not identical with any of the stored images, the system will disable the vehicle engine.
  4. Start a ventilation motor in the -vehicle.
     (a) Two sensors well detect if there is anyone in the vehicle while the vehicle in the parking case to prevent suffocation.

Chapter 2

Theoretical Background

2.1 overwie

In this chapter, we are going to talk and define the techniques used in our project and about the literature review.

2.2 Theoretical Background

2.2.1 Bluetooth

Bluetooth is a wireless instrument for exchanging data over short distances (using short wavelength radio transmissions) from fixed and mobile devices. Silver works as a serial (TX/RX) pipe. Any serial stream from 9600 to 115200bps can pass seamlessly to the target. The Bluetooth Module signal pins of TX and RX are 3V to 6V tolerant, so there will be no level shifter or level translator for connection to microcontroller. This device has two modes; command mode and data mode. While in command mode, all incoming data were commands (AT-Command). Hence, in data mode, this Bluetooth will transfer all data from source to target. Mostly, all data mentioned here were texts or ASCII codes where it commonly used in this project. [1]

Reliability

Reliability is concern with robustness of the protocol .the Bluetooth technology implements three techniques to ensure the protocol reliability: frequency hopping code division multiple access (FH-CDMA) .Error correction and received signal strength indicator (RSSI).

In brief, (FH-CDMA) minimizes the possibility of interface within the Bluetooth network as well as with other radio-link systems such as Home-RF, microwave etc. Error correction ensures the validity of the data using forward error correction (FEC) and packet re-transmission. RSSI reduces the power conception foe radio wave transmission by determining the appropriate power

needed for the satisfactory communication between a pair of nodes. These reduce the occurrence of transmission collision so that performance degradation minimize. [2]

Speed

Bluetooth wireless technology facilitates high-quality voice and data transmission. It's designed to be fully functional even in very noise environments, and it's voice transmission are audible even under noisy conditions .it provide transmission speed 1Mpbs and it aggregate capacity handle up to three voice channels simultaneously, the asynchronous channel can be support maximal 723.2 Kbps asymmetric or 433.9Kpbs symmetric. [2]

Power

Bluetooth technology put a limit on the radio transmitters output power according to the demands of the specific connection. Bluetooth receivers with the help of RSSI can determine the approximate transmission (golden transmit power) to be used by transmitter , this information exchanged and used by the transmitter to alter it power level dynamically ,thereby enabling enhanced control over power consumption. [2]

Security

Basically, Bluetooth is a technology that provides wireless communication solution between devices . It's three build-in features provide for secure data and/or voice transmission, authentication, encryption and transmission level security.

- The authentication processes prevent undesirable access to data transmitted. It also prevents falsifying of the message originator.
- Encrypting the data to sent over-the-air (OTA) eliminates possible eaves-droppings. Decrypting of such data requires an appropriate key.
- * The possibility of eaves-droppings is further prevented by use of frequency hopping spread spectrum and limited transmission rang. [2]

2.2.2 Arduino

Arduino is a tool for making computers be able to sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicated with software running on your computer (e.g.

Flash, Processing, MaxMSP.) The boards canassemble by hand or purchased preassembled.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, whichisbased on a processing multimedia programming environment. [3]

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing).

The simplest Arduino platform is the Uno. This model supports 13 digital input/outputs along with 6 analog inputs. It can run off USB power or via an external "wall wart" power supply. The onboard microcontroller supports up to 32K of program code with 2K of RAM. This may not seem like a lot, but in 8-bit microcontroller terms,it is probably more than most prototypes need. Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, MaxMSP).The Arduino Software is free, open source, and available for Windows, Mac OS, and Linux. [4]

2.2.3 Face detection

Is a computer technology that determines the locations and sizes of human faces in arbitrary (digital) images it detects facial features and ignores anything else, such as buildings, trees and bodies.

Face detection can regarded as a specific case of object-class detection. In object-class detection, the task is to find the locations and sizes of all objects in an image that belong to a given class. Examples include upper torsos, pedestrians, and cars. [5]

- Face recognition System

  A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database.

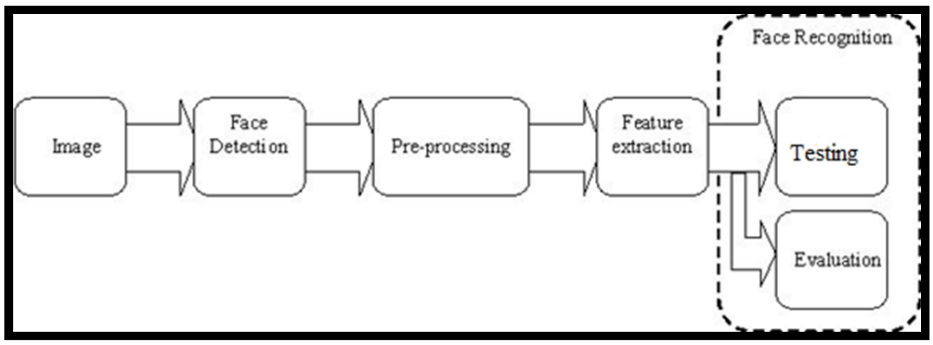


Figure 2.1: The architecture of a face recognition system

Face recognition has drawn the attention of researchers in fields from security, psychology, and image processing, to computer vision.

Facial recognition technology (FRT) has emerged as an attractive solution to address many contemporary needs for identification and the verification of identity claims. It brings together the promise of other biometric systems, which attempt to tie identity to individually distinctive features of the body, and the more familiar functionality of visual surveillance systems.

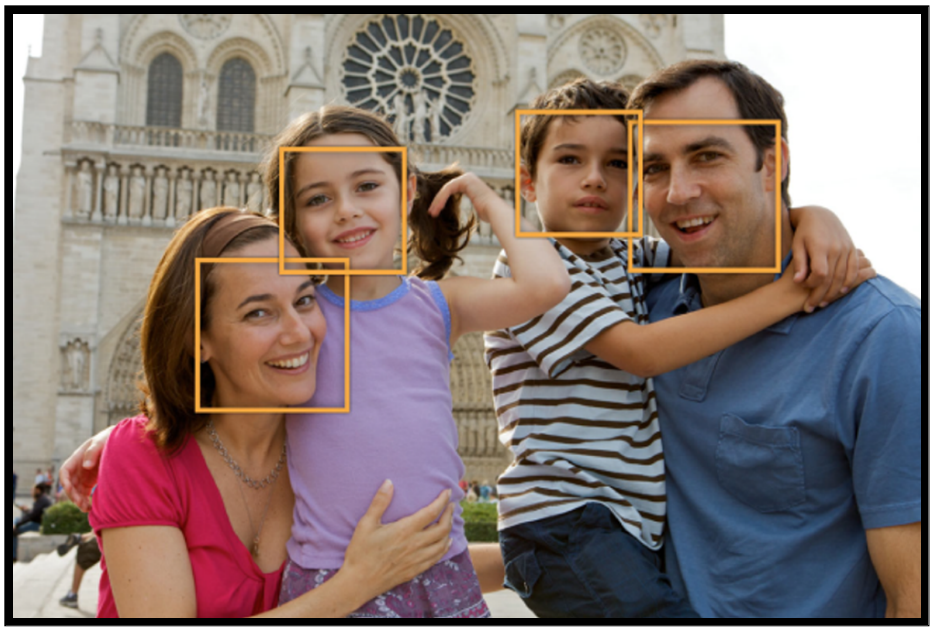


Figure 2.2: Face recognition example

- FRT in operation(FRT: face recognition technology)

The typical way that a FRS can be used for identification purposes. The first step in the facial recognition process is the capturing of a face image, also known as the probe image. This would normally be done using a still or video camera. In principle, the capturing of the face image can be done with or without the knowledge (or cooperation) of the subject. This is indeed one of the most attractive features of FRT. As such, it could in principle, be incorporated into existing good quality "passive" systems. However, locating a face in a stream of video data is not a trivial matter. The effectiveness of the whole system is highly dependent on the quality and characteristics of the captured face image. The process begins with face detection and extraction from the larger image, which generally contains a background and often more complex patterns and even other faces. The system will, to the extent possible, "normalize" (or standardize) the probe image so that it is in the same format (size, rotation, etc.) as the images in the database. The normalized face image is then passed to the recognition software. This normally involves a number of steps such as extracting the features to create a biometric "template" or mathematical representation to compare to those in the reference database (often referred to as the gallery). In an identification application, if there is a "match," an alarm solicits an operator's attention to verify the match and initiate the appropriate actions. The match may either be true, calling for whatever action is deemed appropriate for the context, or it may be false (a "false positive"), meaning the recognition algorithm made a mistake. The process we describe here is a typical identification task. [6]

2.2.4 sensors

The strain gauge sensor

The strain gauge has been adopted for many years. It represents the fundamental sensing element for many types of sensors, including pressure sensors, load cells, torque sensors, position sensors, etc.

The majority of strain gauges are foil types, available in a wide choice of shapes and sizes to suit variety of applications. They consist of a pattern of resistive foil that mounted on a backing material. They operate on the principle that as the foil is subject to stress, the resistance of the foil changes in a defined way.

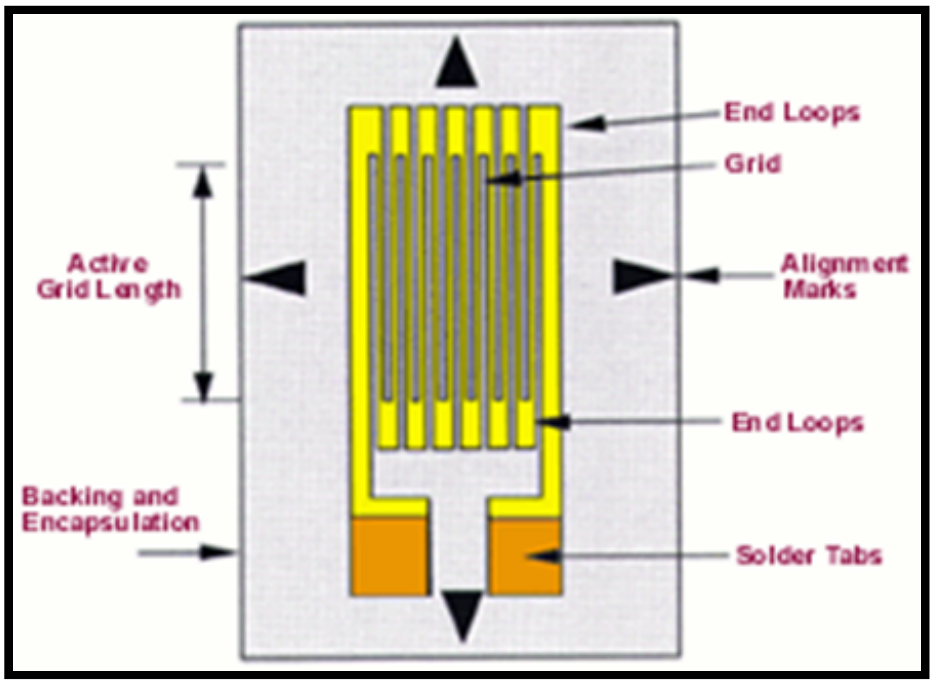


Figure 2.3: Strain gage sensor

The strain gauge is connected into a Wheatstone bridge circuit with a combination of four active gauges (full bridge), two gauges (half bridge), or less commonly, a single gauge (quarter bridge). In the half and quarter circuits, the bridge is completed with precision resistors.

Most manufacturers of strain gauges offer extensive ranges of differing patterns to suit a wide variety of applications in research and industrial projects.

They also supply all the necessary accessories including preparation materials, bonding adhesives, connections tags, cable, etc. The bonding of strain gauges is a skill and some suppliers offer training courses. There are also companies which offer bonding and calibration services, either as an in-house or on-site service [7]

Motion Detector

Laser transmitter and receiver will be used in this system, A laser diode transmitter, or LD, is an electrically pumped semiconductor laser in which the active medium is formed by a p-n junction of a semiconductor diode similar to that found in a light-emitting diode.

The laser diode is the most common type of laser produced. Laser diodes have a very wide range of uses that include, but are not limited to, fiber optic communications, barcode readers, laser pointers, CD/DVD/Blu-ray reading and recording, laser printing, scanning and increasingly sources, in this system well be used as motion detector , the receiver will be photo resistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. The resis-

tance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor can be applied in light-sensitive detector circuits, and light- and dark-activated switching circuits.

A photo resistor is made of a high resistance semiconductor. In the dark, a photo resistor can have a resistance as high as a few mega ohms (M), while in the light, a photo resistor can have a resistance as low as a few hundred ohms. If light incide on a photo resistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands. [8]

Alarm system

If you want to think about a car alarm in its simplest form, it is nothing but one or more sensors connected to some sort of siren. The very simplest alarm would have a switch on the driver's door, and it would wired so that if someone opened the door the siren would start wailing. You could implement this car alarm with a switch, a couple of pieces of wire and a siren.

Most modern car alarm systems are much more sophisticated than this. They consist of:

- An array of sensors that can include switches, pressure sensors and motion detectors
- A siren, often able to create a variety of sounds so that you can pick a distinct sound for your car
- A radio receiver to allow wireless control from a key fob
- An auxiliary battery so that the alarm can operate even if the main battery gets disconnected
- An electronic control unit(ECU) that monitors everything and sounds the alarm

The ECU in most advanced systems is actually a small computer. The ECU job is to close the switches that activate alarm devices your horn, headlights or an installed siren – when certain switches that power sensing devices are opened or closed. Security systems differ mainly in which sensors are used and how the various devices are wired into the ECU.

The ECU and alarm features may be wired to the car's main battery, but they usually have a backup power source as well. This hidden battery kicks in when somebody cuts off the main power source (by clipping the battery cables, for example). Since cutting the power is a possible indication of an intruder, it triggers the brain to sound the alarm. [9]

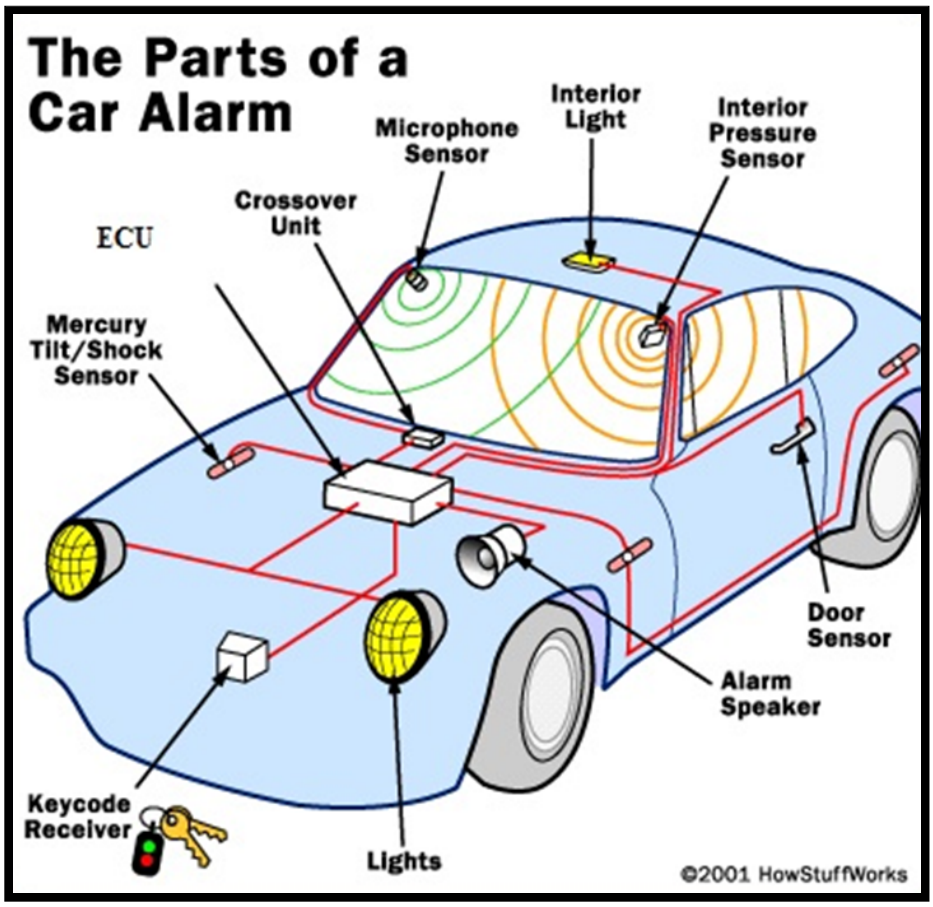


Figure 2.4: Alarm system parts

2.2.5 Actuators

This section talks about actuators which will be used in this system.

Brakes motor

Brake motor is a DC motor with a warm gear reduction to increase torque and improve a self-braking characteristic to avoid accidents, which caused by forgetting to operate the handbrake after using the car or caused by children.

Ventilation motor

In this system, we will use the air conditioning system fan motor in parallel concoction with air conditioning system circuit

Main injection pump

In this system, we will use the main injection pump to cut of the fuel from the engine.

2.3 Literature Review

A paper, published n ModibboAdamma University of Technology, talked about security system connects the alarm system with mobile with GSM network, which work to activate or inactivate the car system by a code sent by phone owner.

Using DTMF decoder to connect car microcontroller with owner mobile, using actuator to demobilized the car.

Another systems was proposed by S. P. Pingat suggests a Security system for cars depend on FDS (face detection system+ fingerprint detection system) . The First protection liar is the fingerprint detection; if it was surpassed, the face detection will work and send the photo take for the driver to the owner phone by MMS.

As will the GPS, system in the car will send the location for the owner phone.

Another paper talked about security, was focused on only deactivating the car from starting if the car was lost or under steeling threats. The driver must send a code from his mobile to deactivate this car by a microcontroller which controls the injection system or pumping fuel .

A new proposeal for 2nd generation security system for cars was proposed by a paper that talked about the ordinarily security systems. When someone tries to open the car, it starts the flasher and horn to make notify people around the car. It also activate the immobilizer when receive a wireless signal from the remote or the key owned by car owner. If the signal match the saved signal in the immobilizer within a specific distance it will operate the car if not it will cut the fuel by closing pumping fuel or by stopping the injection.

Our project shares some similarly with some of the aforementioned projects, like using image processes to implemented face recognition and send the photo to the owner to tilled about car breaking in ,located car location by GPS , but with different technology ,that because all projects use MMS and SMS to sent data while we up to use GPRS which is the same effective with lower cost .

Some projects use PC to processes the images takes by camera, but in this project we process the images on the same phone in the car. Also, we will improve a technology that will improve safety that is more efficient by automatic ventilation opening and self-stopping.

2.4 Summary

In this chapter, we talked about all the techniques we used in our project like Bluetooth, and face detection and recognition. In addition, we talked about the works and projects, which related to our project.

Chapter 3

Project Management Plan

3.1 overview

In this chapter we will talk about the project management plan for the system, and we will determine the requirement resources for the project, and determine the total time and total cost for the system.

3.2 Project management plan

- Task set

  1. Analyze the system and identify the stakeholders and end users for the system.(3 days)
     (a) Draw the flow chart for the system.
     (b) Determine the output and the main aim from the project.
  2. Meet users in order determine the requirement for the system .(3 days)
     (a) Determine the hardware requirement.
     (b) Determine the software requirement
  3. Determine the scope for the project.(2 days)
  4. Test the hardware Components and Equipment .(3 days)
     (a) Test the sensors.
     (b) Test the car in order to make sure that it will work well.
     (c) Test the microcontroller.
     (d) Test the Bluetooth module and the wire.
     (e) Test the 2 smart phones
  5. Determine schedule for the project.(2 days)

(a) Put a Flour Time plan for the project.(2 days)

6. Risk management. (3 days)
   (a) Identify the risks for the project from all sides
   (b) Identify the impact for these risks on the project
   (c) Put the Potential solutions for the expected risks
7. Analysis for the project.(25 days)
8. Design. (23 days)

3.2.1 Risks

Table 3.1: Risks

Risks	Impact	solutions
Delay in delivery	Critical	Good Time Management.
The damage of hardware components	Critical	Replace it with a good ones.
The damage of software programs	Marginal	Backup for the programs.
The project will not work after programming	Catastrophic	Try to Review the programming work.
The damage of Connections between hardware Equipments	Critical	Following the connection and find out the problem to fix the malfunction
Staff inexperienced	Critical	Learn more
Lack of training on tools	Marginal	Practicing on it

3.2.2 roject resource and total estimated cost

- The project needs two smart phones support Bluetooth technology, also can support android environment.

- Bluetooth modem to send and receive signals.
- Arduino microcontroller to control of every signal and send it in the correct direction.
- Pail electric sensor can detect the Presence of humans in the vehicle.
- Strain gage sensor to measure the Weight on the driver seat.
- Solenoid valves to operate the brake system after the driver leave the vehicle.
- Electrical power windows to open the ventilation in the window when needed.

3.2.3 Time estimation

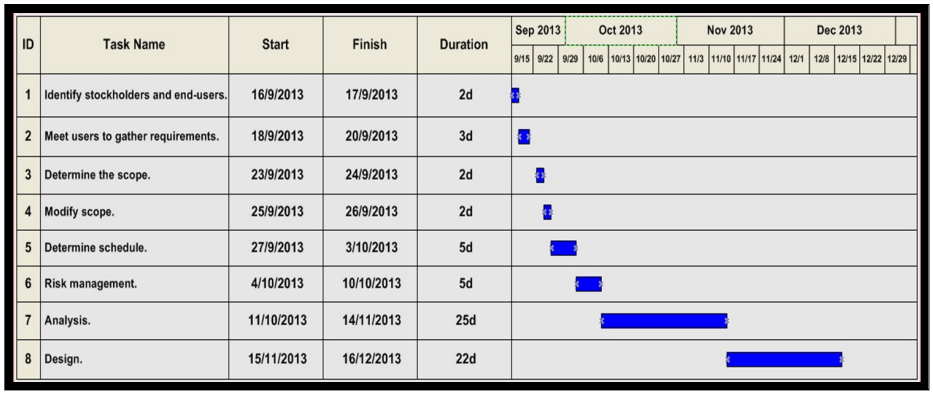
Table 3.2: Time estimation for first semester

ID	Task name	Start date	Finish date	Duration
T1	Analyze the system and identify the stockholders and end users for the system.	15/9/2013	17/9/2013	3days
T2	Meet users in order determine the requirement for the system.	18/9/2013	20/9/2013	3days
T3	Determine the scope for the project.	21/9/2013	22/9/2013	2days
T4	Test the hardware Components and Equipment.	23/9/2013	25/9/2013	3days
T5	Determine schedule for the project.	26/9/2013	1/10/2013	4days
T6	Identify the risks for the project from all sides.	2/10/2013	6/10/2013	3days
T7	Analysis for the project.	7/10/2013	11/11/2013	25days
T8	Design.	12/11/2013	16/12/2013	25days

Table 3.3: Time estimation for second semester

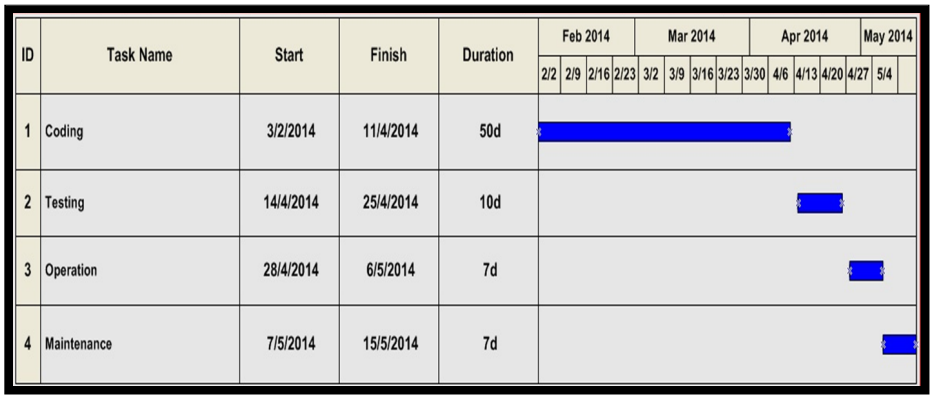
T1	Coding.	3/2/2014	11/4/2014	50days
T2	Testing the code and whole project.	14/4/2014	25/4/2014	10days
T3	Operation.	28/4/2014	6/5/2014	7days
T4	Maintenance.	7/5/2014	15/5/2014	7days

- Gantt chart activities time estimation



ID	Task Name	Start	Finish	Duration
1	Identify stockholders and end-users.	16/9/2013	17/9/2013	2d
2	Meet users to gather requirements.	18/9/2013	20/9/2013	3d
3	Determine the scope.	23/9/2013	24/9/2013	2d
4	Modify scope.	25/9/2013	26/9/2013	2d
5	Determine schedule.	27/9/2013	3/10/2013	5d
6	Risk management.	4/10/2013	10/10/2013	5d
7	Analysis.	11/10/2013	14/11/2013	25d
8	Design.	15/11/2013	16/12/2013	22d

Figure 3.1: Activities time estimation for first semester



ID	Task Name	Start	Finish	Duration
1	Coding	3/2/2014	11/4/2014	50d
2	Testing	14/4/2014	25/4/2014	10d
3	Operation	28/4/2014	6/5/2014	7d
4	Maintenance	7/5/2014	15/5/2014	7d

Figure 3.2: Activities time estimation for second semester

3.3 Project methodology

In this section, we will talk about project methodology and options that we have.

