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DESIGNING AND IMPLEMENTING OF INTELLIGENT ANTI-THEFT CAR SECURITY SYSTEM BASED ON ATMEGA328P MICROCONTROLLER

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Master Thesis

Supervisor

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by

Shakir Mahmood Ahmed Al-janabi

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Shakir Mahmood Ahmed Al-janabi

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ABSTRACT

DESIGNING AND IMPLEMENTING OF INTELLIGENT ANTI-THEFT CAR SECURITY SYSTEM BASED ON ATMEGA328P MICROCONTROLLER

M.S., Information Technology, Altinbaş University

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Recently, in the last few years, it has been noticed that the theft of cars and the use of stolen cars in suspicious acts by robbers has been increased. The robbers use modern and new methods to prevent theft of different cars. It is therefore necessary to find serious solutions to protect vehicles from theft. In this system the Arduino microcontroller, vibration sensor, GSM SIM 800L MINI module and Bluetooth HC-05 are using to implement the system, the vibration sensor used the purpose of detecting the vibration resulting from the operation of the engine of the car when the vibration detected the message is sent through the GSM unit and the alarm whistle turning “ON” in order to alert the owner of the car. When the car owner wants to operate his car should be entering the secret code to run the car engine through the 4*4 keypad and also requires to send specific command from the smart mobile phone through the Bluetooth to make car engine turning “ON” and otherwise the car does not work, when the thief tries to enter the password more than twice the alarm will be turning “ON” and all cases will appear on the screen of special software was chosen for this purpose all these to make the system reliable and more secure.

Keywords*:* Arduino UNO, GSM, Bluetooth, vibration sensor, keypad.

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LIST OF ABBREVIATIONS

WI-FI : Wireless-FI.

LED : Light Emitting Diode.

IDE : Integrated Development Environment.

SMS : Short Message Service.

DC : Direct current.

GPRS : General Packet Radio Service.

PWM : Pulse Width Modulation.

SRAM : Static random access memory.

GSM : Global System for Mobile.

CMOS : Complementary Metal Oxide Semiconductor.

RISC : Reduced Instruction Set Computer.

RFID : Radio Frequency Identification.

CPU : Central Processing Unit.

IoT : Internet of Things.

ADC : Analog to Digital Converter.

BJT : Bipolar Junction Transistor.

1. INTRODUCTION

In the last few decades, car thieves are becoming more regular, advanced, and have extent experience to robbery the cars existing in garages at office, home or in public parking garages. If we looked about history of car theft we will see that in 1981, greater than 1,073,988 motor cars were robbed, value a total of over 3.4 billion dollars. This represent a major loss and a major number of cars than ever before. In fact, the introduction of improved security measures in the late 1970s appears to have capped a car theft rate which had more than redoubled in the previous decade, so that the 1980s indeed testified a slight descend in car thefts. However, the obvious decline in the robbery rate does not mean that the problem has reduced in severity, so there are several reasons to consider that the problem has changed in ways that gauntlet until the most foolproof anti-theft devices. First, car theft is no longer an issue of juvenile joyriding. It is become an adult crime increasingly. The rate of persons arrested for car theft who were less than the age of ~8 decrease from 56 percent in 1970 to 40 percent in 1981. A synchronous decrease in cases clearance rate is proportional with the decrease in juvenile participation: younger are usually easier to catch than adults, since they are inexpert at hiding their crimes and may prevalence stories of their exploits. among schoolmates and friends. The commensurate excess in arrests of adults, who are more difficult to identify. and apprehend, suggests that many more of them are active in car theft than before. More than 93% of vehicle robs occur in metropolitan areas where car robbery remains a common problem. In particular, Western states experience a high average car theft, while a car or lorry was robbed in 2007 every 28,8 seconds. In September 2008 the FBI Uniform Crime Reports showed an estimated $ 7.4 billion in 2007 for 1.1 million car robberies. The expensive ownership crimes in the United States, auto theft outcomes in pecuniary losses to victims and affects auto insurance costs for the public leadership and public safety costs for state and local governments. As we see in figure.1.1, the development in the technology shows decrease in the range of car steal [1], [2].