3.3.1 Options

Hardware options

- Microcontroller

  We need microcontroller to connect the vehicle component with our system and to receive the data from vehicle and send it to be processed in the system.

  There are many different microcontrollers because there are different propose and used of microcontroller which it depend on the user.

We have two major kinds of microcontroller, PIC and arduino.

- PIC
  The PIC is one of the latest products from Microchip. It features all the components, which modern microcontrollers normally have. For its low price, wide range of application, high quality and easy availability, it is an ideal solution in applications such as the control of different processes in industry, machine control devices, measurement of different values etc. Some of its main features are listed below. [10]

- Arduino
  Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). The basic Arduino as of this writing is the Uno. This model supports 13 digital input/outputs along with 6 analog inputs. It can run off USB power or via an external "wall wart" power supply. The onboard microcontroller supports up to 32K of program code with 2K of RAM. This may not seem like a lot, but in 8-bit microcontroller terms,it's probably more than most prototypes need. Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, MaxMSP).The Arduino Software is free, open source, and available for Windows, Mac OS, and Linux. [11]

- sensors

  1. Motion detectors
     (a) ultrasonic intrusion detection
     An ultrasonic transmitter in the interior of the vehicle generates an ultrasonic field with a frequency of approx. 20KHz. Pressure fluctuation in this field ,for instance , in response to intrusion or a window being broken , will be detect by the ultrasonic sensor. [12]
     (b) Infrared intrusion detection
     It reacts to moving heat sources, e.g. people and triggers the alarm. [12]
     (c) Pyroelectric infrared sensor
     It detect the human body only by measuring the wave emitted by the human body, human body emits wave with known band width this infrared wave detected by Fresnel lens. [13]
     (d) Laser transmitter and light-dependent resistor (LDR)

     LDR receiver change its resistance with increasing light intensity on it so when somebody cut the leaser line the voltage on the LDR output it well be increased.

  2. Wight sensor

(a) Strain gauge (load cell)
ensing element for many types of sensors, including pressure sensors, load cells, torque sensors, position sensors, etc.
The majority of strain gauges are foil types, available in a wide choice of shapes and sizes to suit a variety of applications. They consist of a pattern of resistive foil, which is mounted on a backing material. They operate on the principle that as the foil is subjected to stress, the resistance of the foil changes in a defined way.

The strain gauge is connected into a Wheatstone bridge circuit with a combination of four active gauges (full bridge), two gauges (half bridge), or, less commonly, a single gauge (quarter bridge). In the half and quarter circuits, the bridge is completed with precision resistors. [14]

(b) Piezoelectric sensor
Is the ability of some materials (notably crystals and certain ceramics) to generate an electrical potential in response to applied mechanical stress. This may take the form of a separation of electric charge across the crystal lattice. If the material is not short-circuited, the applied charge induces a voltage across the material. The word is derived from the Greek word piezien, which means to squeeze or press. [15]

- Transfer data
There are three choices to send signal, Bluetooth technology, Wi-Fi technology, and zigbee technology and just to be fair all of them are good, but for this project one are better than others.

1. Bluetooth
Bluetooth technology is useful when transferring information between two or more devices that are near each other when speed is not an issue, such as telephones, printers, modems and headsets. It is best suited to low-bandwidth applications like transferring sound data with telephones (i.e. with a Bluetooth headset) or byte data with hand-held computers (transferring files) or keyboard and mice.

2. Wi-Fi
The IEEE (Institute of Electrical and Electronics Engineers) has produced a set of standards and specifications for wireless networks under the title IEEE 802.11 that define the formats and structures of the relatively short-range signals that provide Wi-Fi service. The original 802.11 standard (without any letter at the end) was released in 1997. It covers several types of wireless media: two kinds of radio transmissions and networks that use infrared light. The Introduction to Wireless Networks 21 802.11b standard provides additional specifications for wireless Ethernet networks. A

related document, IEEE 802.11a, describes wireless networks that operate at higher speeds on different radio frequencies. Still other 802.11 radio networking standards with other letters are also available or moving toward public release. [16]

3. Zigbee
   ZigBee is a standard communications protocol for low-power, wireless mesh networking. The ZigBee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz. The ZigBee protocol is a standard the same way that Bluetooth is a standard. Any manufacturer's device that fully supports the ZigBee standard can communicate with any other company's ZigBee device. So just as your Motorola Bluetooth headset can communicate with your Apple iPhone, a CentralLite ZigBee light switch can communicate with a Black Decker door lock. [17]

Software options

- Java for android.
- Netbeans.
- Eclipse.
- Dia for drawing UML diagrams.

3.3.2 Analysis of each option

2 This subsection well talk about each option and what is the best option to chosen.

- Microcontroller
  We chose to use arduino for this project. Arduino is the cross-platform development package and the fact that they do not have to wire up the processor before trying things out. It is a standardized platform and everything is tested to work together, so it easier to programming and to deal with. PIC need for other component to complete its circuit and the programmed used for programming PIC not cheap and not easy like arduino.
  But there's a many types of arduino and we will need types fit with other parts of system ,and to not be expensive because cost is very important and active factor ,so depends on all terms we choose to use "UNO arduino", and this summary for Uno arduino specifics. [18]

Table 3.4: Uno arduino specifics

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by boot loader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz [18]

- data transfer
  If we compare Wi-Fi with zigbee we will excludes zigbee because we need component fit with each other ,and sending data from zigbee to mobile are not easy ,while Bluetooth and Wi-Fi will not be problem because the smart phone we chose support both technology, so this remaining Wi-Fi and Bluetooth .
  Because we don't need to transfer so much data and not for long distance ,and only two devices need to connect together Bluetooth will be fine but to support this choice there several points such as power consuming, control of transmit and received data, and cost.

  1. Wi-Fi consumes more power than Bluetooth, so Bluetooth is more practical.
  2. Bluetooth is easier than Wi-Fi to deal with.
  3. Bluetooth modem is cheaper than Wi-Fi modem.
  4. Wi-Fi need wireless internet network to work but Bluetooth do not.

  Therefore, after we decide the technology, we will choose the kind of modem and there are many choices, but as we say before component should be fit with each other, so we see "Bluetooth Mate Silver Retail" a good choice and Appropriate, and so on not expensive.

  Bluetooth HC-05 features

  1. Typical -80dBm sensitivity
  2. Up to +4dBm RF transmit power
  3. Low Power 1.8V Operation ,1.8 to 3.6V I/O
  4. PIO control

5. UART interface with programmable baud rate
6. With integrated antenna
7. With edge connector [19]

3.4 Project components

In this section, we will talk about the system components.

3.4.1 Hardware component

Alarm System

In this project we will use the ordinary alarm system that is used on the vehicle and it consists of a series of sensors and actuator and there are three main types of intruder alarm are used:

- Switch operated on all entry points.
- Battery voltage sensed.
- Volumetric sensing .

Alarm system consists of:

1. Door sensor.
2. Interior pressure sensor.
3. Microphone sensor.
4. Mircuriy shock sensor.
5. Interior light.
6. Horn light.
7. Alarm control unit.
8. Key code receiver.

Sensors

- LDR
  LDR sensor is used in system circuit , it used to detect if anybody entered by concentrating laser line on it , in this project it will be used to detect if there is any creature inside the car while the vehicle in parking and closed .
- Strain gage
  We will use strain gage to measure the weight of the driver on the driver seat and send this measured value to the controller, for gage sensor will be used.

Actuators

- Electrical ventilation motor .
  This motor is installed in the vehicle previously we will connect it with our system to be operate when a creature detected while the vehicle in parking .

- Brakes motor .
  This motor is a DC motor with a warm gear reduction a pulley with 7cm diameter well be installed on it to pull a handbrakes cable .

- Main pump(injection system)
  The main aim of this pump is to deliver the fuel to the injectors and with appropriate pressure and flow, in this system will disable the fuel pump in order to disable the engine to will illegal engine vehicle starting, by cutting the power of the pump.

3.4.2 Software component

1. Microsoft Office.
2. Eclipse.(for android environment).
3. Visio.
4. Dia.(for drawing the use-case diagrams).

3.5 summary

In this chapter, we talked in detail about every component we used in our project and analyzed each component; also, we determined the time required for the project as well the total estimated cost.

Chapter 4

Software Requirements Specification

4.1 General overview

This chapter describes the software requirement specification; section 4.2 describes the requirement as a scenario, sections 4.3 explain the responsibility for every class, section 4.4 describes the class hierarchies and relationships.

4.2 Requirement Description

- **Use case:** Face recognition

  Primary actor:user.
  Goal in context: do not allow to start the engine only to person authorized to do so.
  Precondition:the user must have a picture stored on the mobile.
  Trigger:the driver will set on the driver seat.

  Scenario:

  1. when the driver sets on his seat the load cell strain gage sensor will have a measure.
  2. This measure will be sent to the Arduino which will send a command to phone to operate the camera.
  3. The camera of the mobile will take a picture to the driver.
  4. The mobile will start the image processing.

Exceptions:

1. If the camera of the mobile did not recognize the user then it will capture another photo.
2. If the lighting on the vehicle is dim so it will affect the picture, we will use a good lighting system on the vehicle.

- **Use case:** Alarm system

  Primary actor: system.
  Goal in context: to increase protection of the vehicle by Activating the brakes of the vehicle.
  Precondition:the alarm system must be connected with the user's mobile in order to alert him if any strange motion happened and also the Alarm system must be connected to the microcontroller in order to enable or disable the engine .
  Trigger: If any strange motion happened and activated one of the alarm system sensors.
  Scenario:

  1. activated one of the alarm system sensors.
  2. The alarm system will send a signal to the microcontroller.
  3. Microcontroller will send a message to the user's mobile to inform him about the motion .
  4. The user will enter the code to ensure that brakes will not deactivate.
  5. The brakes will still activated.

  Exceptions:
  1. if the user enters the incorrect number, the system will ask for reentering the code.

- **Use case:** Safety system preventing Suffocation **Primary actor:** system.
  Goal in context: The protection of life of people or any Creatures placed on the vehicle.
  Precondition:the Safety system must be connected to the microcontroller in order to open windows of the vehicle.
  Trigger: : if the Sensing Sensors of the vehicle Discovered the Presence of any creature in the vehicle.
  Scenario:

  1. Sensing Sensors of the vehicle discovered the Presence of any creature in the vehicle.
  2. The alarm system will send a signal to the microcontroller.
  3. Microcontroller will open a ventilation in the windows distance automatically.

About the existence of the creature in the vehicle.

Exceptions: sensing parts not operating, so the solution replacing them.

- **Use case:**Safety system activating brakes **Primary actor:** system.
  Goal in context: preventing vehicle from had a self motion.
  Precondition:: the Safety system must be connected to the microcontroller in order to activate the brakes of the vehicle.
  Trigger:when the driver seat is empty
  . **Scenario:**

  1. Sensing Sensors of the driver seat will have zero measure.
  2. The alarm system will send a signal to the microcontroller.
  3. Microcontroller will operate the ABS system automatically.

  Exceptions:sensing parts not operating, so the solution is replace them.

- **Use case:** diagrams
  These figure below shows and explain the whole system operating principles and scenarios as explained previously.

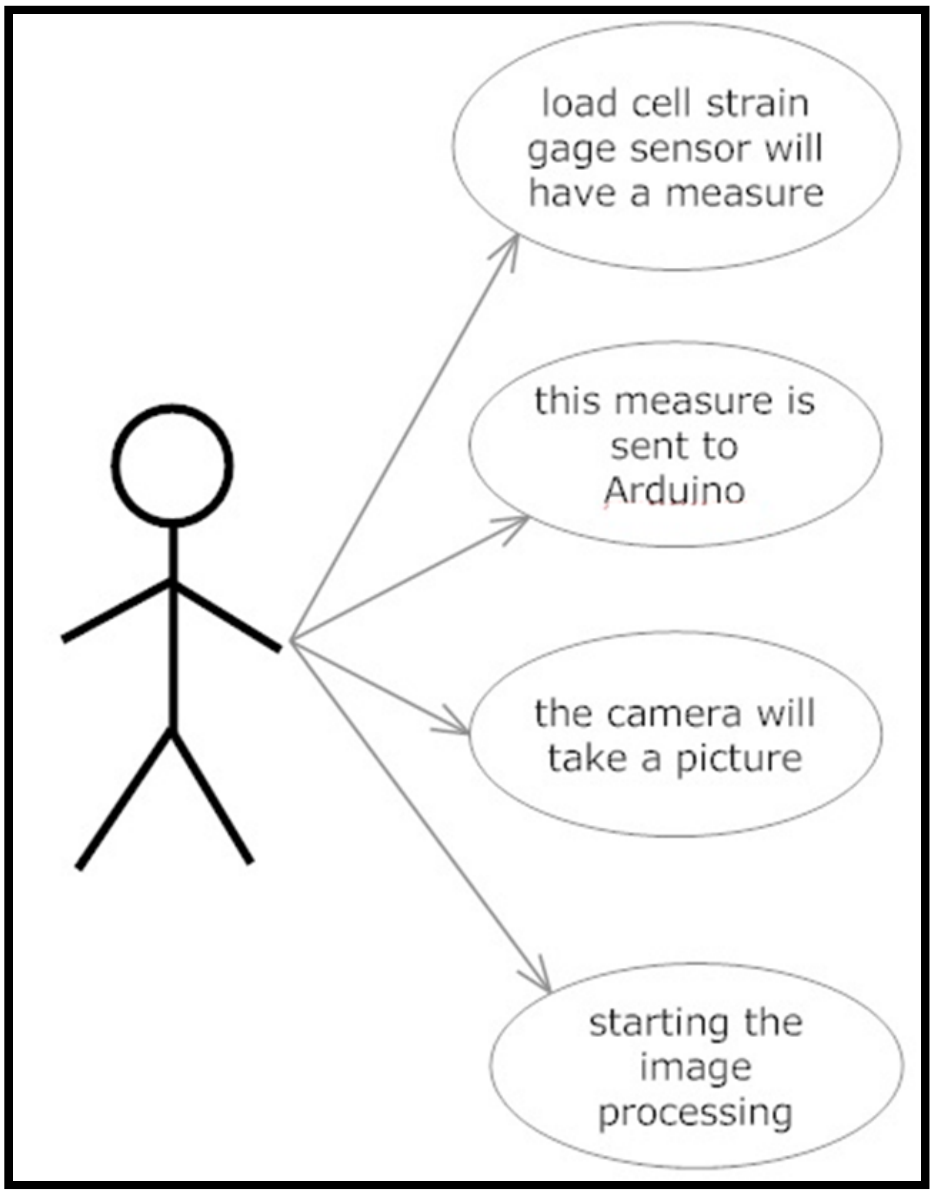


Figure 4.1: Use case for face recognition system

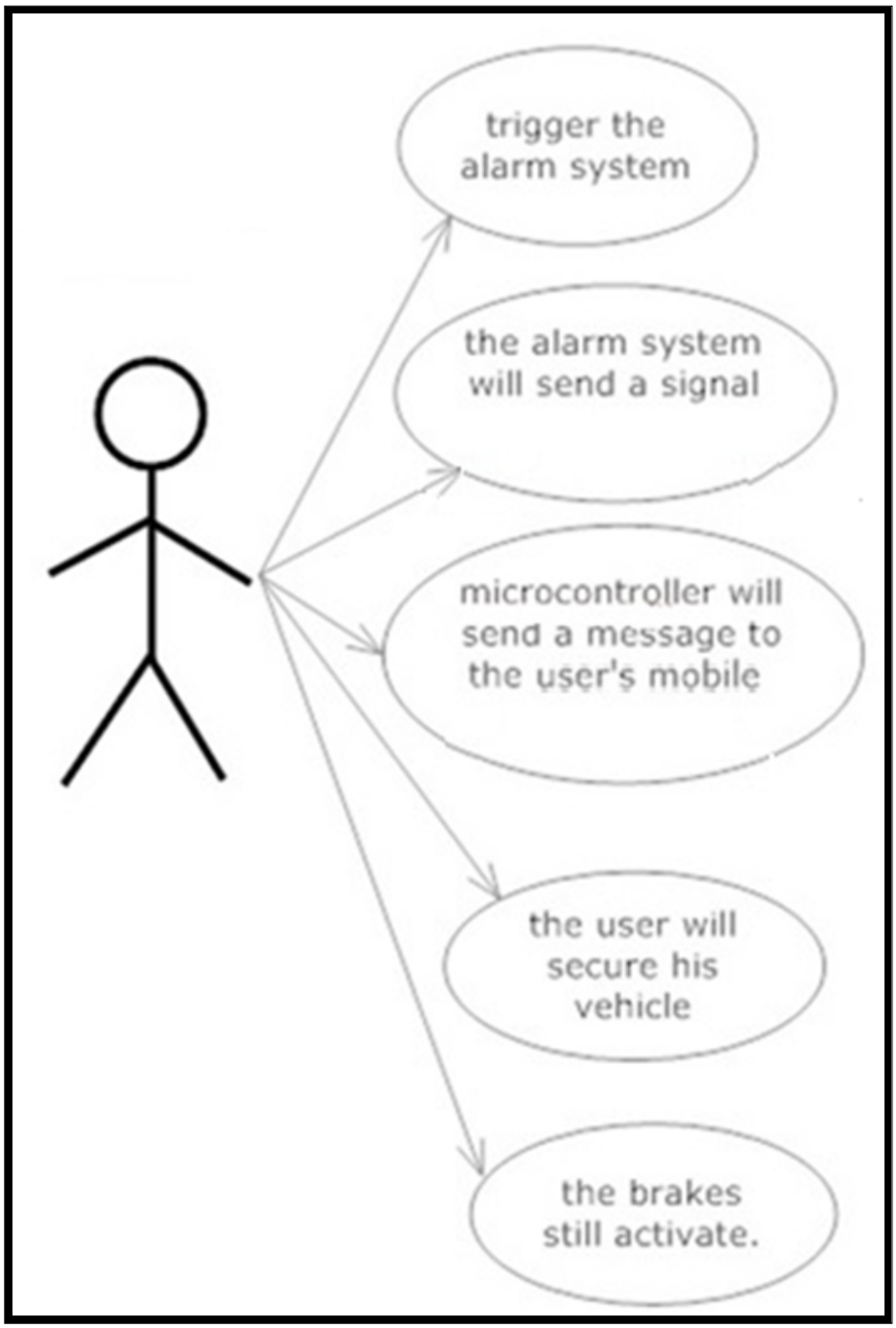


Figure 4.2: Use case diagram for alarm system

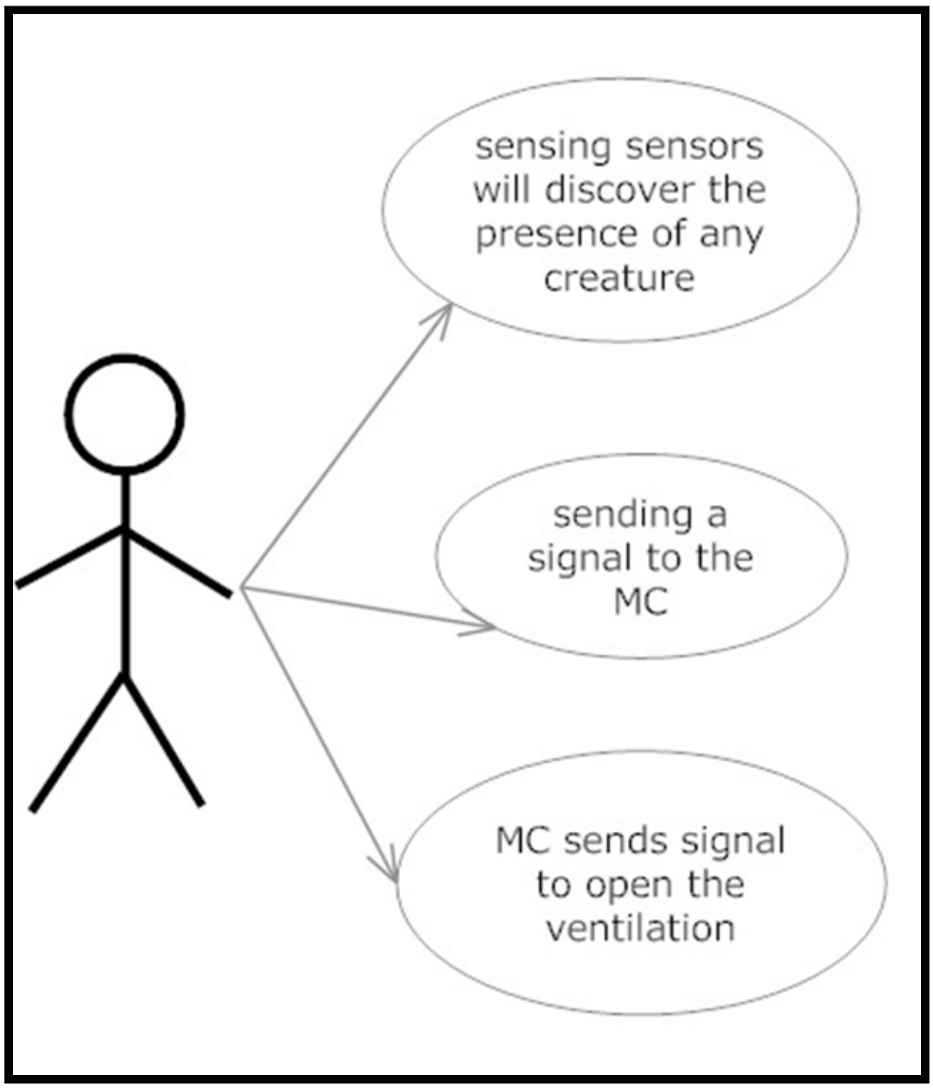


Figure 4.3: Use case diagram for preventing suffocation.

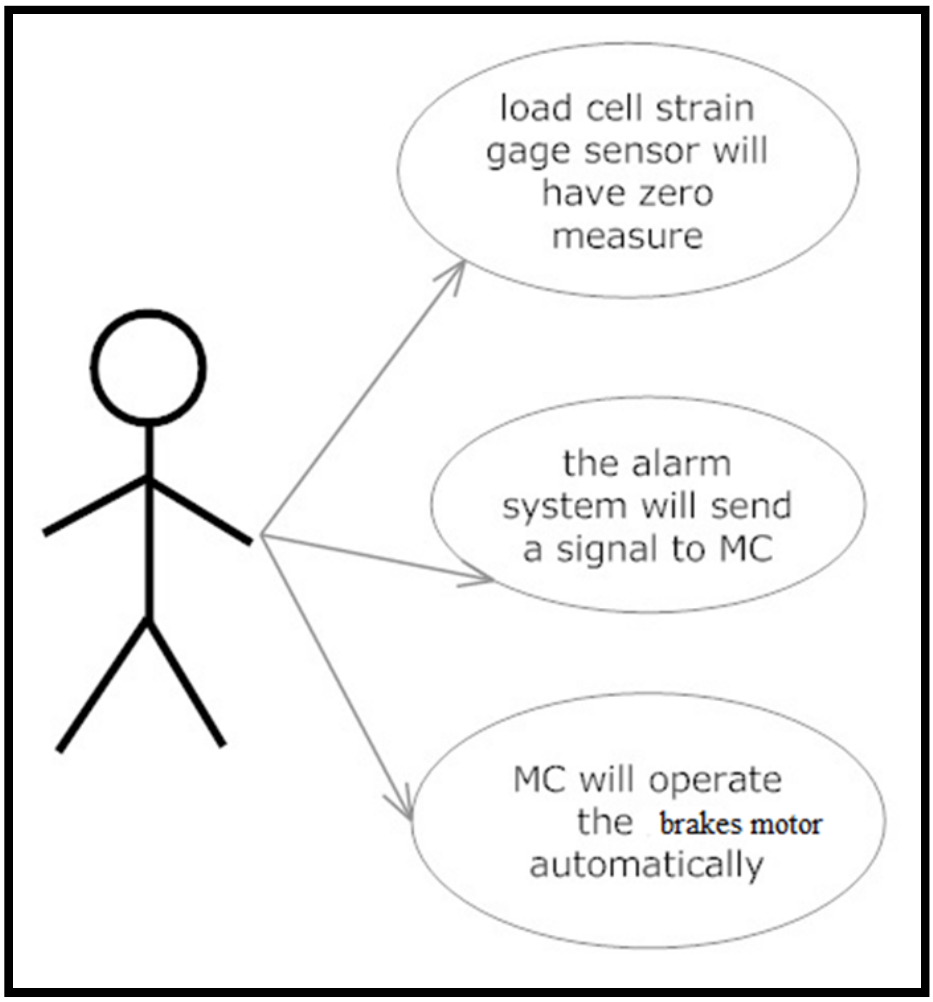


Figure 4.4: Use case diagram for activating the braking system

4.3 Class responsibility collaborator CRC

The table below shows Class responsibility collaborator CRC for each subsystem.