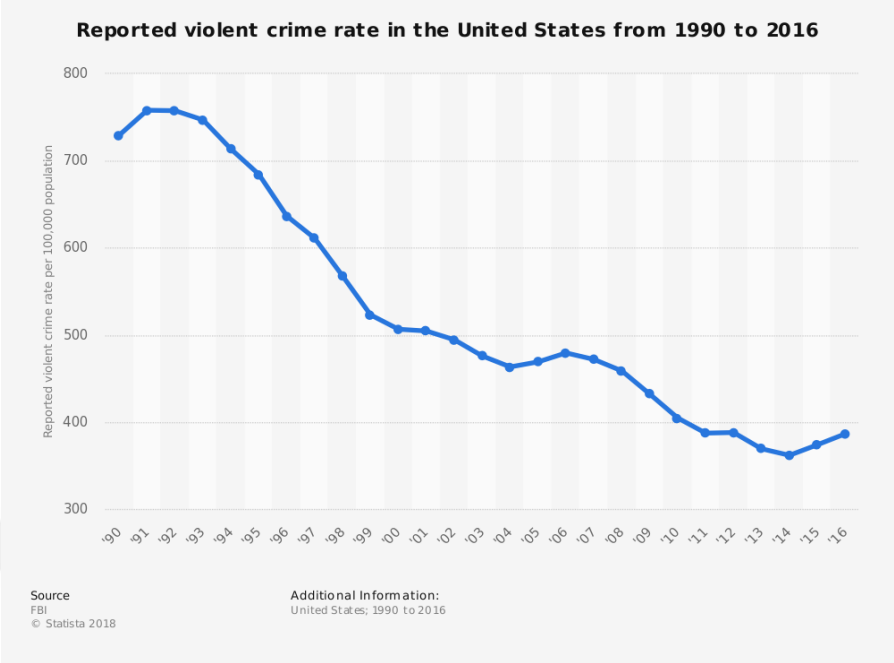

Figure 1.1: Car theft rate period 1990-2016 [2].

Normal car theft, like those perpetrated by joyriding juveniles, still exists but has become a lesser part of the auto theft trouble. Increasingly, car theft is a developed criminal project which involves title deception, vehicle identification reproduction, and cars denudation for parts in "chop shops". The local and international black market for robbed vehicles and their parts is a gainful trading. robbed cars also are occasionally used in drug trading, The process of shooting from the car and armed thefts. These vehicles, often desolate after they serve their objective, help the perpetrator evade authorities, he has no legal relation to the car implicated. One vehicle robbed in a while of opportunity and used for a teenager, look alike The crime was relatively minor, given one rubric old car that was stolen in Greater Toronto Area, Canada, following a month of container discovery in port Rotterdam, The Netherlands, Ghana, Africa introspectively. For the interested vehicle owners, these two states are about having taken his or her personal car without a license. Similarly, the criminal performance embodiment may be much deeper. There is no misdemeanor as engine vehicles misdemeanor or engine vehicles stolen. Globally, for example: pilfering; deposit swindle; possessions theft; car theft or home steal. Under law execution, there is no always have the same priority level for Motor Vehicle Crime compared with The areas of crime dope, Commercializing abuse of children and terrorism in human beings. The stolen motor vehicles in many states should literally be seen as the vehicle of the crime in

the fight against organized crime. Stolen vehicles have been found to be used illegally for bank robbers, drugs are paid with stolen vehicles, human trafficking is carried out by stolen vehicles and car bombs are hidden in stolen vehicles. [3]. In 2012, the FBI registered more than 700,000 motor vehicle thefts in the United States, which lead to more than 4.3 billion dollars in losses. More than three - quarters of a million vehicles were stolen in the United States in 2016 and nearly half of those stolen were due to driver errors. Car stealing is a multi - million-dollar crime, with robbery costs of around $ 6 billion in 2016 by themselves, up from about $ 5 billion in 2015. The worst season for car steal is Summer. So, the National Expressway Traffic Safety Administration is continuing its yearly car steal forbidding Campaign during July—National month to assist drivers keep their car safe. Most vehicle safety is inadequate. Thieves are able to shatter into and drive away with most form and models of car in less than a minute. Research offers that specific kinds of thieves Preferred certain models because they have found ways to easily robber them Figure.1.2 shows car theft methods.