Table 4.1: Class responsibility collaborator CRC

Vehicle	
Model Number Color	
getModel() getNumber() getColor()	Sensors.

Sensors	
Operation Number Quality	
getOperation() getNumber() getQuality()	Vehicle.

Microcontroller	
Operation Number Type Price	
getOperation() getNumber() getType() getPrice()	Laptop

mobile	
Model Number Name Price	
getModel() getNumber() getName() getPrice()	Vehicle.

4.4 Class Hierarchies and Relationships

The chart below shows the Class Hierarchies and relationships for the whole system.

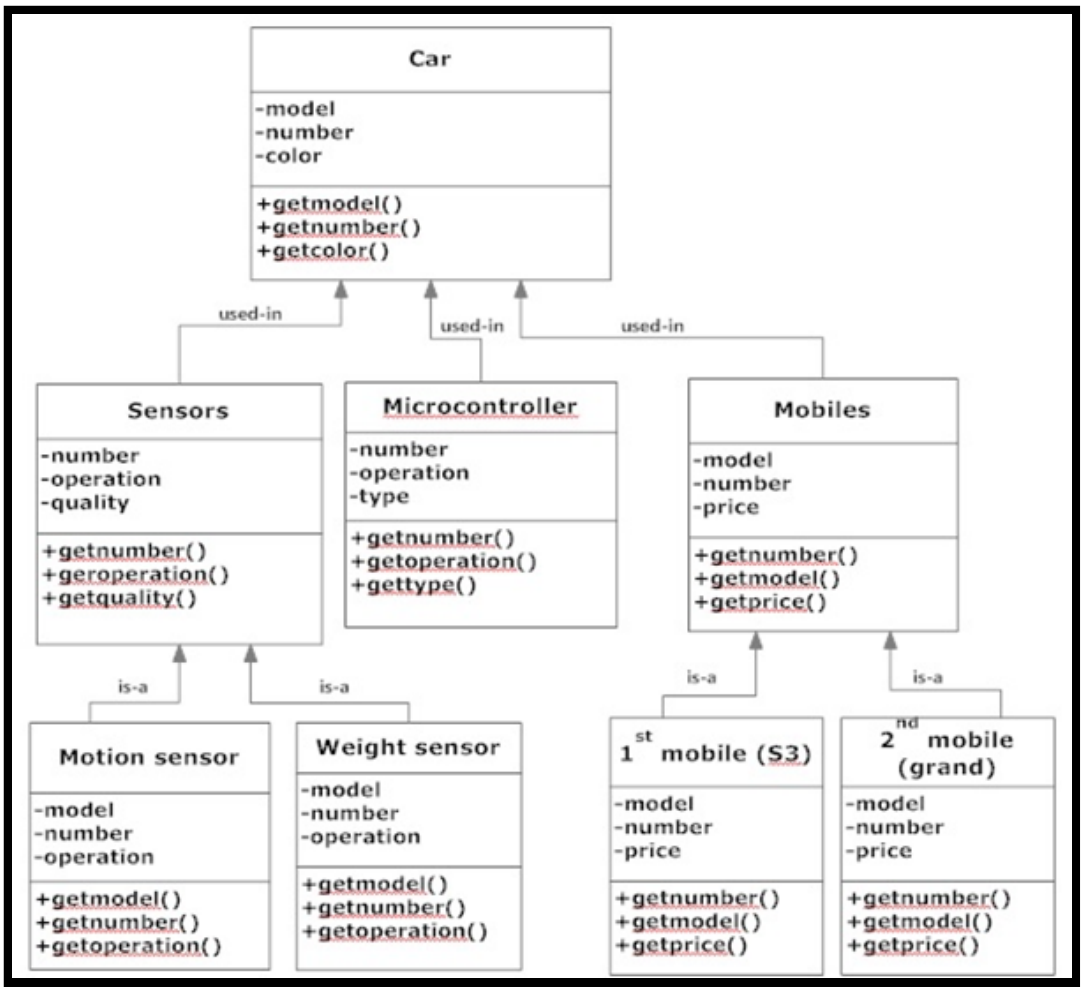


Figure 4.5: Class Hierarchies and relationships

4.5 Summary

In this chapter we talked about the requirement of the project and explained them as a scenario using the use case diagram, also the class's responsibility collaborator and the relationships between classes.

Chapter 5

System Design

5.1 Introduction

In this chapter, we will talk about the whole system and we talk about each subsystem and the components that define the system and the relations between objects and the interfaces, and we also have drawn control, data, state diagrams, and we show the inner and the outer interfaces between the blocks of the system.

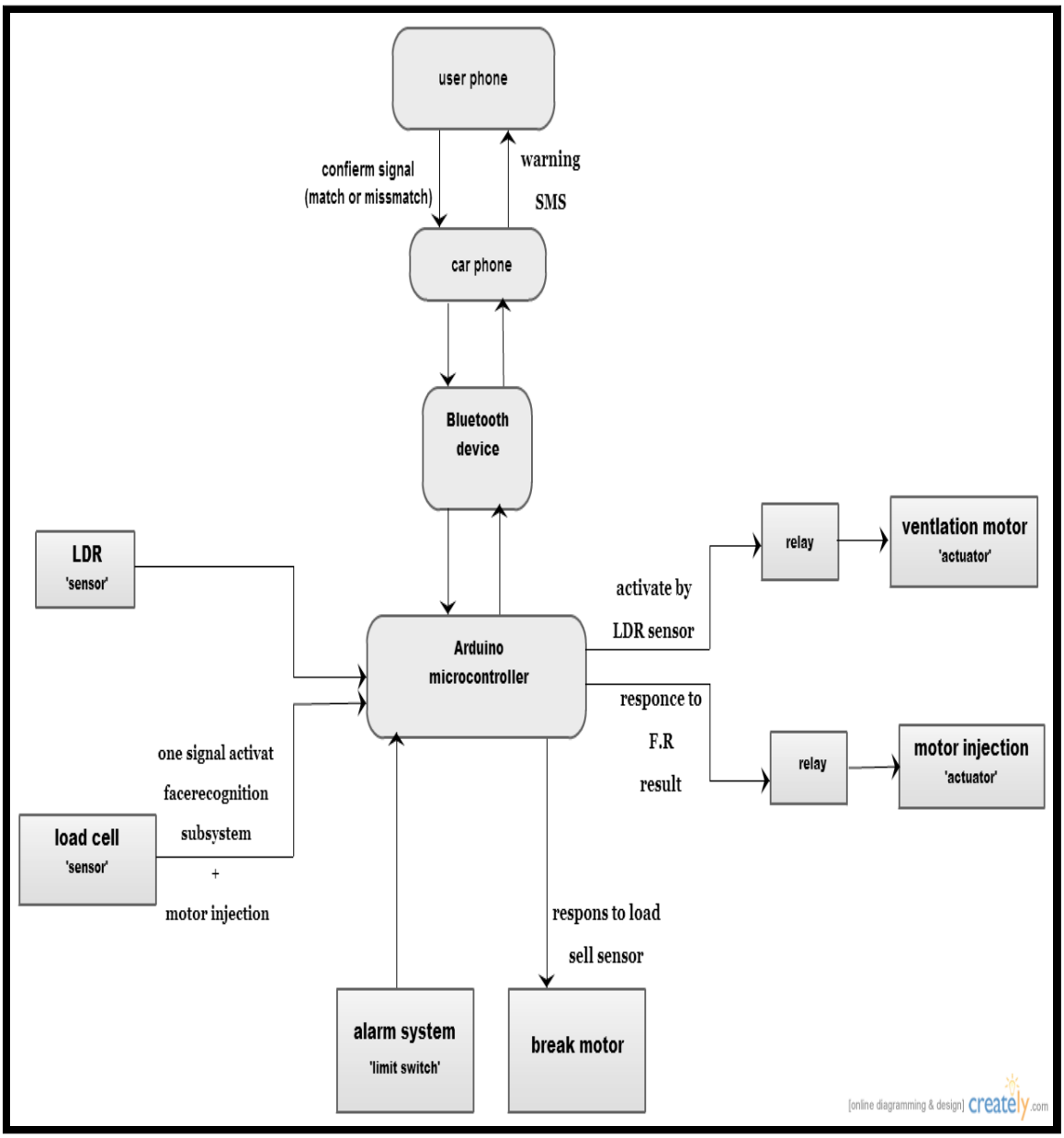


Figure 5.1: System block diagram

Before we start explain the system in details, Figure 5.1 show us an overview of the system in general with the main component and the important subsystems are used.

5.2 objects relational model

The figure below explains the objects relational model.

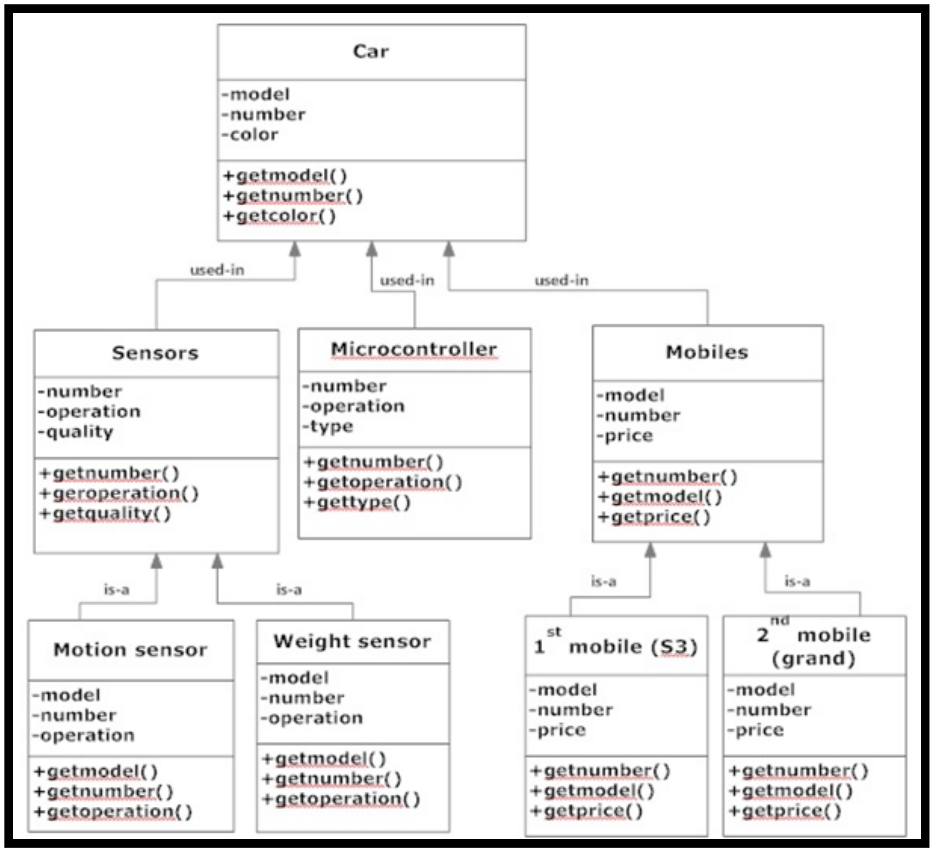


Figure 5.2: Objects relational model

5.3 State behavior

This section will discuss each subsystem state behavior.

5.3.1 Control flow

Figures below shows the control flow for each subsystem.

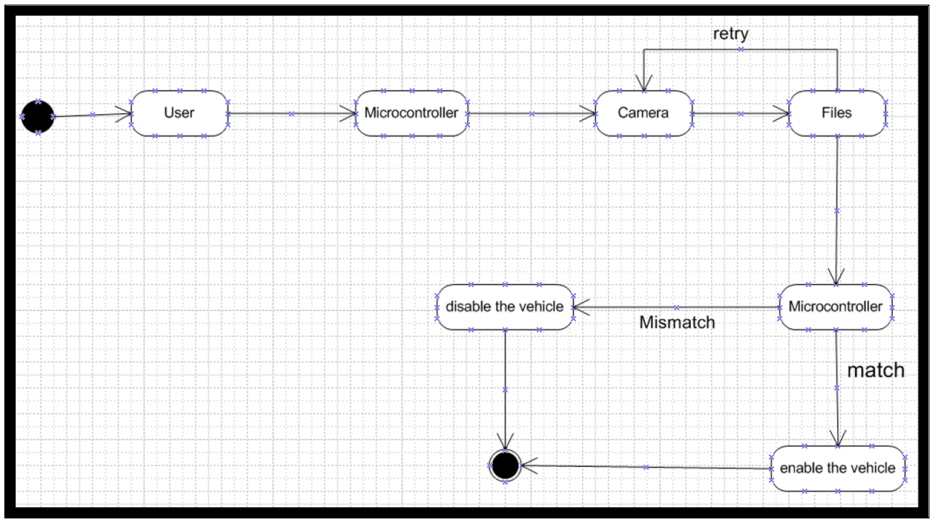


Figure 5.3: Control flow to enable or disable the vehicle

If a person tries to start driving the vehicle, he will pass in these stages:
first stage: he will sit in the driver's seat, then the load cell strain gage will be trigged , camera of the mobile will capture a photo for this person then the system will compare the captured photo with the one stored before, if it is matched the engine will be enabled, if mismatched happened, the engine will be disabled .

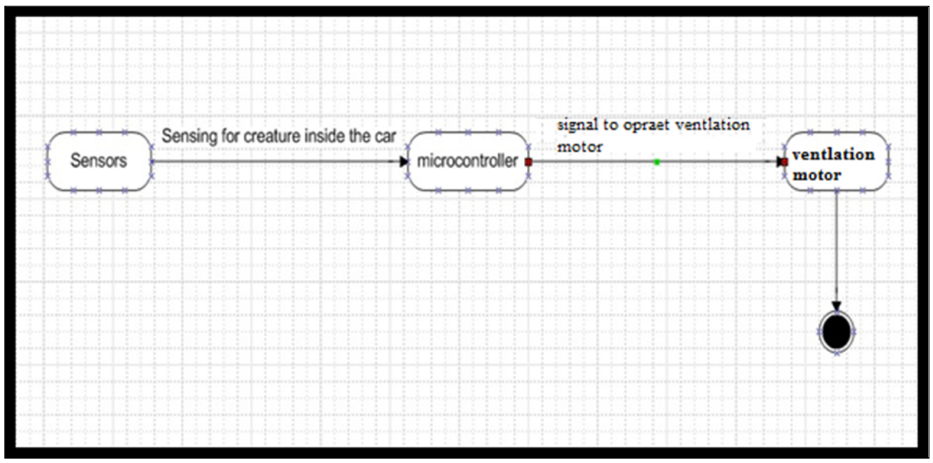


Figure 5.4: Control flow diagram for open the windows

Sensors will sense if there is a creature inside the vehicle, if there is a creature the microcontroller will send a signal to the windows in order to open a ventilation opening, in order to save that creature from Suffocation.

5.3.2 Data flow

"Data flow is the movement of data between the entity, the process and the data store. It portrays the interface between the components." [20]

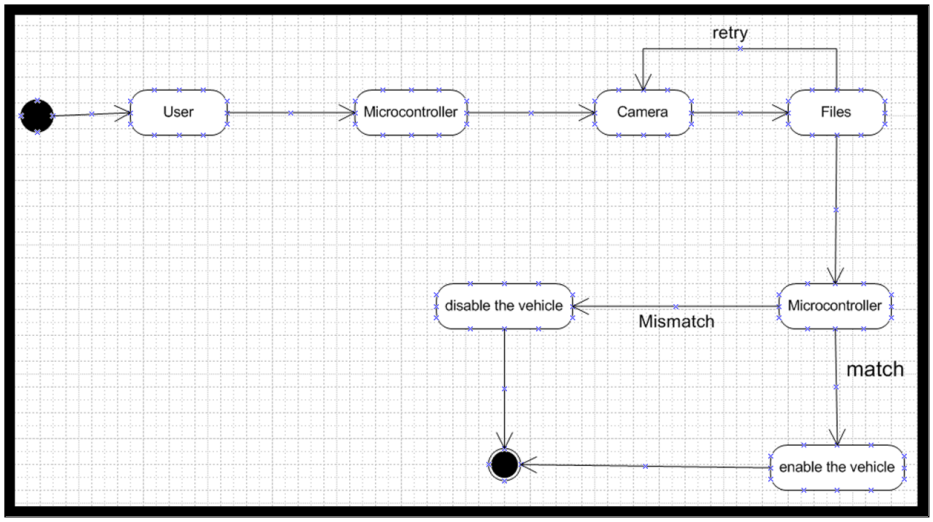


Figure 5.5: Data flow diagram for enable or disable the vehicle

If a person tries to start driving the vehicle, he will pass in these stages:
The first stage: he will sit in the driver's seat, then the load cell strain gage will be trigged , camera of the mobile will capture a photo for this person then the system will be compared

the captured photo with the one stored before if it is matched the engine will be enabled if mismatched happened, the engine will disabled.

5.3.3 State flow

State diagram for enabling or disabling the vehicle.

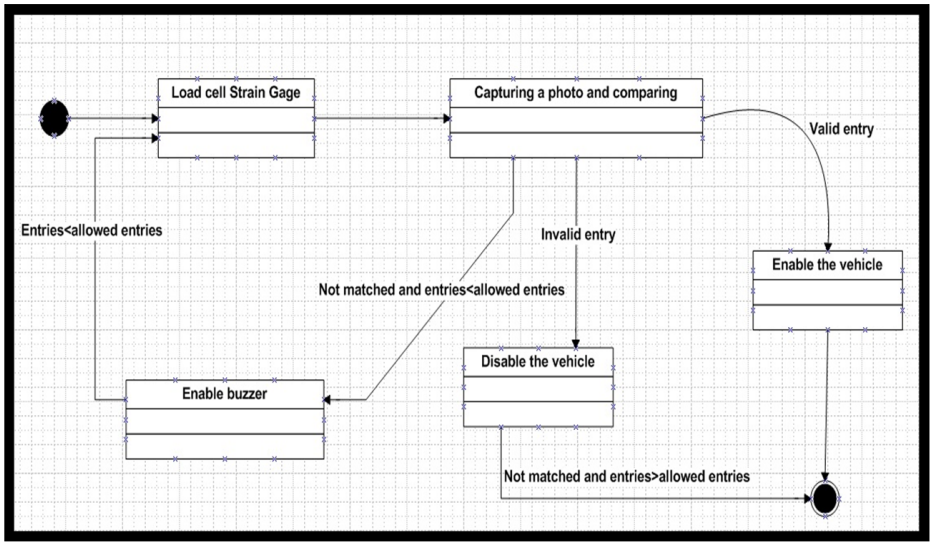


Figure 5.6: State flow diagram for enabling the vehicle

If a person tries to start driving the vehicle, he will passes in these stages:
The first stage: he will sit in the driver seat, then the load cell strain gage will be trigged , camera of the mobile will capture a photo for this person then the system will be compared the captured photo with the one stored before if it is matched the engine will be enabled if mismatched happened, the engine will be disabled.

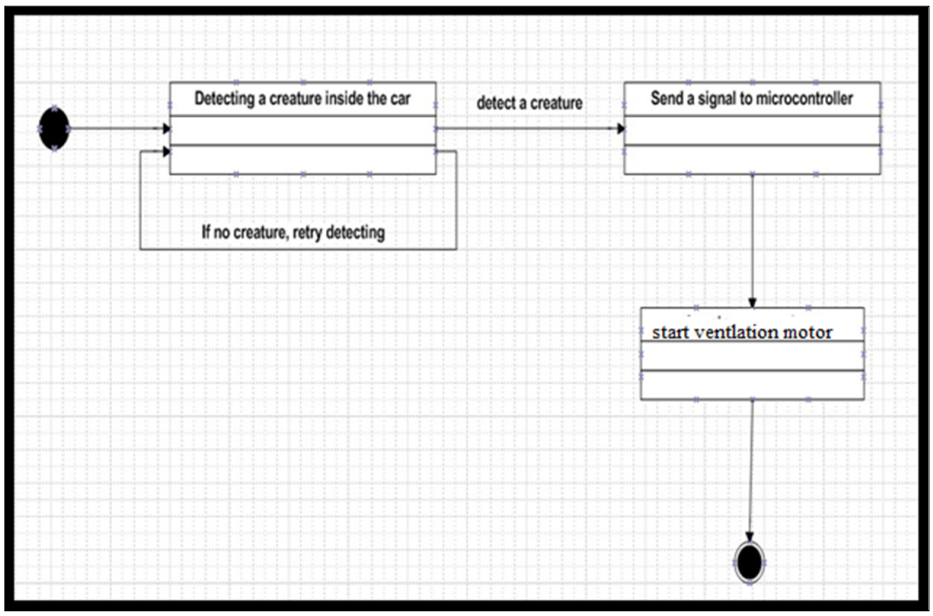


Figure 5.7: State flow diagram for the presence of any creature inside the vehicle

Figure 5.7 illustrates the Examination if there is a creature inside the vehicle, so if this Condition became true the sensing sensor will send a signal to the microcontroller in order to open ventilation .

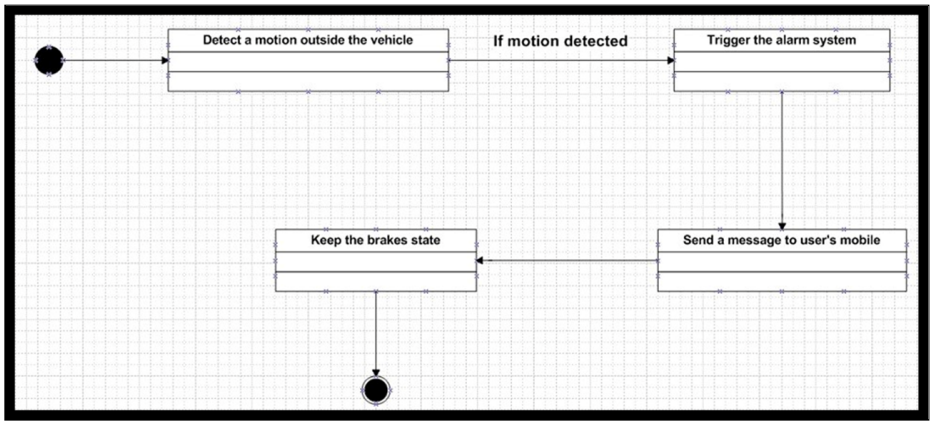


Figure 5.8: State flow diagram for Alarm System.

The system will detect if there is a strange motion outside the vehicle, if the Condition became true the alarm sensor will be triggered then the system will send a message to users mobile in order to warn him.

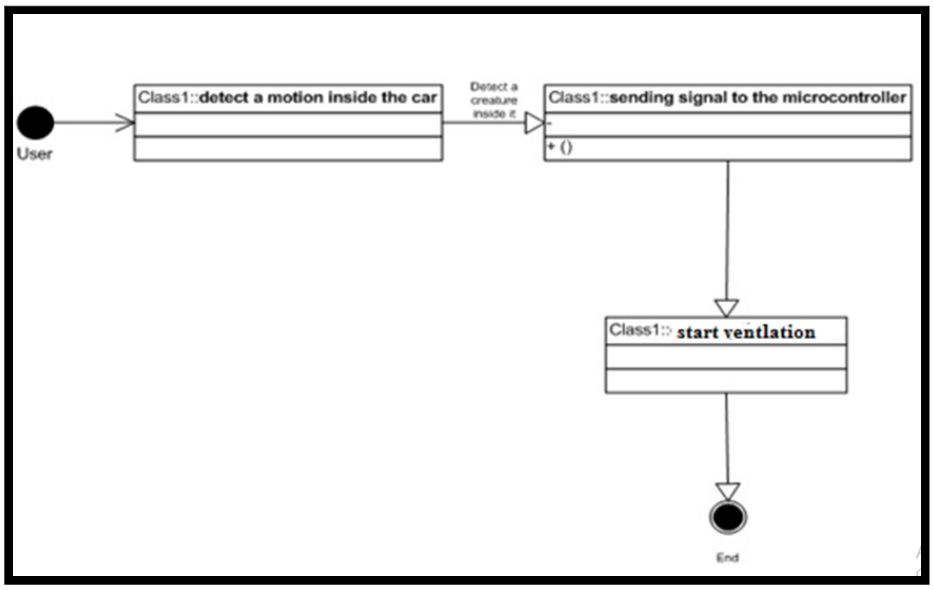


Figure 5.9: State diagram for detect a presence of any creature inside the vehicle.

This figure illustrates the Examination if there is a creature inside the vehicle, so if this Condition became true the sensing sensor will send a signal to the microcontroller in order to open ventilation.

5.4 Hardware subsystem design

Our project is a smart vehicle security system that can be divided into subsystems as following:

- Face recognition and alarm system:
  In this subsystem the user enters his/her picture on the vehicle's phone , then the phone will take a photo for the user, then compare it with the one stored on mobile, so it determines whether this person is allowed to use this car so the Microcontroller will send a signal to the brakes to deactivate it in order to run the car, on the other hand, if the photo is not identical to the one that stored the brakes will still deactivated and the vehicle will not run.

- Detecting the Presence of any creature in the vehicle:
  Sensors will sense if any motion happened inside the vehicle , and existence of any creature , then if there is any motion the sensor will be activated and the microcontroller will send a signal to the windows of the vehicle in order to open a ventilation .

- Activating the braking system:
  Load cell strain gage will sense the existence of the driver on the driver's seat, if not it

will have a zero measure so the microcontroller will send a signal to ABS solenoid valves to be operated.

5.4.1 Vehicle

sensors

1. Alarm system
   An alarm system triggers optical and acoustic warning signals in the event unauthorized intervention or impact.

   This comprises of the following components:

   - Remote control
   - Control unit with power supply
   - Contact switch ,for example ,for doors
   - Infrared sensor or ultrasonic transponder for interior monitoring
   - Status display
   - Signal horn
   - Starting system

   Operating principle: when the alarm system is activated , the control unit checks by way of the contact switches that mentioned above if all requirements are met for the looked status, the alarm can be activated after a delay of 10 to 20 seconeds. A flashing LED, for example indicates that the alarm system is armed. [21]

   In this system we will use the signal which will be sent from the alarm control unit to the alarm horn to activate as input for this system microcontroller (arduino). To indicate that the alarm is trigged to translate this signal in our microcontroller to connect it to the vehicle owner mobile by a Bluetooth module. Bluetooth is connected to the Arduino, which sends it to the vehicle internal mobile which by terms send it to the owner mobile as a call.

   So the signal which will be taken from control unit. It will be 5 volts on alarm horn rely in case the alarm is triggered and zero in case the alarm isn't.

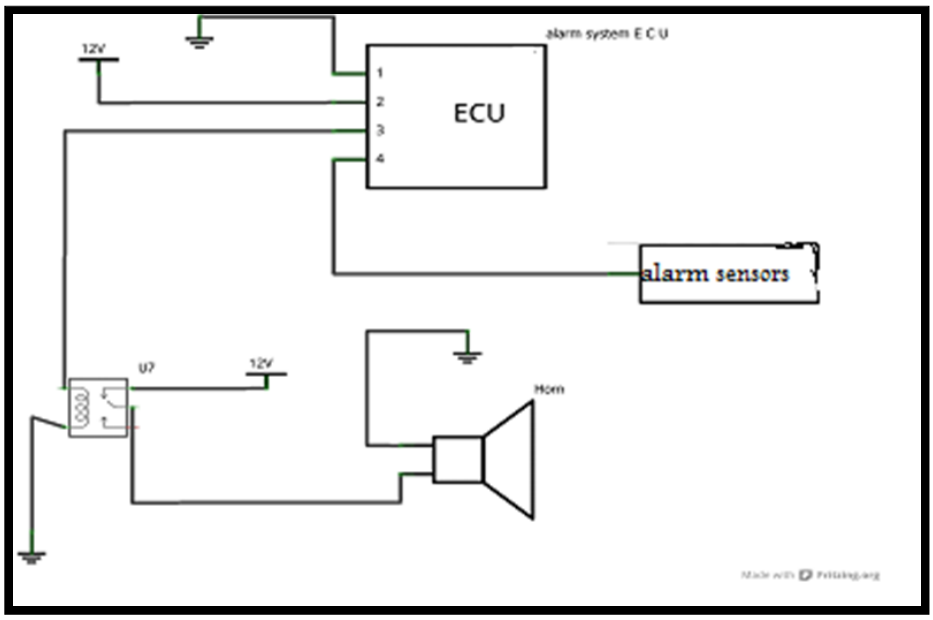


Figure 5.10: Simple alarm system circuit

2. Load cell Strain gage
   the strain gage will be used to measure the Weight of the driver to take it as a signal input to the Arduino. It will decide to activate brakes or based on there is a driver in the car or not.

Figure 5.11: Load cell

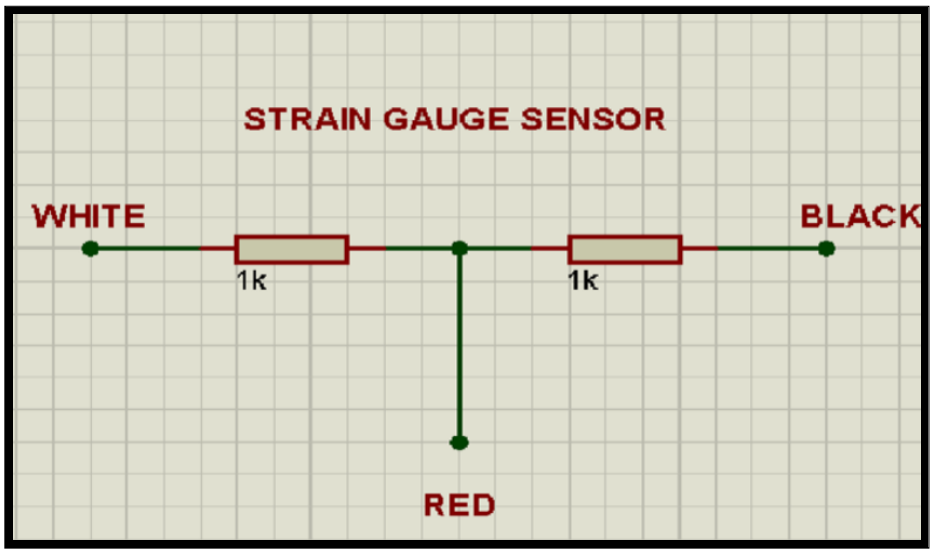


Figure 5.12: Load cell circuit

The output equation will be

$$V = E((1 + V)\delta R)/2R$$

Where V: is the output voltage.
E: the input voltage (battery voltage).
V: the poison ratio.
R: the resistance of the strain gage.

The non-inverting operational amplifier well be used for amplify the output signal from the load cell as shown in figure below.

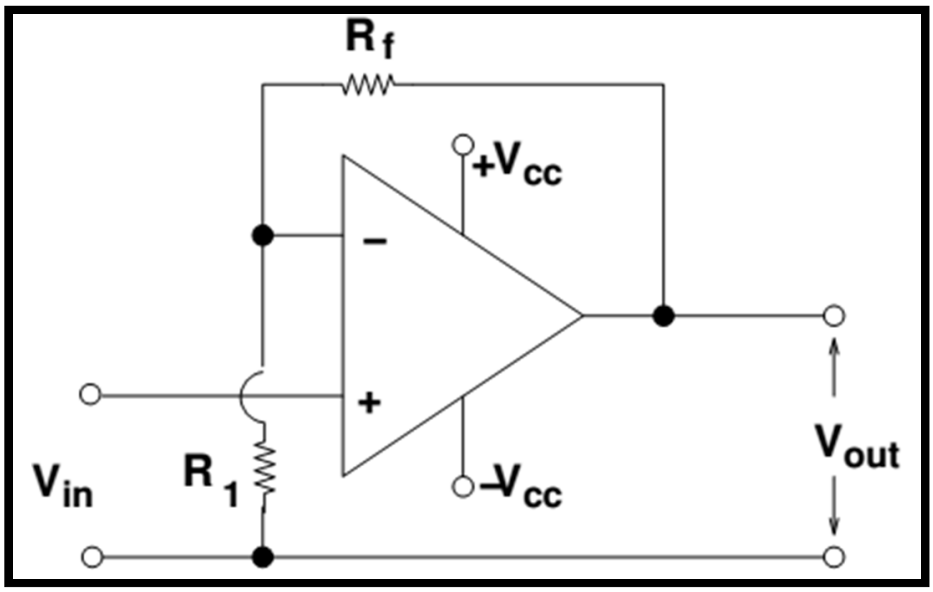


Figure 5.13: operational amplifiers

The output voltage well be calculated from this equation

$$Vout/Vin = 1 + R_f/R_1$$

3. Motion detector (intrusion detection)LDR
   A photo resistor or light-dependent resistor (LDR) or photocell is a light-controlled variable resistor. The resistance of a photo resistor decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. A photo resistor will be used to detects the existence of creature .

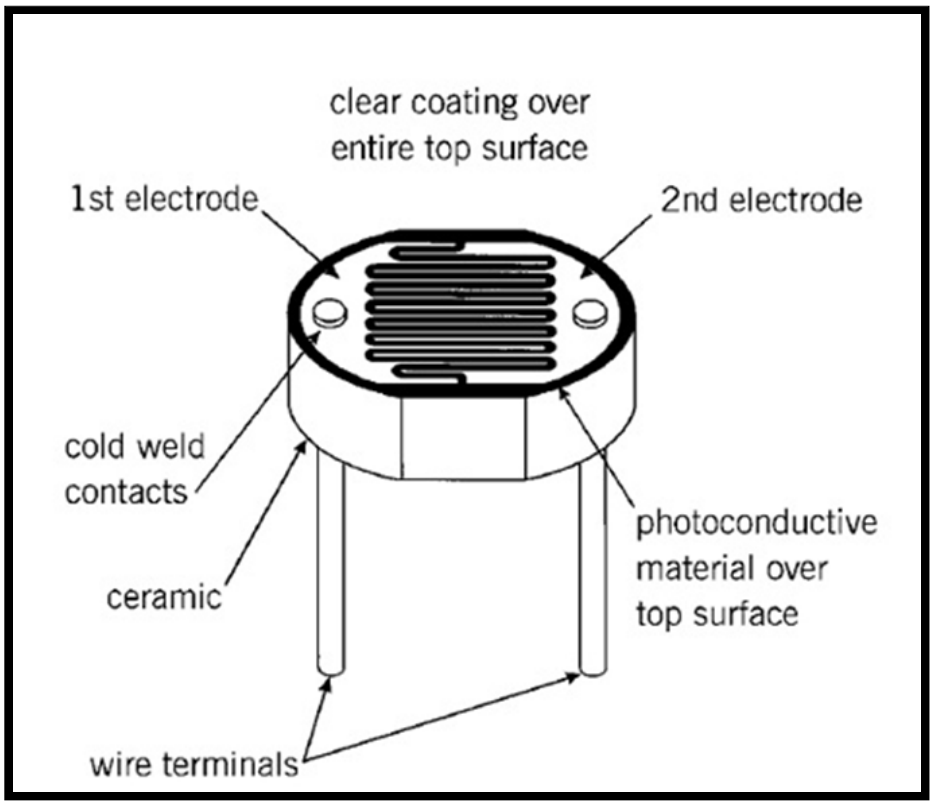


Figure 5.14: LDR sensor

Actuators

- Brakes motor
  This motor is a DC motor with a warm gear reduction a pulley with 7cm diameter well be installed on it to pull a handbrakes cable the figure below shows the operating circuit of the brakes motor

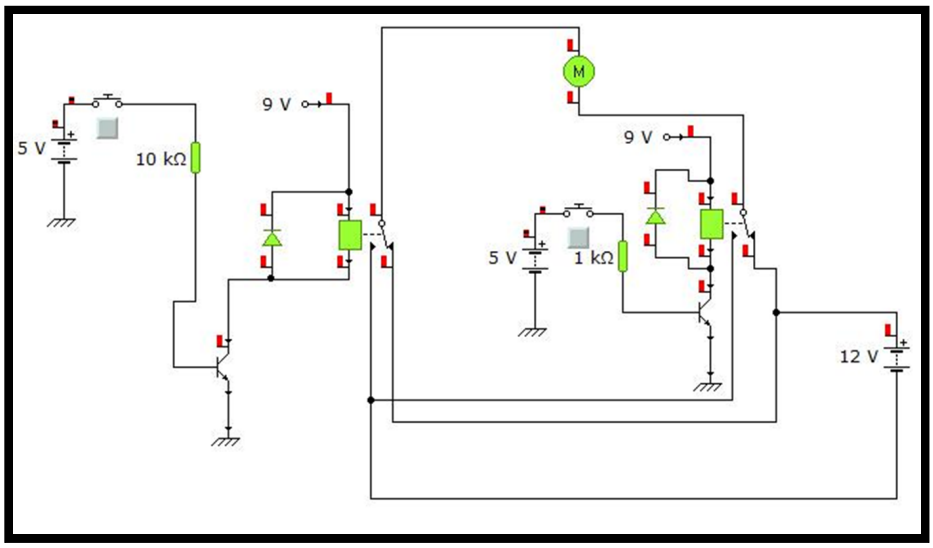


Figure 5.15: Breaks motor control circuit

- Ventilation motor
  This motor has a blower on it this will provide a good ventilation ability since the air tracks is designed to pass the air inside the vehicle in a good way.

Figure 5.16: Ventilation motor

In this system we will use the original vehicle window motor which is a DC motor, this

system will control it on parallel with original control circuit.

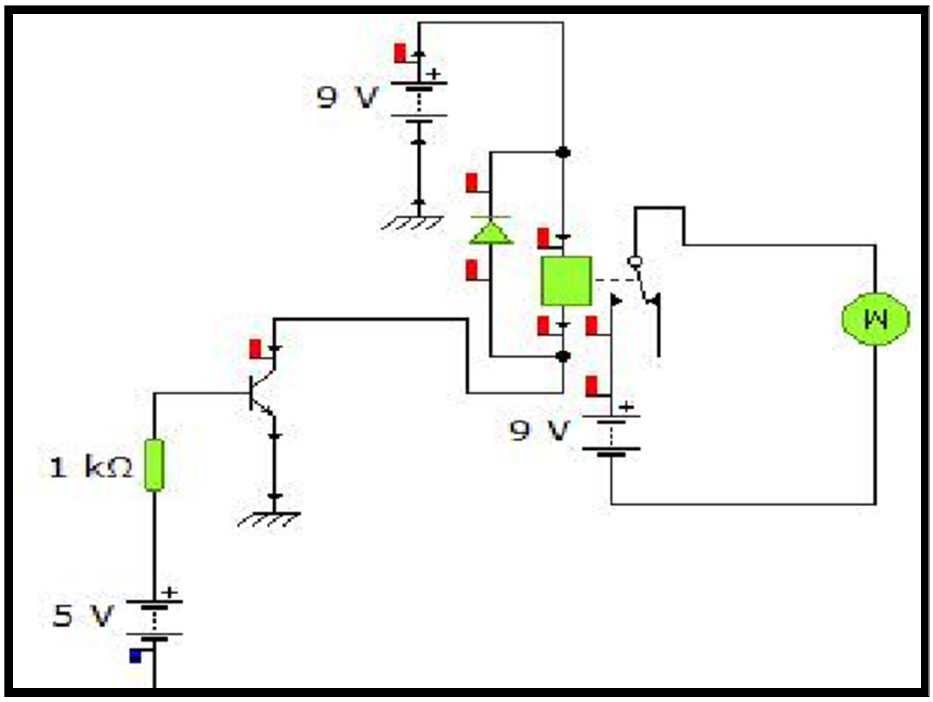


Figure 5.17: Ventilation motor control circuit

- Engine starting control (disable the vehicle)

  Stolen cars and theft from cars account for about a quarter of all reported crime.A huge number of cars are reported to be missed each year and over 20 percentage are never recovered.Even when returned many are damaged. Car and alarm manufactures are constantly fighting to improve security .so enabling and disabling the vehicle is needed to protect the vehicle, the is three main ways to disable the vehicle:

  - Ignition circuit cut off.
  - Starter circuit cut off.
  - Engine ECU code. [22]

  In this system we will use the first way to disable the vehicle.The input command or signal comes from the vehicle mobile, while the driver set on the seat.The mobile will take a photo for the driver and compare it with images saved for the vehicle owner.If they matched, it will send to the Arduino matched massage by Bluetooth, the Arduino will cut the ignition circuit by cutting the power supply of main pump. The figure below shows the control circuit of this part.

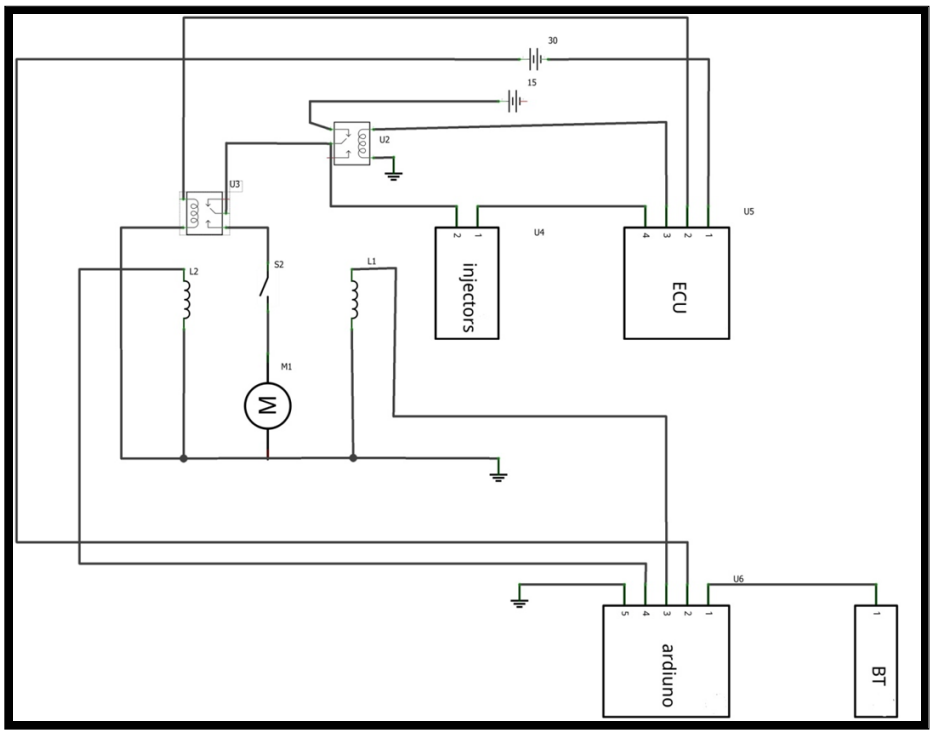


Figure 5.18: Vehicle enable disable circuit

5.4.2 Bluetooth module

- BT function in our system
  The workof Bluetooth module in these system summaries of transfer the data in two directions from and to devices, first device car computer and second one is Arduino. BT will send character -which is came from the arduino ,to the car laptopto send message to the owner in case someone try break the vehicle , and Bluetooth received a signal from car laptop content the result of face recognition process.

5.4.3 Arduino

It's the main brain of the system all the operation take order and command from Arduino based on the data received from sensors , or BT.

- Arduino and BT
  Direct connection occur between those two components, Bluetooth will receive signal to active or not activate the injection in the car ingénue this signal is the result of face recognition operation,Moreover, we cannot ignore the signal come from the limit switch, the purpose of this signal warning the owner that someone try to storm his car.
  All The privies are about security in the car, but what about safety!

  There is a safety part working by cooperation of the arduino with sensors and accumulators. First sensor is gage sensor which measure the weight on the driver seat and if it

not convenient arduino will give a command for ABS to work so car can't move without exist of adult person in it, second sensorLDR, this sensor make sure if there someone in the car or not, to turn ventilation motor on, so this person not Suffocated because leak of oxygen.

5.5 Class and object design

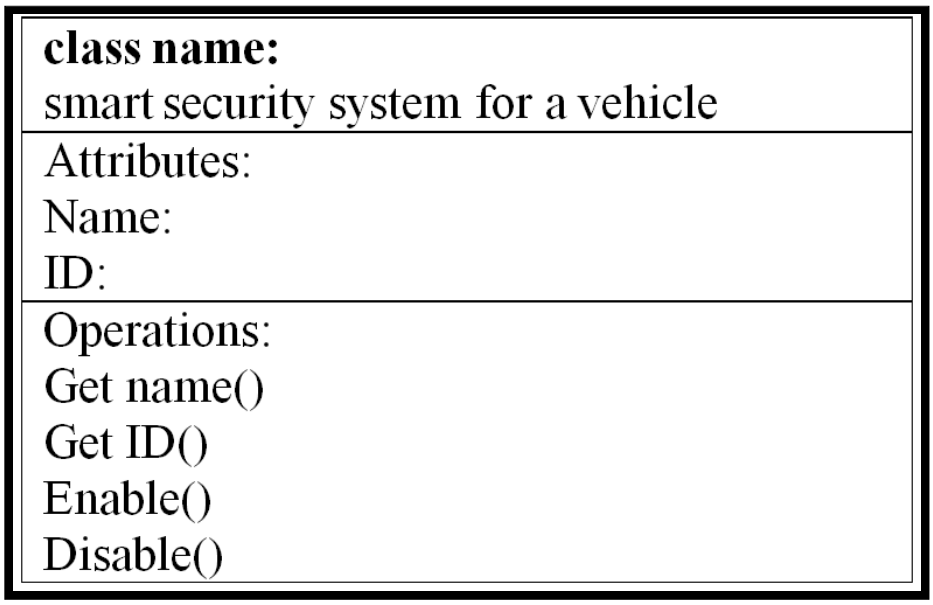
This section gives more details about each class for our system .

Class name: Smart security systemfor a vehicle.
This class contains the attributes and the operation for the smart security system for a vehicle.

Attributes:
-Name: chart: it contains the name (type char) for the smart security system for a vehicle.
-Id: int: id of smart car security identification number of type positive integer. And this number is unique.
Functions:
+get name ():
Name is a public function which returns a value of type char. And return the name of smart car security system.
+get id ():
Is a public function which returns a value of type int.And return the unique number of smart car security system in the system.

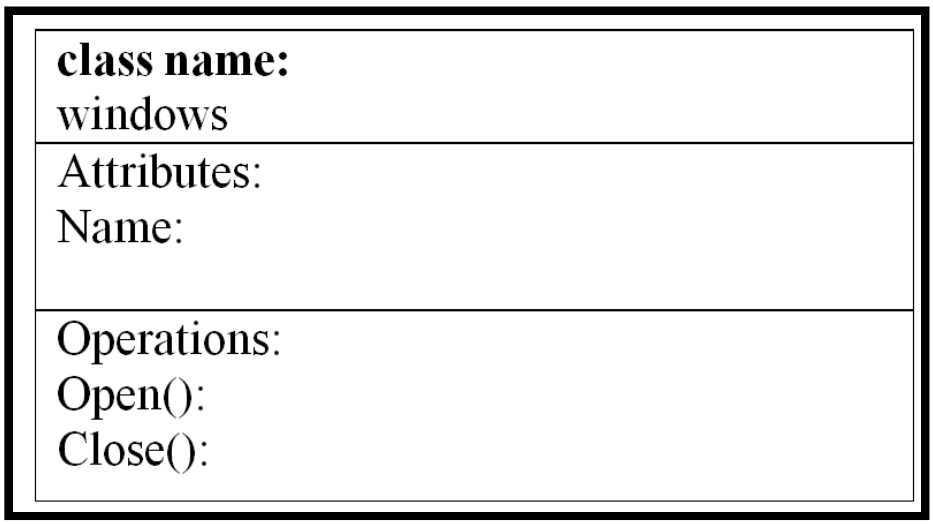
+Disable ():
Is a public function which does not return any value When this function is called, this function will disable the system when needed.