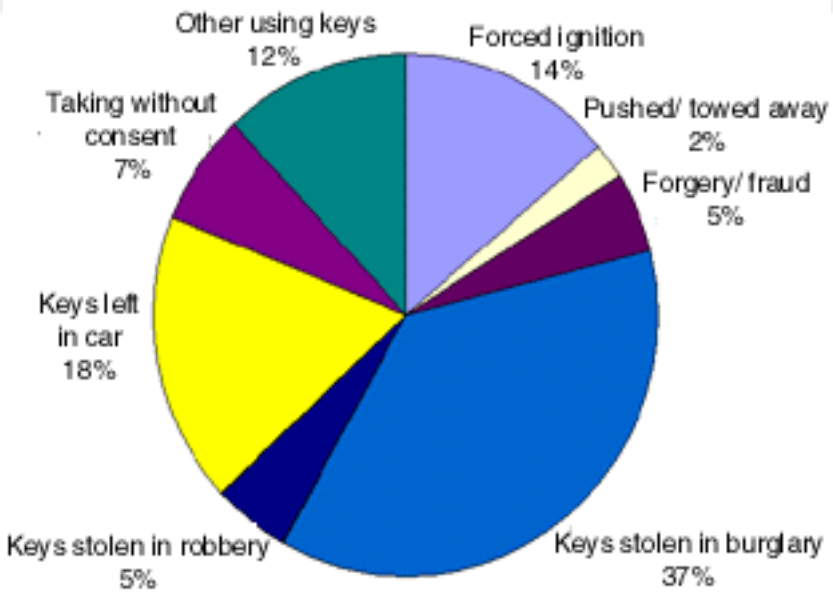

Figure 1.2: Car theft methods [4].

1.1. PROBLEM STATEMENT

It is spotted that the vehicle steal is a global issue. None wants his or her vehicle to get robbed. The insurance company's sensitivity to the pressure to push through the customer's appeals. Due to that, the insurance companies have to increase the premium for insurance. If this happens only a small proportion of the population would receive a better insurance premium. The premium insurance increase is also due to the lack of safety systems installed in the vehicle. A lower standard safety device such as an alarm - based safety system was put in place by car industrialists. Although, this system is not adequate effectively. It has no cell phone system attached to it. The vehicle robber only takes a few minutes to remove the safety system. Otherwise, when the vehicle alarm goes off, no one will pay attention. Because of these reasons, the vehicle anti - theft systems are developed and prepared to make progress on rendering the current vehicle security system based on the Atmega328p microcontroller development.

1.2. AIM OF STUDY

Car thieves are becoming more regular, advanced, and have extent experience to robbery the cars existing in garages at office, home or in public parking garages. The problem advanced in the last few year, recently a new era for this problem was started to reduce or solve it. This works is goal to create new and smart solutions for the security system, we designed the system using ATmega328 Microcontroller, WIFI camera and vibration sensor. When the thief attempt to open the door of the car or one of the windows or even the running of the engine of car, all of the above will be generate shaking and the vibration sensor will sense the resulting vibration and thus the microcontroller will make the car stop electrically and send a message to the owner of the car that there is an attempt to steal the car will also be Run the alarm whistle. The wireless camera will help us identify the person who steals or tries to steal the car. The system can be operated wirelessly via Bluetooth and smart mobile phone. The result of this study was provide a new and advanced system to secure the car from thieves. The Figure.1.3 illustrate the block diagram of primary Anti-Theft car system based on the ATmega328P microcontroller.

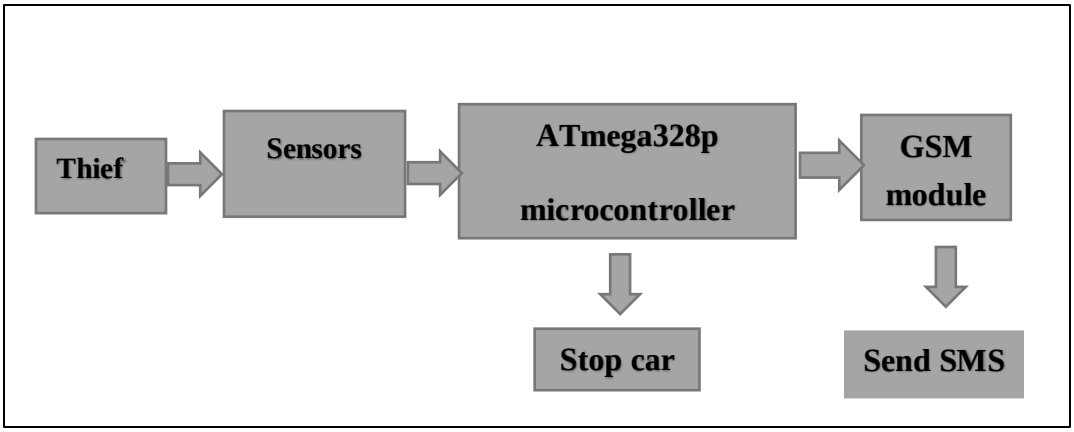

Figure 1.3: The block diagram of primary Anti-Theft car system.