+Enable ():
Is a public function which does not return any value When this function is called, this function will enable the system when needed.



Class name: Windows
The windows class shows the attributes and the operations for the windows, and our system smart car security system contains many windows.
Attributes:
-number: int: identification of the windows
Function:
+open (): these functions open the windows when the system discovered the presence of any creature inside the car.

+close (): this function will close the windows when the system request this.

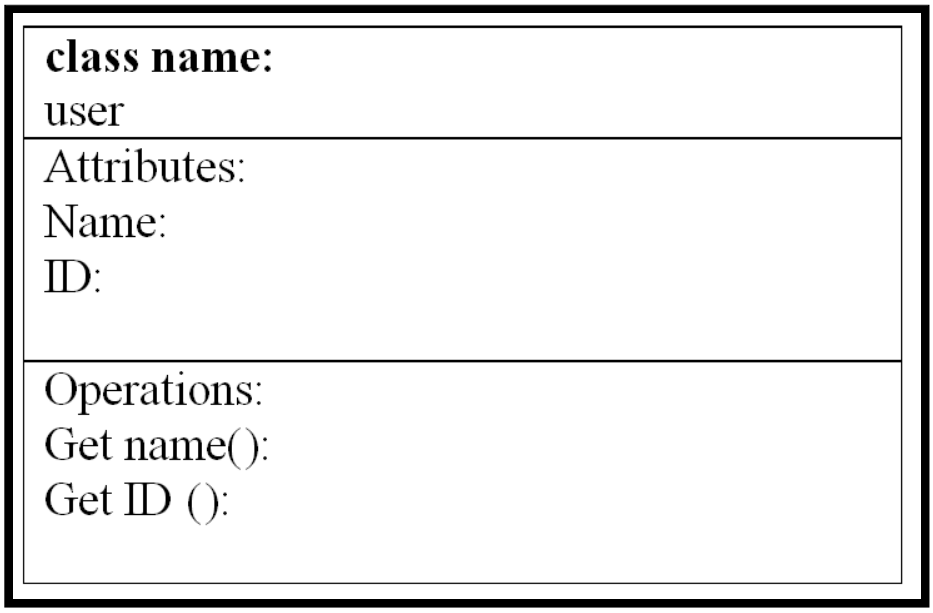


Class name: user

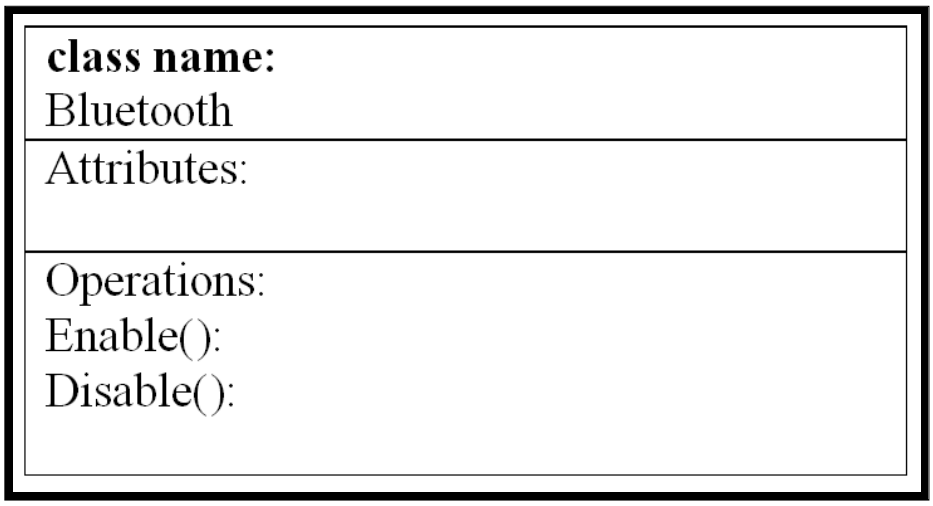
The user class shows the attributes and the operations for user.

Attributes:
-Name: char: it's a name that identifies the name of user. It is public attribute.
-ID: int: user ID is a user identification number of type positive integer. It is a private attribute, And mean the special code for the user in order to control his car.

Functions:
+Get Name (): is a public function which returns a value of type char. And return the name of user.
+Get ID (): is a public function which returns a value of type int. And return the ID of the user to identify his identity in the system.



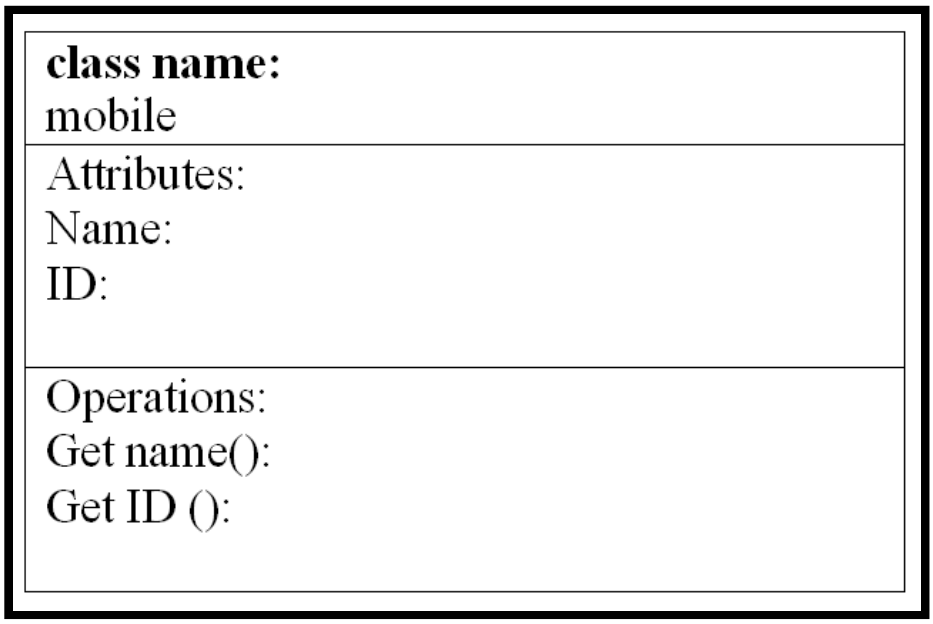
Class name: Bluetooth
The Bluetooth class shows the attribute and the operation of the Bluetooth.
Functions:
+Enabled (): is a public function which does not return any value. When this function is called the Bluetooth will be enabled.
+Disabled (): is a public function which does not return any value. When this function is called the Bluetooth will be disabled.



Class name: mobile
The mobile class shows the attributes and the operations for mobile that we used it in our system.
Attributes:

-Name: chart: it's a name that identifies the name of mobile. It is public attribute.
-ID: int: user ID is a user identification number of type positive integer.

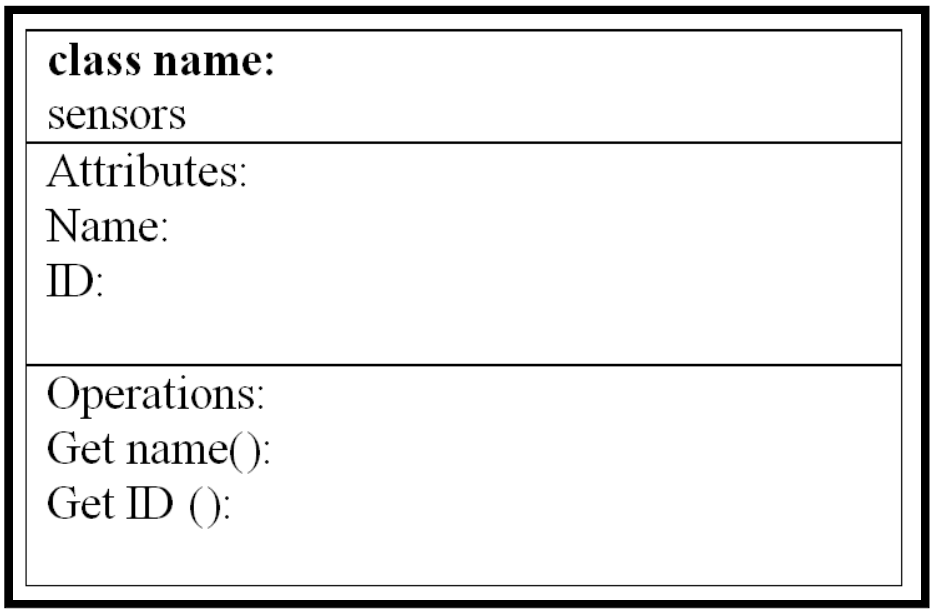
Functions:
+Get Name (): is a public function which returns a value of type char. And return the name of user.
+Get ID (): is a public function which returns a value of type int. And return the ID of the mobile.



Class name: sensors
The user class shows the attributes and the operations for mobile that we used it in our system.

Attributes:
-Name: chart: it's a name that identifies the name of the sensor. It is public attribute.
-ID: int: user ID is a sensor in order to identify the sensor.

Functions:
+Get Name (): is a public function which returns a value of type char. And return the name of sensor.
+Get ID (): is a public function which returns a value of type int. And return the ID of the sensor.



5.6 Software Interface Design

5.6.1 Object Interfacing

Software interface design in this system is represented in two component, mobile used in the car and microcontroller (Arduino).
Car's mobiles connected form one side, and from the other with Bluetooth model ,which it doesn't need software.
The other component is Arduino, it will connect directly with Bluetooth model and the sensor in the car, so it needs a software to control all the data coming in and directs the commands to go out for the motors and actuators.

The definition of face recognition technology

A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database.

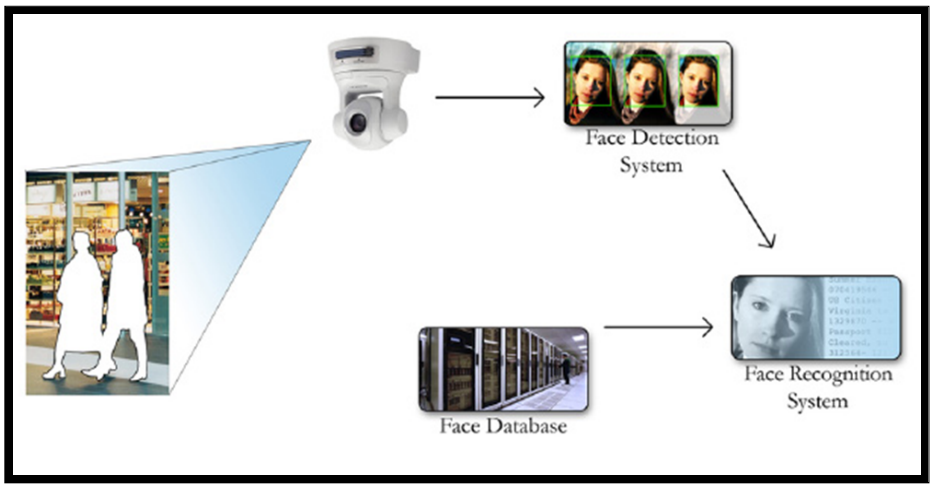


Figure 5.19: Overall system view of a face recognition system

It is typically used in security systems and can be compared to other biometrics such as finger print or eye iris recognition systems.

Figure 5.20: Detecting the face

Steps in the facial recognition process

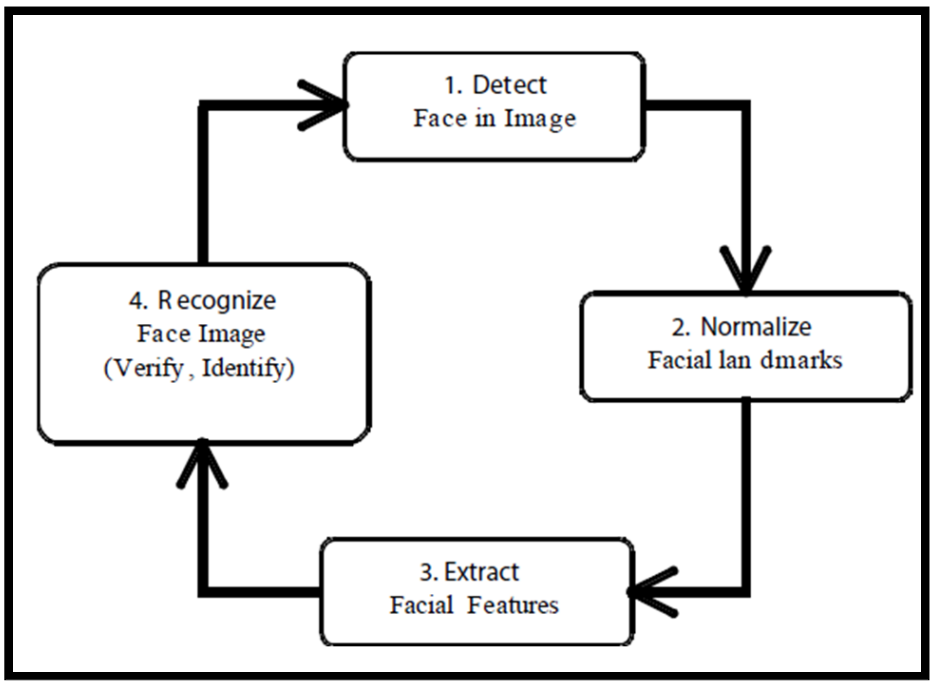


Figure 5.21: Indicates the logical sequence of the different steps of face recognition.

5.6.2 Face recognition algorithms

The early work in face recognition was based on the geometrical relationships between facial landmarks as a means to capture and extract facial features. This method is obviously highly dependent on the detection of these landmarks (which may be very difficult is variations in illumination, especially shadows) as well as the stability of these relationships across pose variation. These problems were and still remain significant stumbling blocks for face detection and recognition. This work was followed by a different approach in which the face was treated as a general pattern with the application of more general pattern recognition approaches, which are based on photometric characteristics of the image. These two starting points: geometry and the photometric approach are still the basic starting points for developers of facial recognition algorithms.
To implement these approaches a huge variety of algorithms have been developed. Here we will highlight three of the most significant streams of work: Principal Components Analysis (PCA), Linear Discriminant Analysis (LDA), and Elastic Bunch Graph Matching (EBGM).

Principal Components Analysis (PCA)

The PCA technique converts each two dimensional image into a one dimensional vector. This vector is then decomposed into orthogonal (uncorrelated) principle components (known as Eigen

faces)—in other words, the technique selects the features of the image (or face) which vary the most from the rest of the image.

- **PCA steps:** [23]

Pattern recognition in high-dimensional spaces -Problems arise when performing recognition in a high-dimensional space (curse of dimensionality).
-Significant improvements can be achieved by first mapping the data into a lower-dimensional sub-space.

$$x = \Big[a_1, a_2, ..., a_N] > reducedimensionality > y = \Big[b_1, b_2, ..., b_N]$$

$$(K << N)\ldots\ldots\ldots\ldots..$$

The goal of PCA is to reduce the dimensionality of the data while retaining as much as possible of the variation present in the original datashet.

- **Dimensionality reduction:**

PCA allows us to compute a linear transformation that maps data from a high dimensional space to a lower dimensional sub-space.

$$b_1 = t_{11}a_1 + t_{12}a_2 + ... + t_{1N}a_N$$
$$b_2 = t_{21}a_1 + t_{22}a_2 + ... + t_{2N}s_N$$
$$b_2 = t_{k1}a_1 + t_{k2}a_2 + ... + t_{kN}s_N$$

or $y = T_x$ where

$$T = \left\{ \begin{array}{cccc} \mathrm{t}_{11} & \mathrm{t}_{12} & ... & \mathrm{t}_{1N} \\ \mathrm{t}_{21} & \mathrm{t}_{21} & ... & \mathrm{t}_{2N} \\ ... & ... & ... & .... \\ \mathrm{t}_{k1} & \mathrm{t}_{k2} & ... & \mathrm{t}_{kN} \end{array} \right\}$$

Lower dimensionality basis .
Approximate vectors by finding a basis in an appropriate lower dimensional space.

1. Higher-dimensional space representation:

$$x = a_1 v_1 + a_2 v_2 + ... + a_N v_N$$

where :

$$: v_1, v_2, ..., v_N, is a basis of the N–dimensional space.$$

2. Lower-dimensional space representation:

$$x = b_(1) u_1 + b_(2) u_2 + + b_N u_N ..... 1...$$

$$u_1, u_2, \ldots, u_K is a bases of the K - dimensional space$$

-Note : if both bases have the same size($N = K$) , then $x = x$ - Information loss
- Dimensionality reduction implies information loss !!

Want to preserve as much information as possible, that is: minimizeĘ$x - x$Ę$(error)$

• How to determine the best lower dimensional sub-space? The best low-dimensional space can be determined by the best eigen vectors of the covariance matrix of x.

• Methodology:

Step 1:

$$x = \frac{1}{M} \sum_{i=1}^{M} x_i$$

Step 2: subtract the mean :

$$\phi = x_i - x$$

Step 3: from the matrix

$$A = [\phi_1, \phi_2, ..., \phi_M]$$

($N\ddot{O}Mmatrix$), then compute :

$$C = \frac{1}{M}\sum_{i=1}^{M}\phi_n\phi_n^T = AA^T$$

(sample covariance matrix ,$N\ddot{O}N$, characterizes the scatter of the data)

Step 4: compute the Eigen values of

$$C_(1) >_(2) >>_N$$

Step 5: compute the Eigen values of

$$Cu_1, u_2, \ldots, u_N$$

Since C is symmetric $u_1, u_2, \ldots, u_N$form a basis, (i.e., any vector x or actually$(x - x)$, can be written as a linear combination of the Eugen vectors):

$$x - x = b_1u_1 + b_2u_2 + ... + b_Nu_N = \sum_{i=1}^{N} b_iu_i$$

Step 6:
(dimensionality reduction step) keep only the terms corresponding to the K largest eigenvalues:

$$x - x = \sum_{i=1^k b_iu_i}$$

where KN

The representation of $x - x$ into the basis $u_1, u_2, \ldots, u_k$ is thus

$$[b_1, b_2, ..., b_k]$$

5.7 Hardware interface Design

The main parts on the hardware was described earlier. Now, it is important to focus on the interfacing where all components are connected together to work as a system.

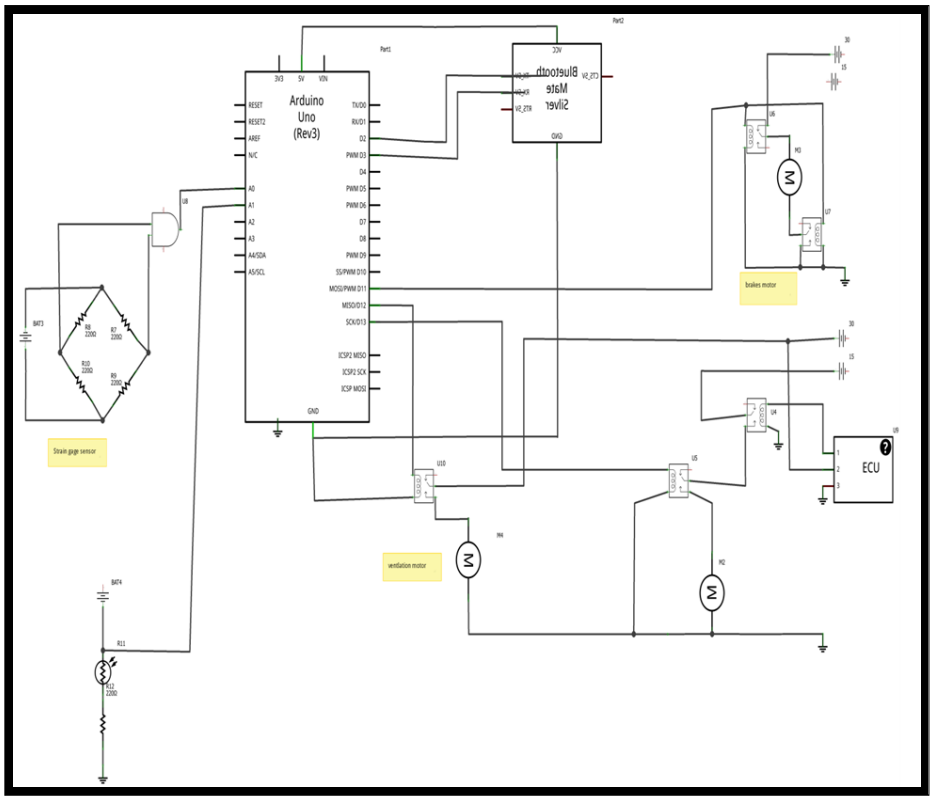


Figure 5.22: System interfacing design

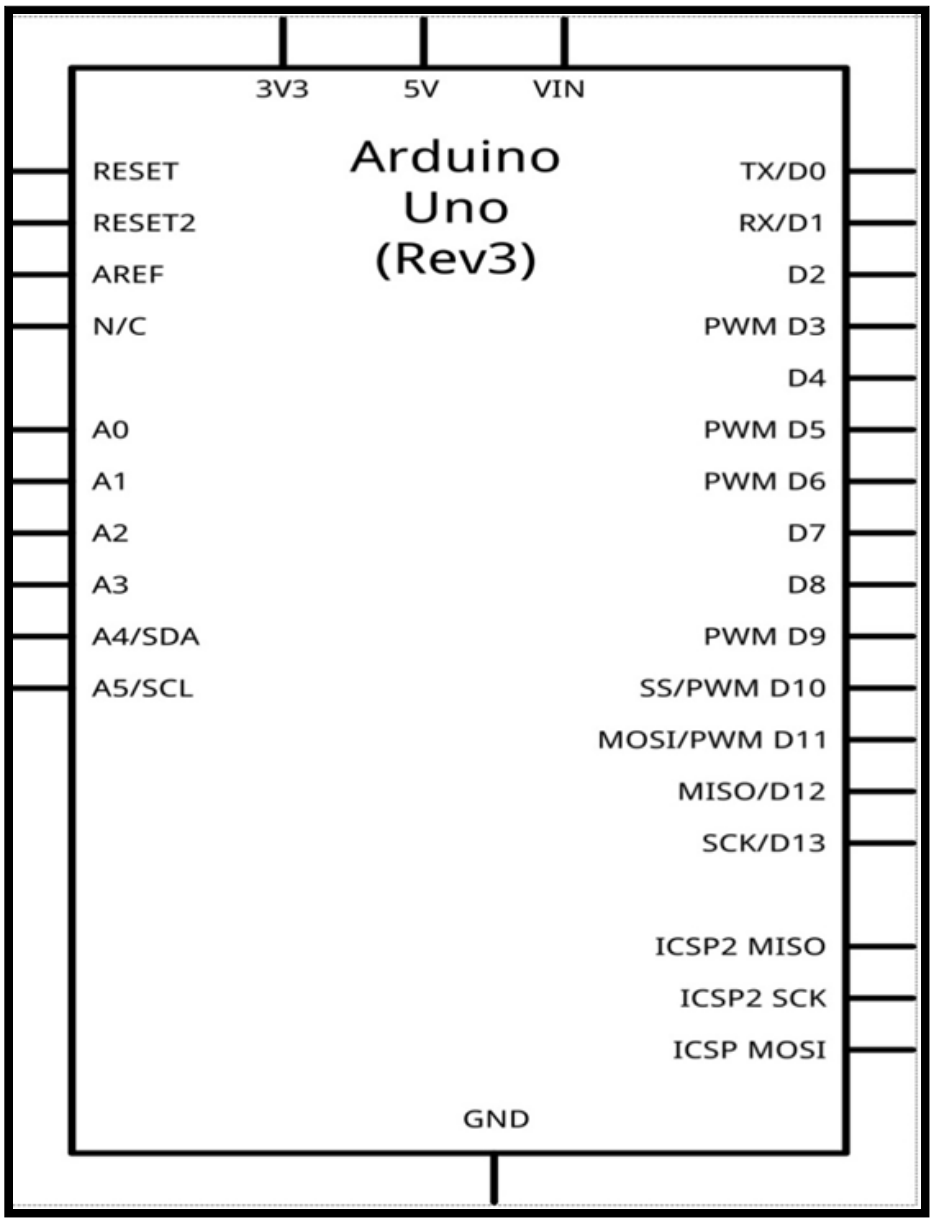


Figure 5.23: Arduino Uno

This figure represent the scheme of Arduino Uno (microcontroller) will use to control of input/output signals, simple explain of the pins it.

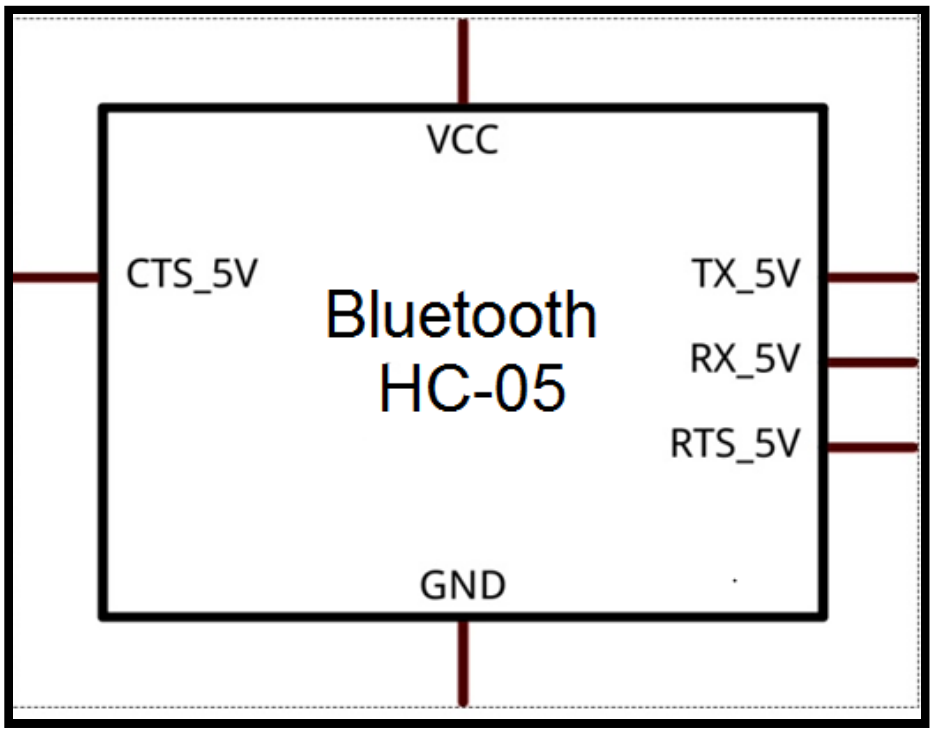


Figure 5.24: Bluetooth HC-05

Scheme of the Bluetooth model will use, input/output, power, ground pins. Use to transfer data and signals from Arduino to car mobile and versa.

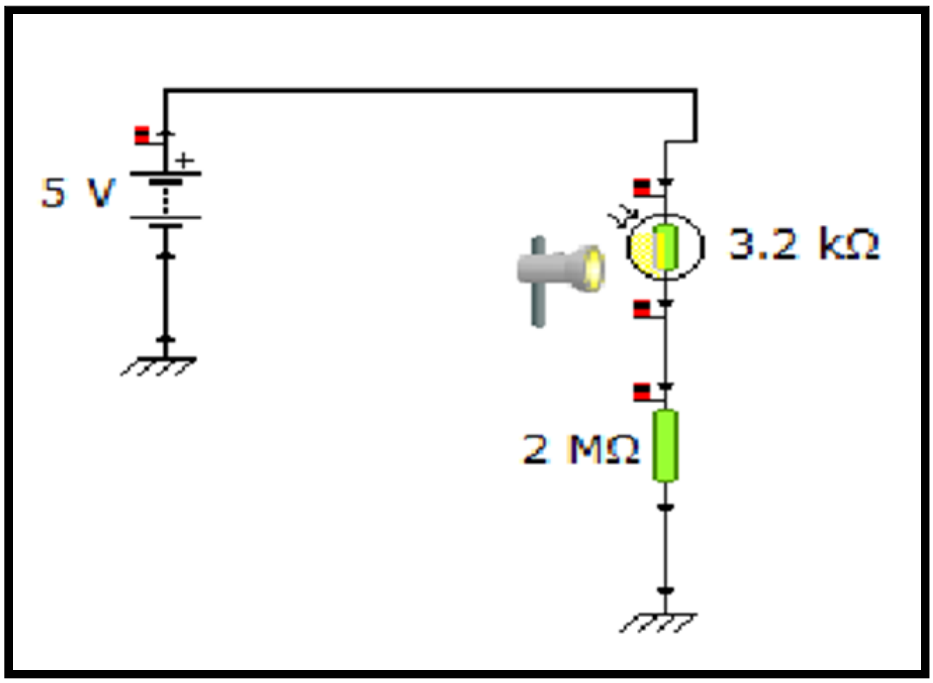


Figure 5.25: LDR sensor

Circuit of LDR sensor, which connect directly with Arduino.

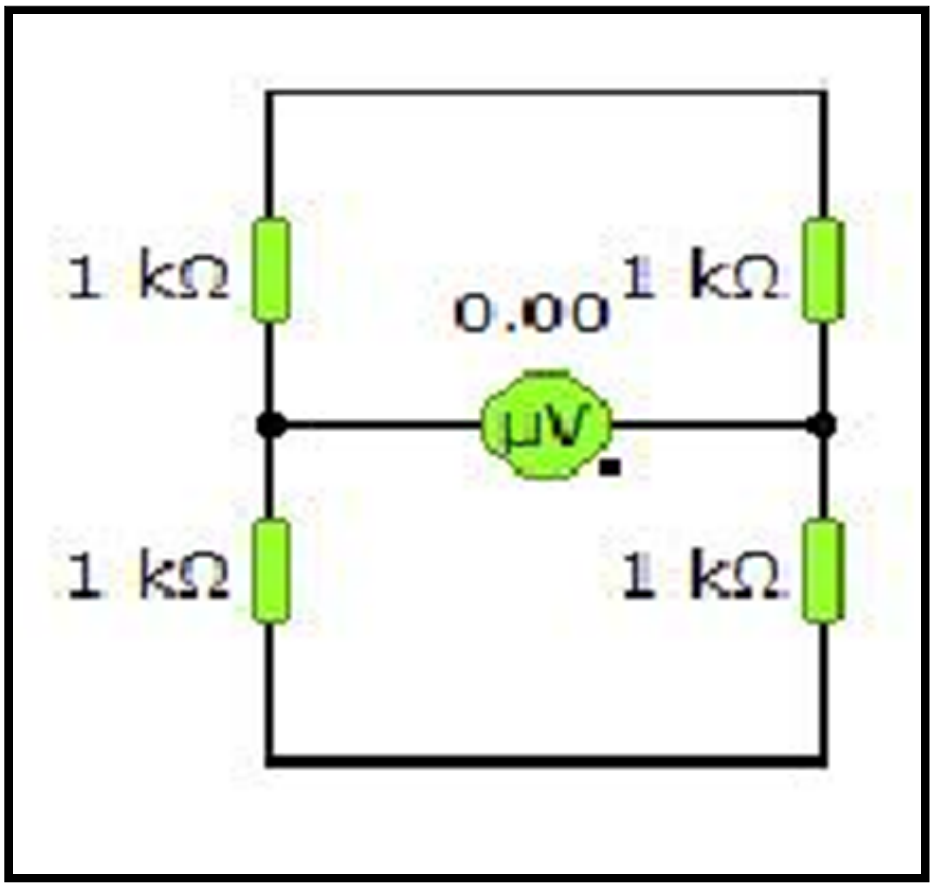


Figure 5.26: full bridge Load gage cell sensor

The circuits of load gage cell sensor gives analog value and connect directly to Arduino. Other parts of circuit had been shown and explained previously.

5.8 Summary

In this chapter we talked about the system design as a whole system, then we put a detailed block diagram for our project, we put details about the components, modules, classes that form the whole system. We also have drawn control, data, state diagrams, and we show the inner and the outer interfaces between the blocks of the system.

Chapter 6

System Implementation

6.1 INTRODUCTION

During the implementation stage, the team tests each single part of the system individually and the results have recorded. This chapter will focus on the testing stage of the project systematically, and finally a summary for the testing scenarios.

6.2 Hardware System Implementation

This section well talks about each component implantation.

6.2.1 Electrical system implementation

The next figure shows the hardware component before they are connected together. Arduino, which is the microcontroller and main component, is used to control signal came from sensors. The signal should be arrive for actuators in the vehicle. Wires and Bluetooth serve as connectors. Bluetooth model used to receive message from the smart phone and send trigger command to the software to activate it. The car phone is connect with arduino via Bluetooth and runs the software of face recognition.

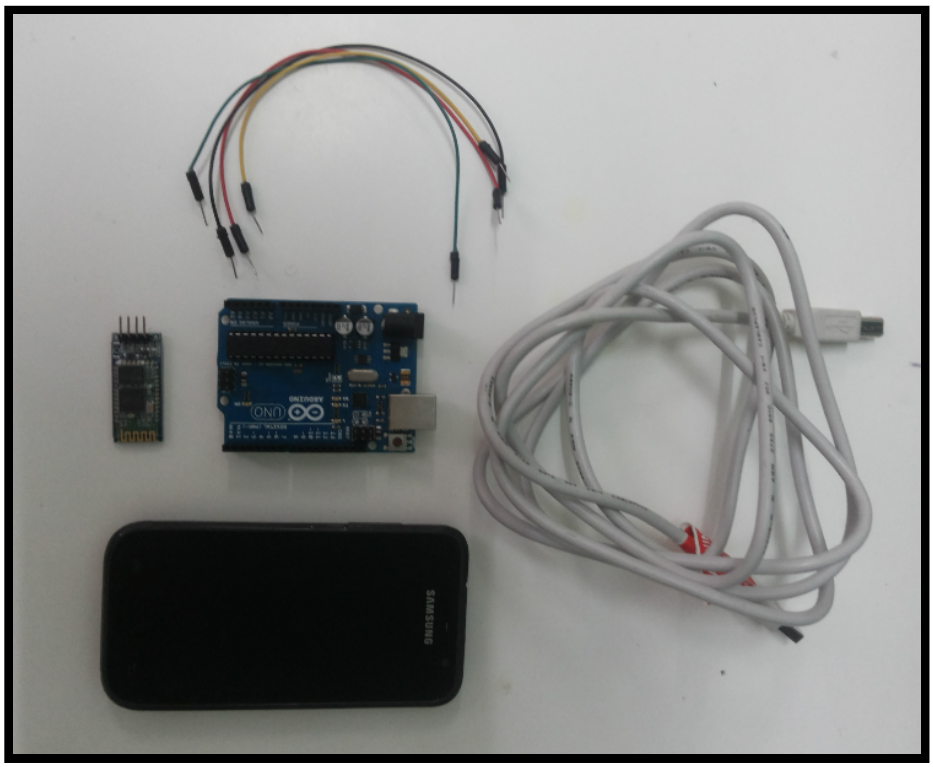


Figure 6.1: Electrical subsystem components

6.2.2 Sensors

- Load cell strain gage
  In this system we used three type of sensors first sensor is the motion detector which consist of laser diode transmitter and receiver those are installed on the vehicle doors to detect human existence inside the vehicle while it in parking .
  The second sensor in this system is the load cell strain gage sensor, which installed in the driver seat to measure the driver weight, this sensor will be gave the signal to the microcontroller to:

  1. Start face recognition and state the engine
  2. Activate or deactivate the brake actuator

  This sensor consist of four strain gage connected to together to form Whitestone Bridge will pressing it will change the voltage from 0 to 3 mV so amplification is needed figure below will shows the load cell in testing

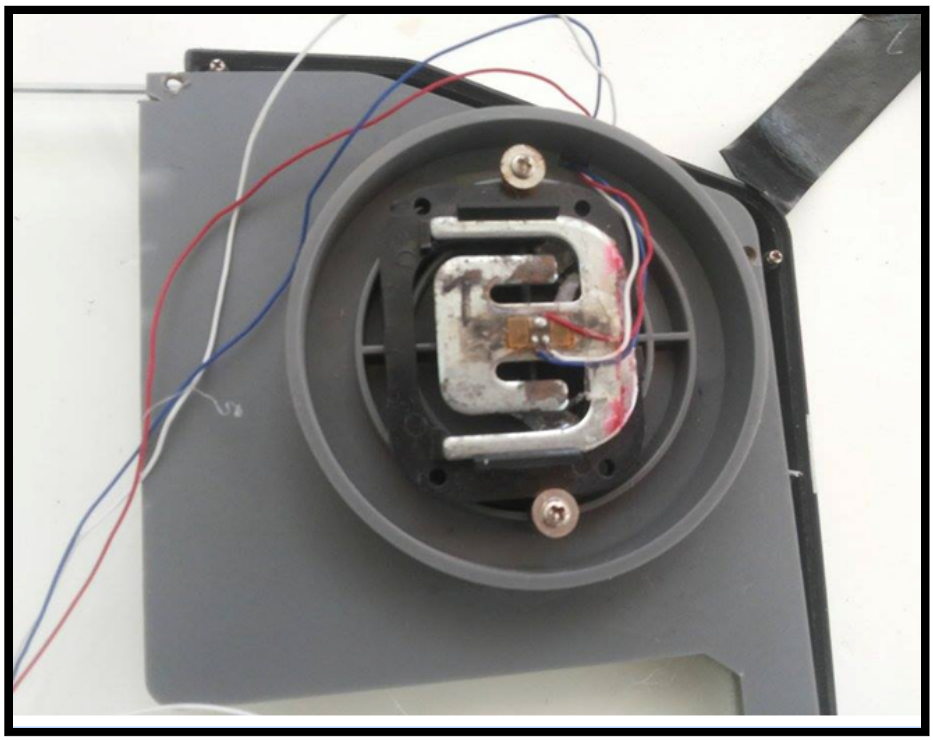


Figure 6.2: Load cell

- Alarm system

The second sensor is the alarm system sensor. In this system, we used a limit switch on the vehicle door to activate it when someone tries to open the vehicle in order to break the Arduino out of the system.

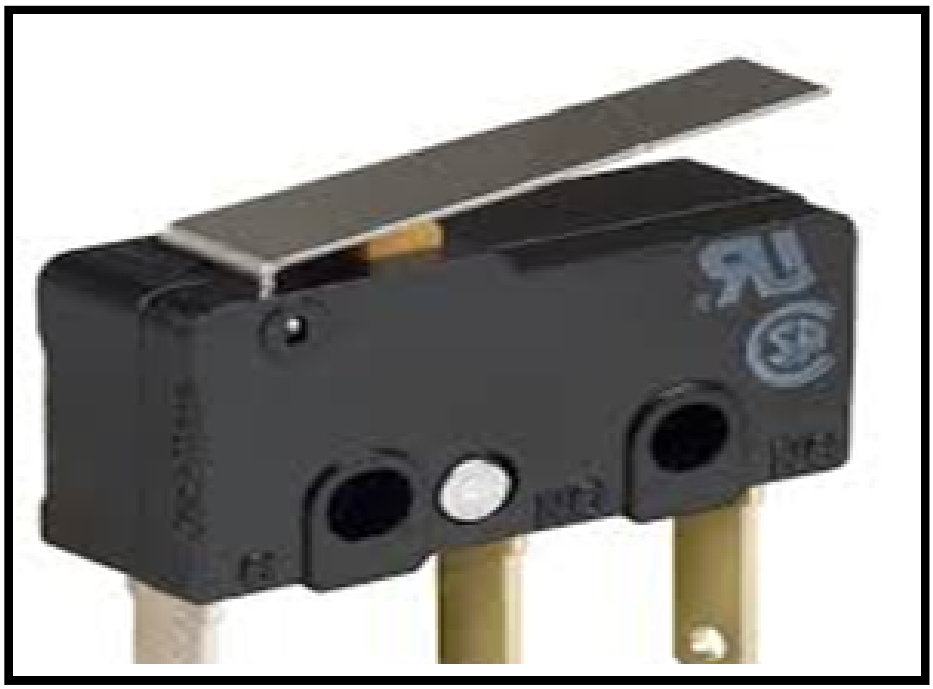


Figure 6.3: Limit switch

- LDR motion detector

The LDR photo resistor sensor is installed on the vehicle passenger's door opposite to laser transmitter to detect the existence of anybody inside the vehicle. It will be activated only when the vehicle is off. A signal will be sent from the ignition switch to the MC, which by turns will operate the LDR and laser transmitter.

6.2.3 Actuators

In this system, we have three actuators brakes motor, ventilation motor and main pump.

- Brakes motor
  The figure below shows the brakes actuators, which consist of motor with warm gear. The warm gear provide a very good torque to pull the park brakes cable by a pulley with 7 cm diameter and two groves. The warm gear will provide self-braking so it will hold its position.

Figure 6.4: Brakes motor

Moreover, the figure below shows the two control relays for the brakes motor, which will allow it to rivers its direction of rotation.

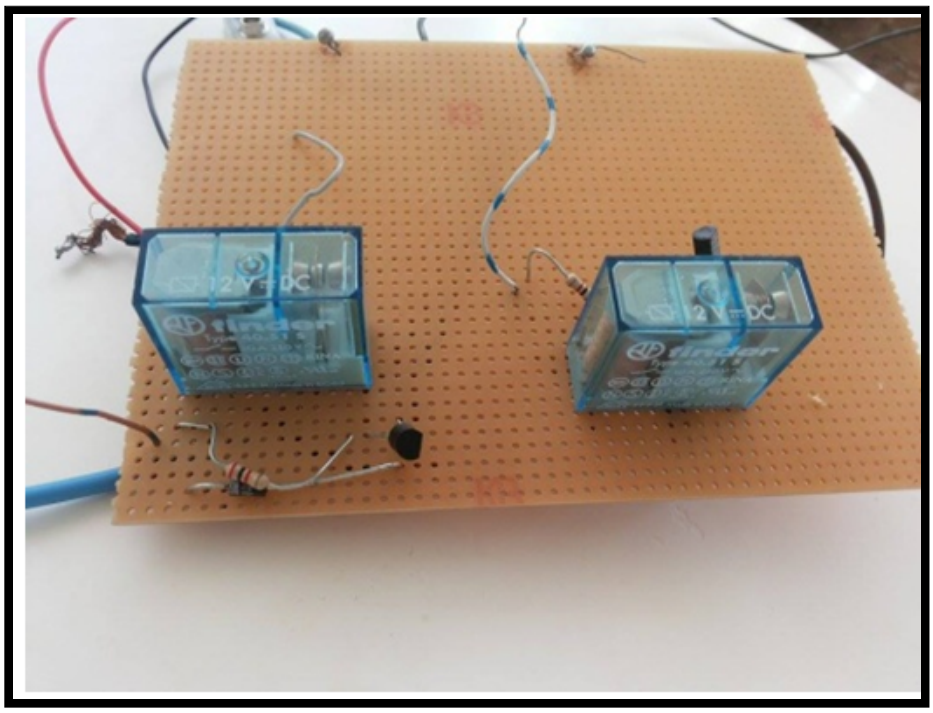


Figure 6.5: brakes motor relays

- Ventilation motor

This system aims to leverage the existing parts in the vehicle. So for ventilation, we've used the air condition parts. The figure below shows the ventilation motor with its control relay. This motor will operate when LDR sensor is trigged. In order to save power, it well operates every 30munits 10 minutes of working.

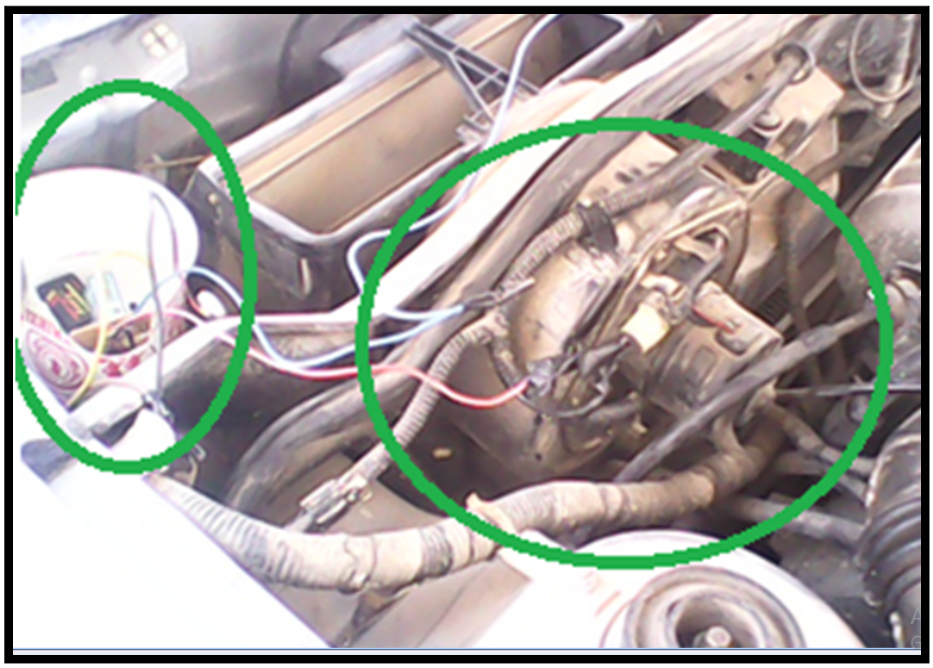


Figure 6.6: Ventilation motor

- Main fuel pump

  The fuel pump of the vehicle installed under the back passenger seat a normally open relay state. The main relay is connected with it in series, so that the on/off signal will be sent to the NO relay, which by turns will operate the fuel pump.

Figure 6.7: Main fuel pump

6.3 Installing and Preparing software System

- Server Application

The system has many sides , the right side contains the window for detecting the face and capturing the photo, and the Bluetooth information which contains the" signal from" which mean where did we get the signal from and to whom we can send the signal after capturing the photo and decide if it is the person who can drive the car or not.

Also contain the Bluetooth side which contains the scanning window and the devices that discovered.

The system also contains the training side, which save the photo after detecting and recognize the face and then put it in the train faces folder for the system.

In addition, the results if there is persons present in the scene or not and the number of faces that the system detect.

6.4 Software implementation

This section talks about software implementation.

- desktop application software
  First we include the libraries that we used in our program, these libraries include the libraries used in emgucv and other libraries that will serve us in build our program. Fig 6.8 illustrates the libraries that we have used.

```
using System;
using System.Collections.Generic;
using System.Drawing;
using System.Windows.Forms;
using Emgu.CV;
using Emgu.CV.Structure;
using Emgu.CV.CvEnum;
using System.IO;
using InTheHand;
using InTheHand.Net.Bluetooth;
using InTheHand.Net.Ports;
using InTheHand.Net.Sockets;
using System.Threading;
using System.Text;
using System.Data;
using System.Linq;
```

Figure 6.8: the used libraries

At first we have used a xml file inorder to decide if there is aface or not and this xml file is included by the emgucv library and from intel company fig 6.13 show the xml file

```
<?xml version="1.0"?>
<configuration>
<configSections>
    <sectionGroup name="userSettings" type="System.Configuration.
        <section name="Face_R_Emg.Properties.Settings" type="Syst
    </sectionGroup>
</configSections>
<startup><supportedRuntime version="v2.0.50727"/></startup><userS
        <Face_R_Emg.Properties.Settings>
            <setting name="device_From" serializeAs="String">
                <value>0</value>
            </setting>
            <setting name="devices_Too" serializeAs="String">
                <value>0</value>
            </setting>
        </Face_R_Emg.Properties.Settings>
    </userSettings>
</configuration>
```

Figure 6.9: xml file

then the program will check if there is faces in the ”train faces” folder or not ,fig 6.8 show the code which check the faces stored in the ”train faces” folder

```
//Load of previus trainned faces and labels for each image
string Labelsinfo = File.ReadAllText(Application.StartupPath + "/TrainedFaces/TrainedLabels.txt");
string[] Labels = Labelsinfo.Split('%');
NumLabels = Convert.ToInt16(Labels[0]);
ContTrain = NumLabels;
string LoadFaces;
```

Figure 6.10: the code for checking the faces in ”train faces” folder

In our program we have a function that will startup the camera and start capturing and convert the captured photo into grayscale this function is The” Frame Grabber ” function. Fig 6.15 show the Fram Grabber function.

```
void FrameGrabber(object sender, EventArgs e)
{
    label3.Text = "0";
    //label4.Text = "";
    NamePersons.Add("");


    //Get the current frame form capture device
    currentFrame = grabber.QueryFrame().Resize(320, 240, Emgu.CV.CvEnum.INTER.CV_INTER_CUBIC);

    //Convert it to Grayscale
    gray = currentFrame.Convert<Gray, Byte>();

    //Face Detector
    MCvAvgComp[][] facesDetected = gray.DetectHaarCascade(
  face,
  1.2,
  10,
  Emgu.CV.CvEnum.HAAR_DETECTION_TYPE.DO_CANNY_PRUNING,
  new Size(20, 20));
```

Figure 6.11: The" Frame Grabber " function

If the photo we captured is the same with the photos in the train faces folder the program will start scan the devices to search for bluetooth connectionand send a signal to the bluetooth in order to send a signal to microcontroller start the engine of the car. We have function for connecting to devise and send /receive signals form and to it, this function is "sendsignaltoodecice()" fig 6.12 show the "sendsignaltoodevise()" function.

```
void SendSignalToodevice()
{
    listBox1.SelectedItem = Face_R_Emg.Properties.Settings.Default.devices_Too;
    deviceInfo = devices.ElementAt(listBox1.SelectedIndex);
    updateUI(deviceInfo.DeviceName + " was selected, attempting connect");

    if (pairDevice())
    {
        updateUI("device paired..");
        updateUI("starting connect thread");
        Thread bluetoothClientThread = new Thread(new ThreadStart(ClientConnectThread));
        bluetoothClientThread.Start();
```

Figure 6.12: the "sendsignaltoodevise" function.

Here are the most important classes which we used :

```
publicfinalclass AddToSetup extends PreferenceActivity
{
publicstaticclass AddToSetupFragment extends PreferenceFragment
implements android.view.View.OnClickListener
    {

staticfinalboolean $assertionsDisabled;
privatefinalString TAG = "FULAddToSetup";
private Button mCancelButton;
private Button mContinueButton;
private TextView mHeaderText;
private TextView mInfoText;

publicvoid onClick(View view)
        {
if (view.getId() == 0x7f080003)
            {
                getActivity().finish();
return;
            }
if (!$assertionsDisabled && view.getId() != 0x7f080004)
            {
thrownew AssertionError();
            } else
            {
                Intent intent = new Intent(getActivity(),
com/android/facelock/SetupFaceLock);
                intent.addFlags(0x2000000);
                intent.putExtra("addToSetup", true);
                startActivity(intent);
                getActivity().finish();
return;
            }
                                                                    }
```

This class is concern about create an interface in order to save and fix the face of the user in the system.

```
publicfinalclass FaceLockUtil
{

privatestaticString GALLERY_FILE_NAME = "lockscreen.gal";
privatestaticString TEMP_FILE_NAME = "temp.gal";
publicstaticfinalString sEnrollStateString[] = {
"ENROLL_STATE_FACE", "ENROLL_STATE_NO_FACE",
"ENROLL_STATE_NO_LANDMARKS", "ENROLL_STATE_OFF_CENTER",
"ENROLL_STATE_DONE", "ENROLL_STATE_ERROR"
    };
privatestaticString sGalleryFilename;
privatestaticfloat sGalleryVariance[] = newfloat[1];
privatestaticboolean sHaveSettings = false;
privatestaticfinalObject sLock = newObject();
privatestaticfloat sMeanGallerySimilarity[] = newfloat[1];
privatestaticint sNumEnrollments[] = newint[1];
privatestaticfinal LockScreenSettings sSetupSettings = new
LockScreenSettings();
privatestaticString sTempGalleryFilename;
privatestaticfinal LockScreenSettings sUnlockSettings = new
LockScreenSettings();
publicstaticfinalString sUnlockStateString[] = {
"UNLOCK_STATE_ALLOW", "UNLOCK_STATE_DENY", "UNLOCK_STATE_MAYBE",
"UNLOCK_STATE_NO_FACE", "UNLOCK_STATE_NO_LANDMARKS",
"UNLOCK_STATE_FACE_OFF_CENTER", "UNLOCK_STATE_LIVELINESS_START",
"UNLOCK_STATE_LIVELINESS_MOTION", "UNLOCK_STATE_ERROR"
    };
```

This class is concern about adjust and specificate to a list of Characteristics of the face in order to fits the Characteristics of the human face.

```
publicfinalclass SetupEndScreen extends PreferenceActivity
{
publicstaticclass SetupEndScreenFragment extends PreferenceFragment
implements android.view.View.OnClickListener
    {

privatefinalString TAG = "FULSetupEndScreen";
private Button mCancelButton;
private Button mContinueButton;
private TextView mHeaderText;
private TextView mInfoText;

publicvoid onClick(View view)
        {
if (view.getId() == 0x7f080004)
            {
                getActivity().finish();
return;
            } else
            {
                Log.w("FULSetupEndScreen", (new
StringBuilder()).append("invalid button, id =
").append(view.getId()).toString());
return;
            }
        }
```

In this class we design a final interface that will be displayed to the user after he save his photo in the system .

- Ardunio software

Many operations occur by Arduino program, Bluetooth programming, sensors analogue input handle, different output voltage, ECT. As sample of the Arduino code we will represent Bluetooth programming.

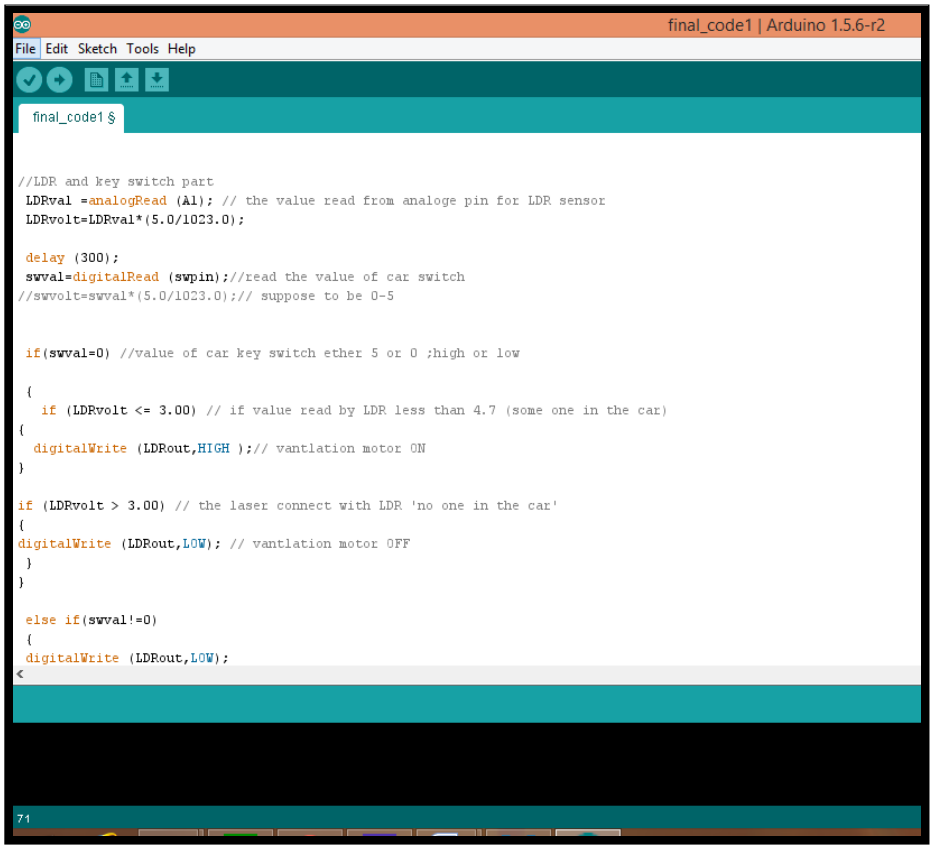


Figure 6.13: Arduino programming

This part of code show how Bluetooth receive face recognition result, and Arduino response for this result by provide injection with 5 volt or zero volt , depended on the receive result.

6.5 summary

In this chapter we have explained the structure and the installation process of each subsystem.

Chapter 7

Testing

7.1 Overview

This chapter describes the project achievements, the challenges and the problems that faced the team during the implementation stage with their suggested solutions, and the conclusion from this project.

7.2 Subsystems testing

LDR sensor and car run switch this test for the response of the LDR sensor of the light, which is laser in this case, in present of car run switch.

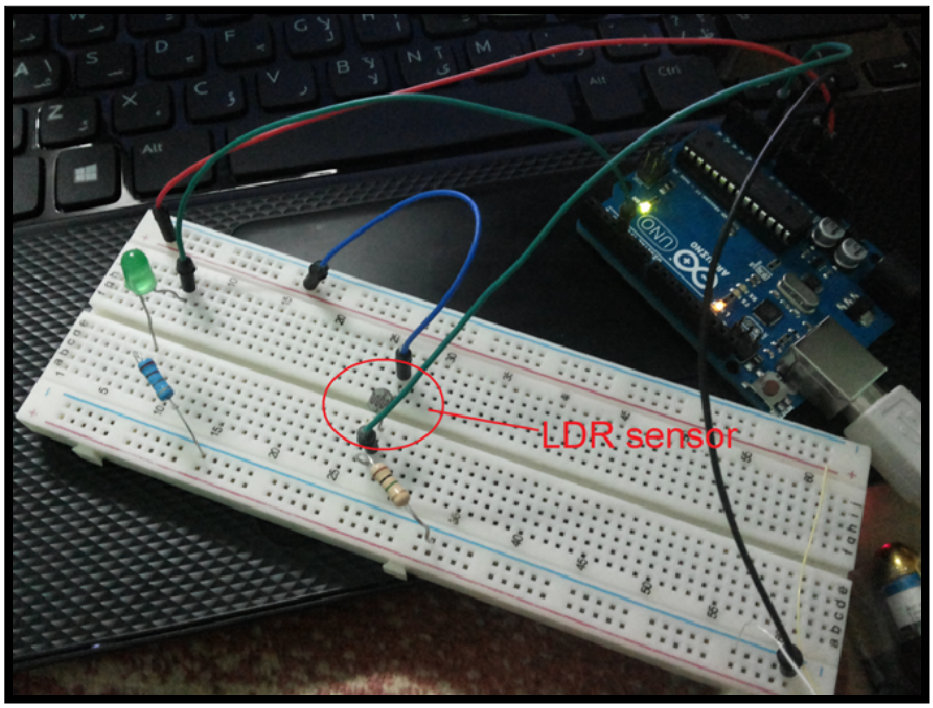


Figure 7.1: LDR with connection

In present of someone in the vehicle the light will be cut off and ventilation motor will turn on, if there is no one the light will not be Interrupt, so no signal will reach ventilation motor and it will be off.

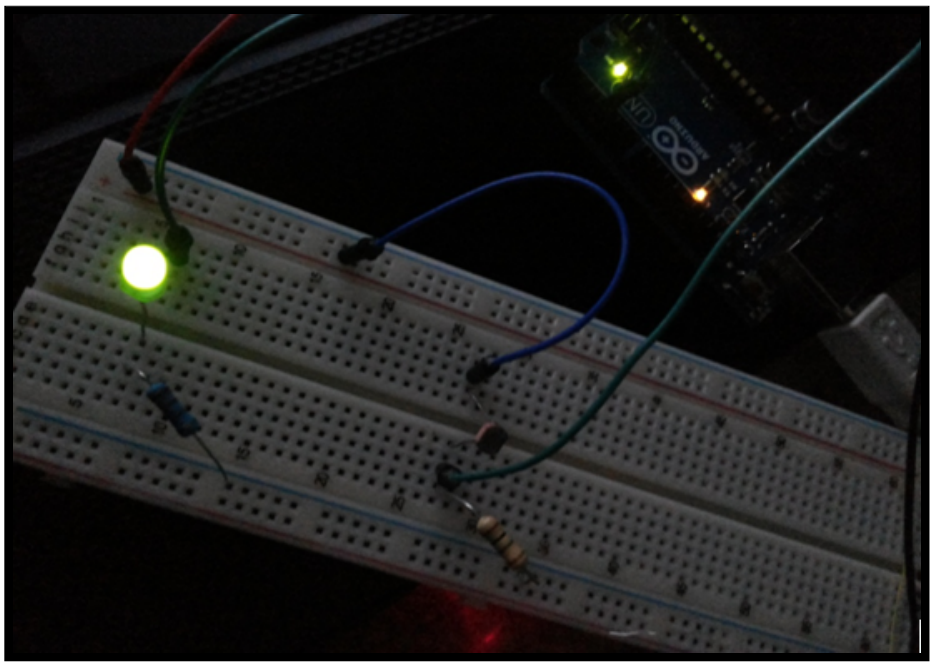


Figure 7.2: LDR with no laser Concentrated, led is ON

When there is no light on LDR. Arduino will provide ventilation motor with logic 1 to activate it.

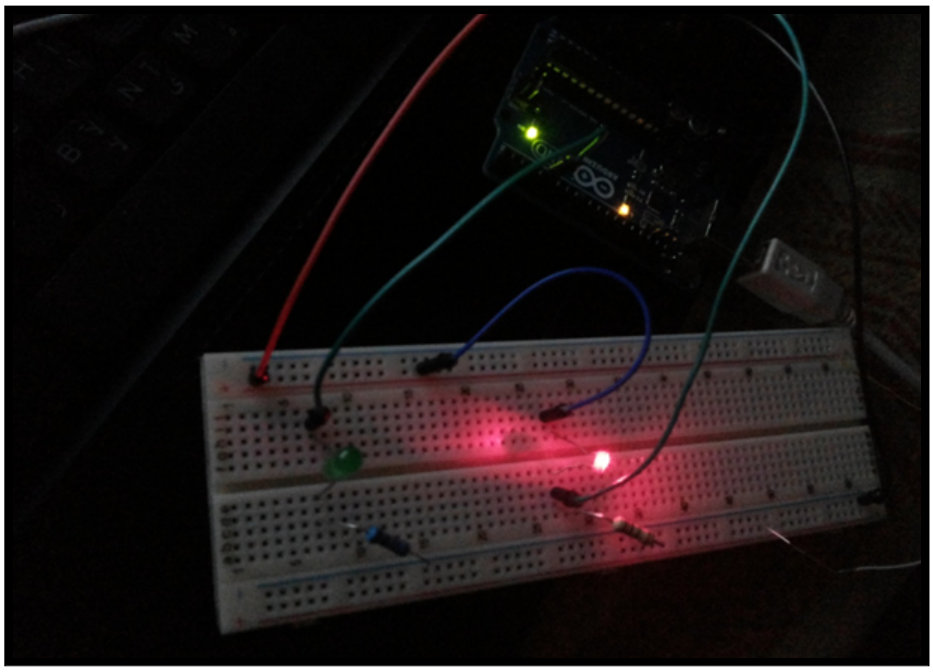


Figure 7.3: LDR with laser Concentrated, led is OFF

The test was performed in dark, because this sensor is very sensitive to light. Therefore,

we make special black box for it to isolate light sources other than the laser light.

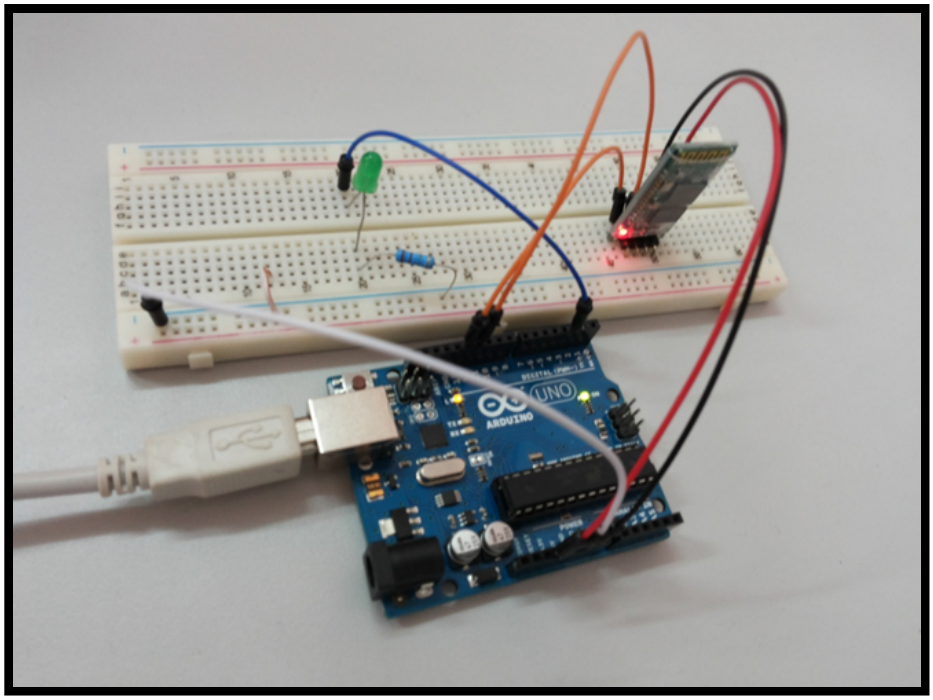


Figure 7.4: Bluetooth receive “OFF” word from computer

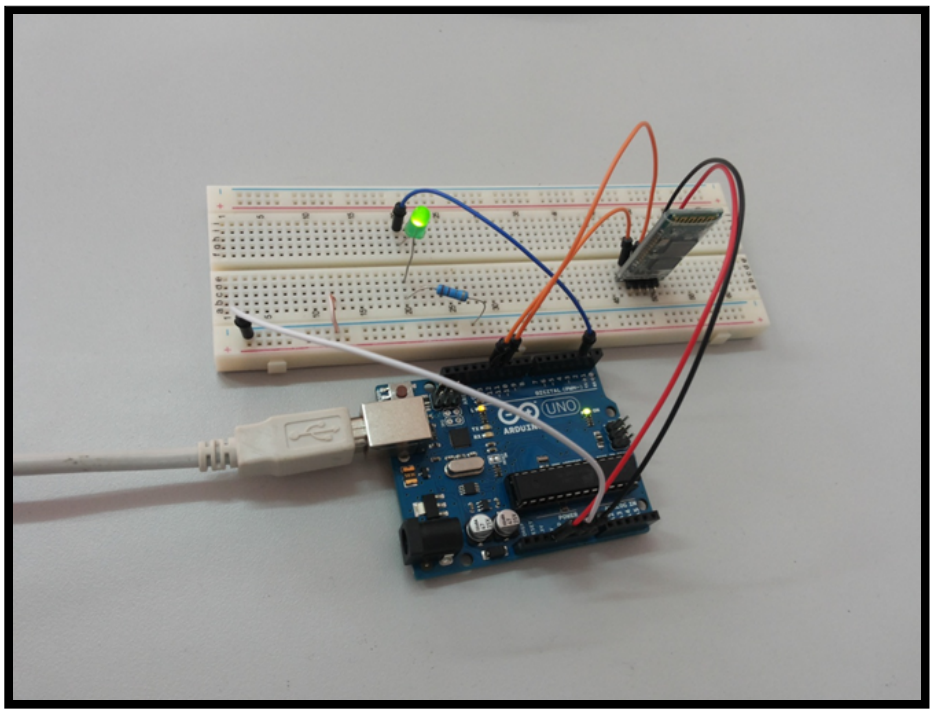


Figure 7.5: Bluetooth receive “ON” word from car phone

This subsystem depends on the result of face recantation either there matches or mismatch between the photos taken by the camera and the photos saved in the computer database. If there is a match, the vehicle will work in normal way, if there is not the mechanical part will rang method to deactivate the vehicle.

Load cell subsystem test:
as mention before load cell sensor was used to measure weight. Then it turns it to voltage for control purposes. Load cell role is to report if there is a mature person Behind Steering wheel. This judge is done by testing driver weight against the minimum allowed weight stored inside the microcontroller.
If the weight of the person who are sitting on the driver’s seat is greater or equal to the specified weight, breaks will work.

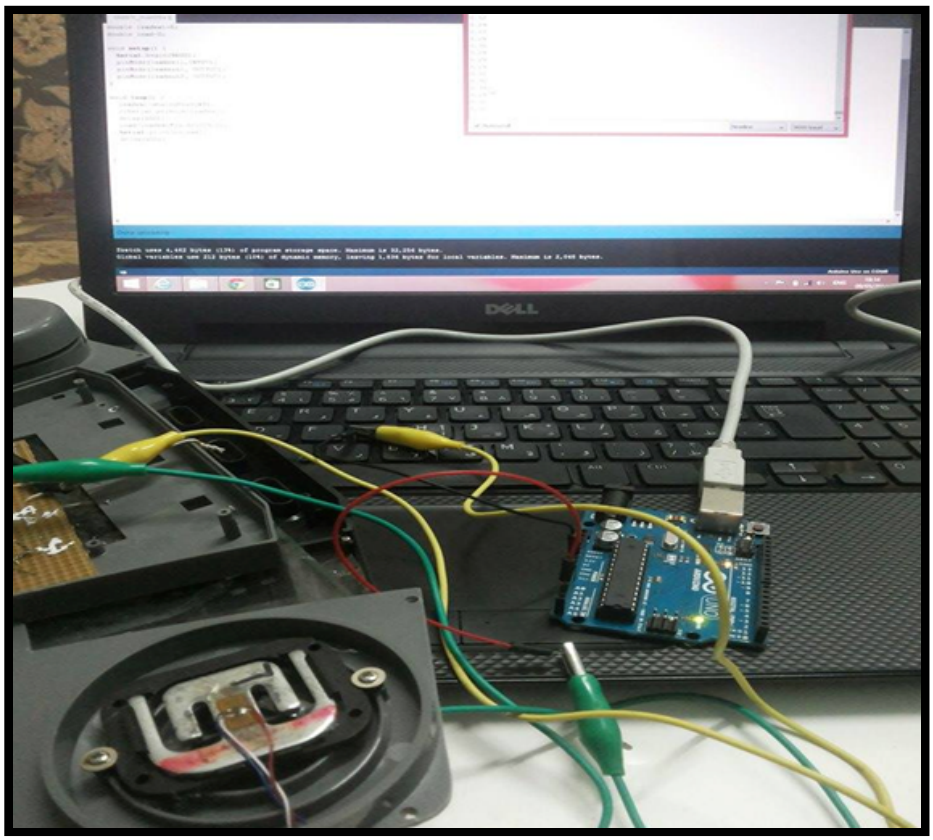


Figure 7.6: Arduino with load cell

The testing of the load cell gave us the flowing outputs values in different mass
57Kg almost give us 1.5V
65Kg almost give us 2V
72Kg almost give us 2.5V

So in this system we took the value 1.5for 57Kg to start image processing and deactivate brakes motor.

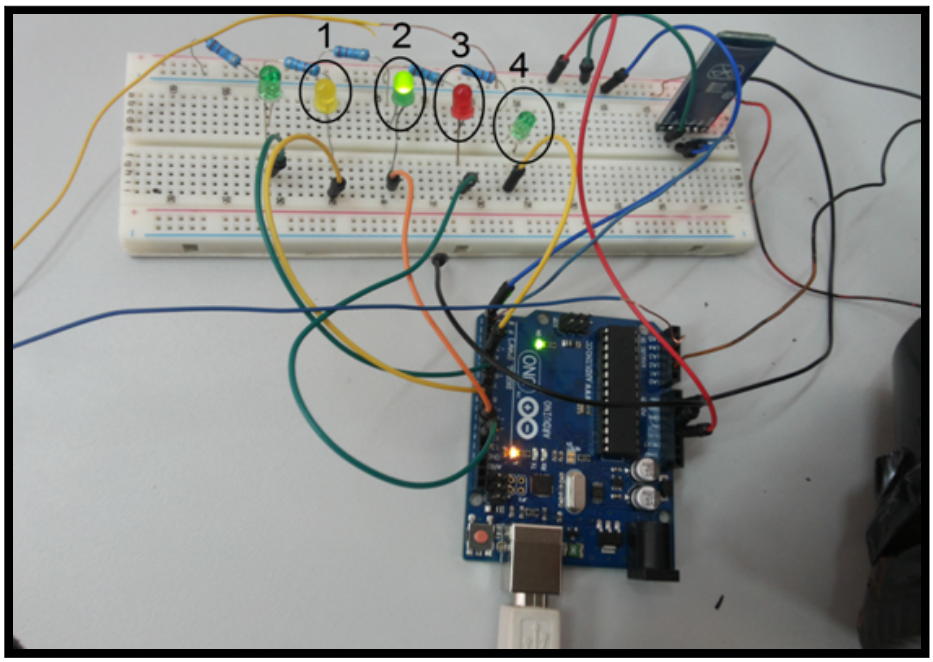


Figure 7.7: Arduino subsystem test

After we were done with subsystems code, it's time to test Arduino code as one unit. This includes LDR sensor, load cell sensor, Bluetooth, and as it shown we use lads with different colours for test, Led number 1 for break (turn right)
Led number 2 for break (turn left)
Led number 3 for face recognition result
Led number 4 for LDR sensor result

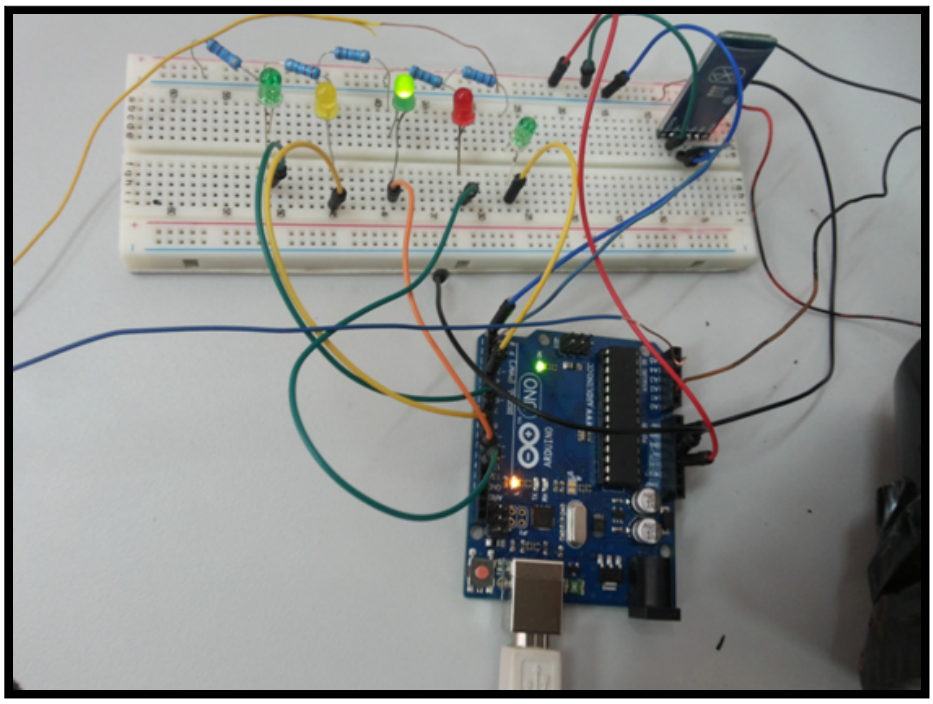


Figure 7.8: Arduino with sensors test

Led number 2 is on because the weight on load cell sensor is not eligible weight condition (less than 57 Kgm).

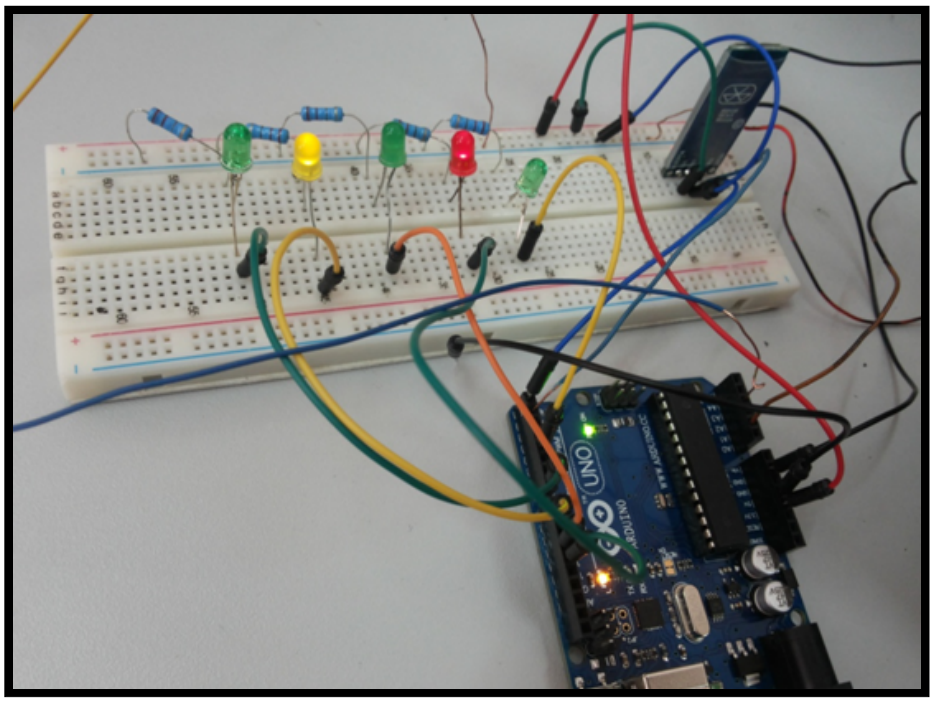


Figure 7.9: proper wiegh and match in fece recognition process

In figure 7.7 led number 1(yellow led) is ON, which mean the weight on load cell satisfy weigh conduction (¿ 65 Kgm) so the Bluetooth send character to the car computer to start face recognition process ,and there was a match ¡ that why led number 3(red led) in ON.

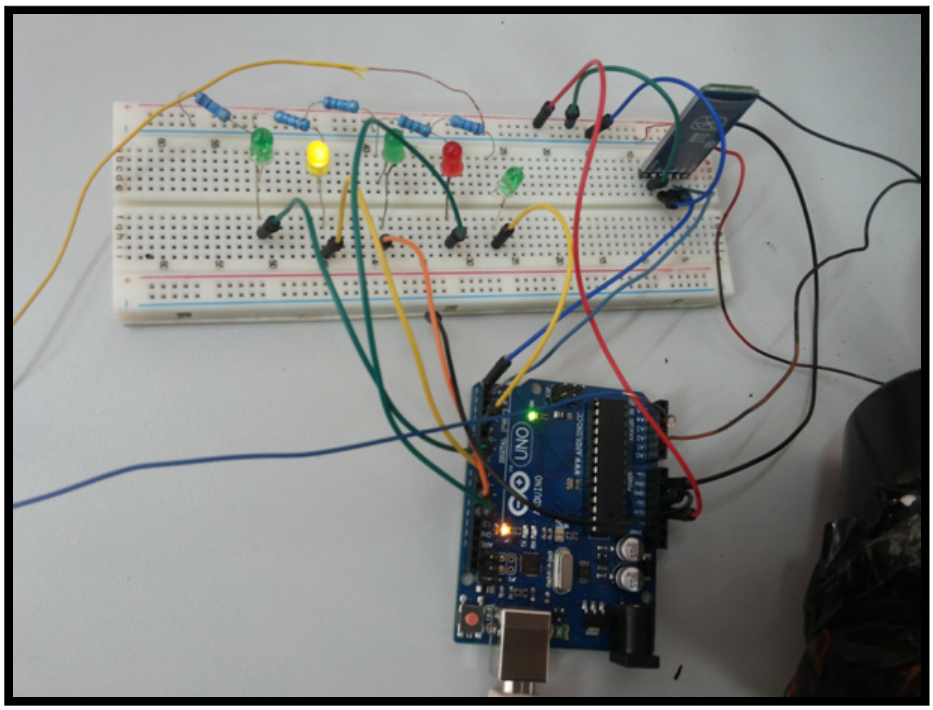


Figure 7.10: mismatch in fece recognition process

Weight is proper but there is mismatch in face recognition process, so led number 3(red led) is OFF.

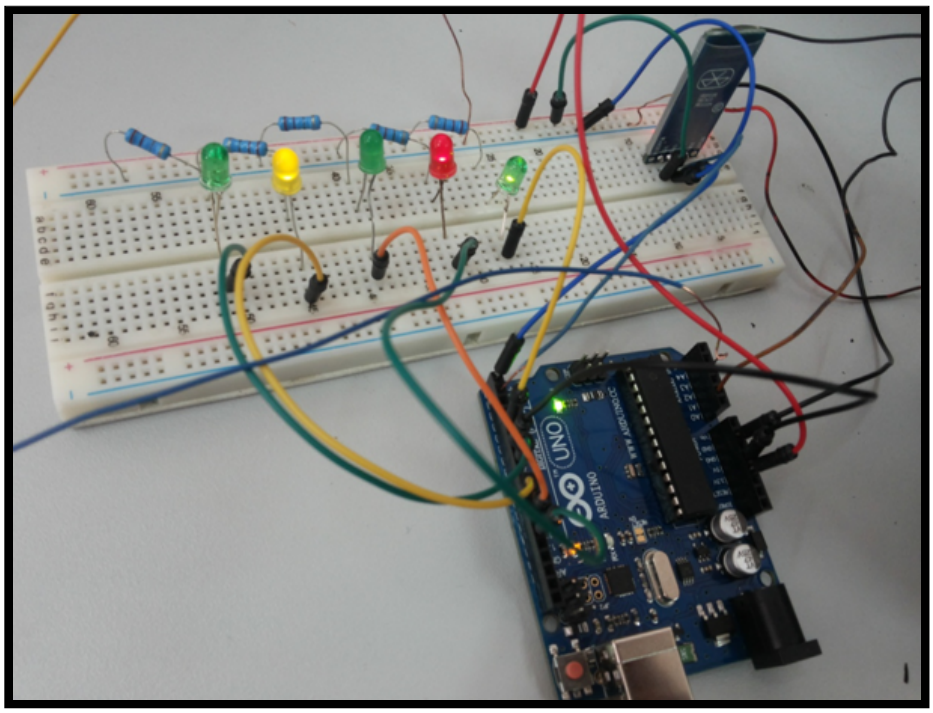


Figure 7.11: LDR, load cell and fece recognition working simultaneously

Figure 7.11 represent LDR, load cell and fece recognition subsystem working together and simultaneously, where led number 4 show the work of LDR sensor.

7.3 Project software testing

This section will discuss the most possible testing scenarios that may occur during system usage.

- At the server side

1. Pair mobile Bluetooth to Bluetooth module to be able to receive/send signals between them.

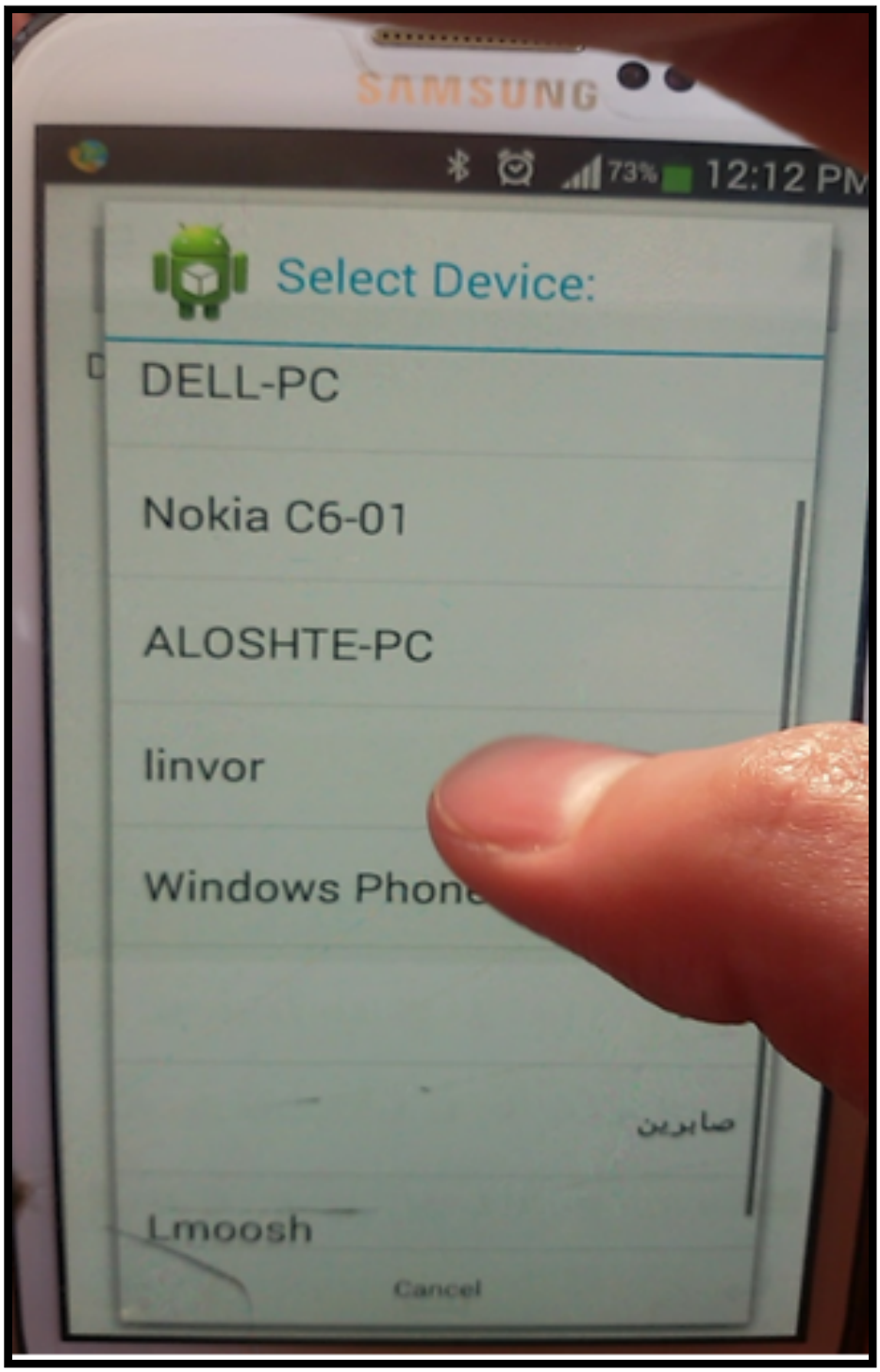


Figure 7.12: Chose Bluetooth module in order to receive/send signals.

2. Bluetooth module appears that it connects to the mobile Bluetooth.

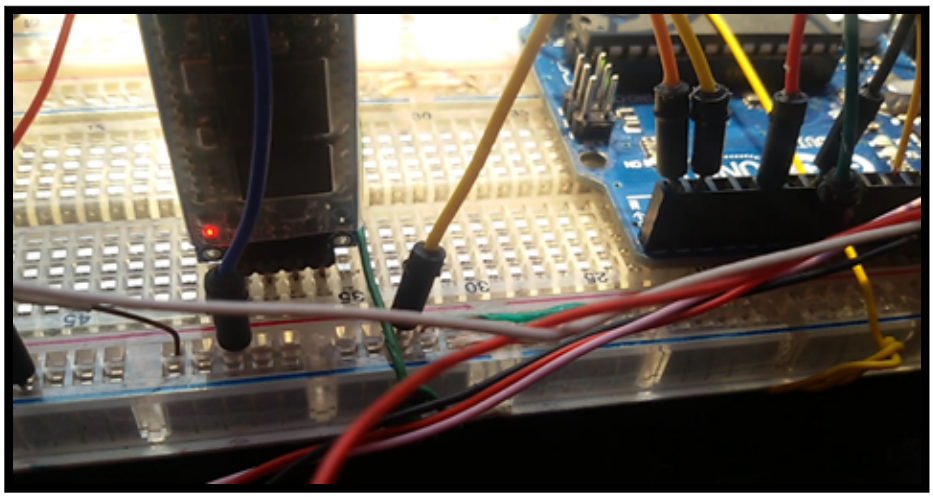


Figure 7.13: Bluetooth module connects to mobile Bluetooth.

3. After the Bluetooth module received a weight signal from Arduino, it will send an ”M” signal to the mobile.

4. Mobile will run the camera and take a photo for the driver.

5. There are two cases for that photo:

Case 1: matches with the saved photo

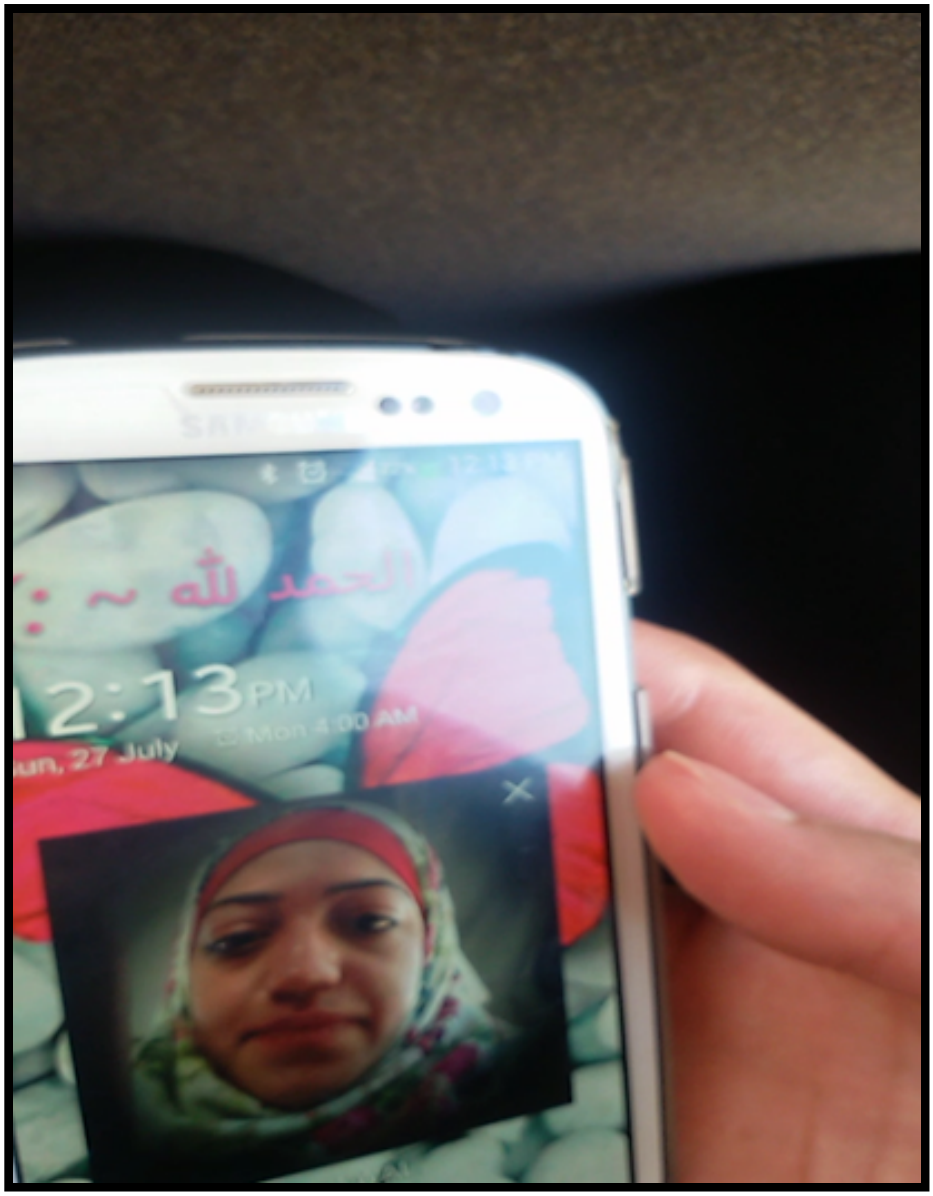


Figure 7.14: face detecting/matching case

In this case, mobile will send a ”1” signal via Bluetooth to the Bluetooth module to be sure that this person is authorized to drive the car.

Case 2: If the system did not recognize the face it will send a ”0” signal via Bluetooth to the Bluetooth module to deactivate the car.

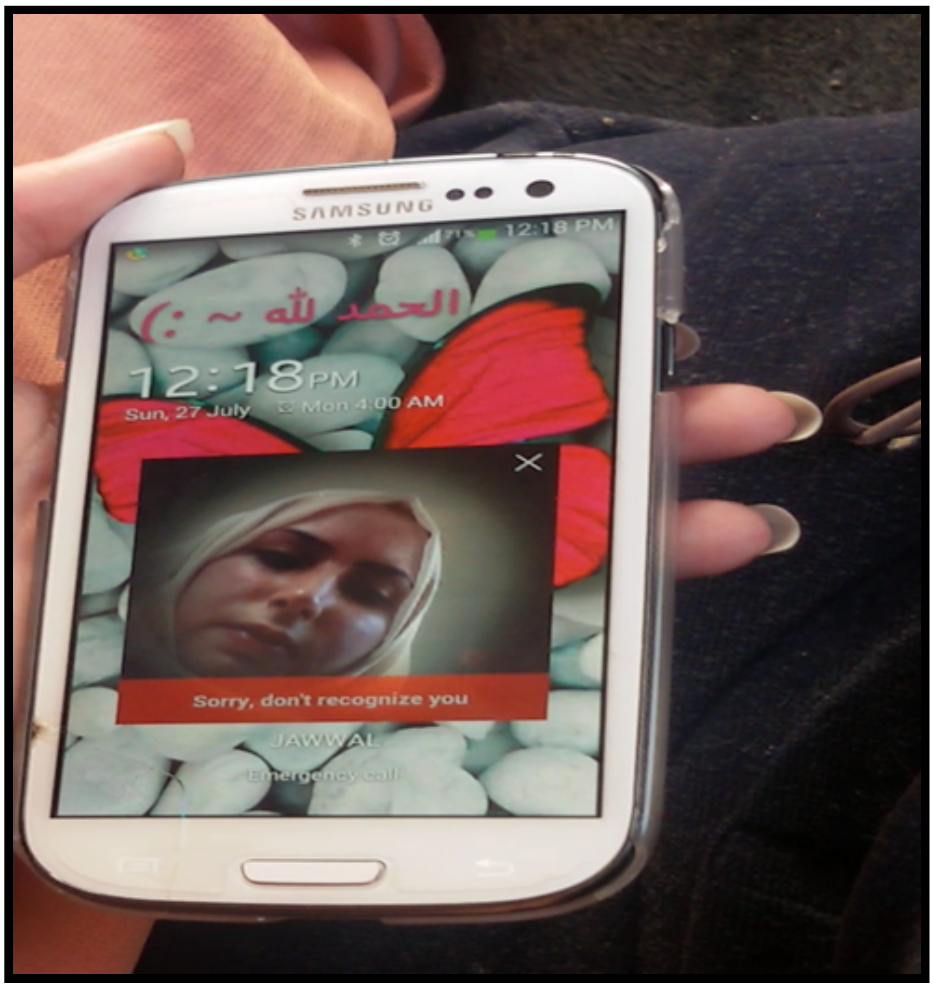


Figure 7.15: face detecting/mismatching case

7.4 Achievements

Through this semester, we build a program that detect faces then recognize and then take a decision according to the recognition and we build a mechanical and electrical system connected with each other with a MC and connected with mobile application.

- Design graphical user interface needed for our project.
- Built a mobile application.
- Construct Arduino program can deal with different kind of inputs (analog, digital), and give outputs response to those inputs.
- Programmed Bluetooth device to send and receive data depends on the system needs.
- Construct a Mechanical system Linked with software.

7.5 Challenges

This section will describe the main challenges that faced our team during the implementation stage.

- The programming environment

Choosing the suitable environment was the first challenge that the team has faced during the implementation stage, firstly the team choose Java environment to build the system, and as you know, the mobile has limited power and memory resources.

- Using vehicle systems

The main purpose of our project is to use the vehicle systems like braking system, we aimed to use ABS system but the vehicle does not have ABS system on it so we moved to plan B, also the alarm system was broken in the vehicle so we cannot use it.

7.6 Conclusion and Recommendations

During this semester we concludes many things from this experience this section will discuss the results and conclusions.

- Working with a team is very important thing, and give a power and meaning to the project, also during work as a team, too many solution will be gotten and this help us a lot when we faced some challenges, each one has his/her own idea and the suggested solution was made from these ideas.

- It is important to program an application using Android because android applications are one of the most common applications.

- Dealing with images in term of image processing issue is not an easy task, and it was harder than we thought. Which mean that the ability to have 100percentage results is not possible.

- In future, we can use ABS system for vehicle braking and antitheft systems.

- It is possible to use the vehicle ECU to implement such a system.

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