1.3. THESIS ORGANIZATION

- Chapter one

In this chapter we will describe the phenomenon of car theft in various countries of the world and for many certain periods. It will be noted that with the increase of theft of cars and the development of technology on the other hand, the theft of cars will decrease and become more ill because with the increase of the development of safety systems and safety to protect the car from theft the car theft will decreases. But, the use of technology by thieves is evolving so we have to be constantly evolving and keep pace with the development of technology in order to design intelligent systems for protection against theft.

- Chapter two

In this chapter we will talk about systems designed by researchers and will be used as a reference point in the design of the proposed system to protect the car from theft in other words it will be a comparison between the system that will be designed and the systems that were designed previously.

- Chapter three

In this chapter will explain the electronic parts (microcontroller, sensors and other parts) used in the implementation and design of the proposed system, as well as will explain the system is implemented in details and described its parts, as well as explain and discuss the results obtained after the practical test of the implemented system.

- Chapter four

In this chapter we will explain and explain the conclusion of the system that has been implemented to protect vehicles from theft. Also, future developments of this work will be planned and discussed as well.

1.4. GRAND THEFT AUTO

Auto theft may happen in an assortment of circumstances, and many states have rules handling various auto theft crimes based on these circumstances. A grand theft auto is one of the most spread crimes. Grand theft auto typically applies to a steal of a parked car that is not occupied by a driver or passenger. however, some steal crimes are deemed “simple crimes” because of the low value of the items stolen, grand theft auto ascribes a more acute indictment to a steal crime because the item (the car) is value so much. Grand theft auto is typically charged as an offense and can result in prison time of a year or more. In order to prove that grand theft auto has happened, a pretender must show that the defendant took a car that belonged to somebody else with the aim to permanently forbade the owner of their car. These elements are similar to other steal crimes and prevent respondent from being charged with steal for wrong use of a car. For instance, because grand theft auto requires an intent to theft, a man who wrong think that his friend has licensed him to scrounge a car would not be condensate of grand theft auto for driving away in his friend’s car. Similarly, if a businessman by wrong drives off a rental car part with the wrong car, this would not be an auto theft crime either. If a person knowingly picks a car that does not follow to him, but planned to reversion it to the owner lately, some states will indictment the criminal with a separate offense, which is a contravention, known as joyriding Figure.1.4 shows Grand Theft Auto.

Figure 1.4: Grand theft Auto [5].

1.5. CARJACKING

carjacking is Another way of auto theft crime, which is a type of steal that include a motor vehicle. A carjacking happens when the car is taken straight from the owner or driver of the car. Typically, as in a steal, force or the threat of force is used to larceny the car from another. Some states deem a carjacking to happen until when a prey is not near their car, but is menace or forced to hand over their keys. Most states classify carjacking as a crime and, because force or thuggery often chaperon the carjacking, a respondent may also be charged with hitting or offence when appropriate. In many states, carjacking is deeming a more critical crime than grand theft auto and can lead in prison time of ten years or more. The Figure.1.5 shows Carjacking.

Figure 1.5: Carjacking [6].

2. RELATED WORK

In a number of research studies the authors gave an analysis of the circuit used in different projects, while the global positioning system (GPS) is generally used for locating and stopping vehicles if they are stolen. The site information can also be sent to the owner of the vehicle using the Internet through Google Maps in the form of a Message including longitude, latitude and speed information. Nowadays, the new technic for car theft prevention is used, which use ATmega328 Microcontroller to control on car theft A number of changes have been made to vehicle theft prevention systems, and some are as follows:

In [7] Carried out The use together with accelerometer and temperature sensor of ARM 7, GSM and GPS modules. Applied for the tracing of the area of the car are GPS and GSM modules. The additional component is the accelerometer, mainly containing the MEMS sensor with a low pass filter, which is used mainly for shake detection, orientation and tape detection. In addition, the use of temperature sensors is performed with a fixed end goal of obtaining the temperature of the vehicle engine that changes through temperature appreciation into electrical signal.

In [8] describes a GPS based tracking system, which tracks the position of the car and its speed on a text messaging mobile phone. The system can provide speed and location alerts in real time. The current position can be bounced and if the car is moved off its present bound location the system will warn the holder. Hourly by sending a message to the car's owner of the GSM modem or mobile, the latitude, longitude and speed information will be provided. By frugally sending the message stop to GSM modem or mobile attached to the circuit board, the owner or user may control or stop the car. The ignition system will switch off after receiving that message.

In [9] have created an intelligent vehicle anti - theft system using mobile phones. It concerns the control of the motor car via Short Messaging System (SMS) over mobile phones. The objective of the system design is to provide a connection between the holder and the car in order to give him remote access to control the motor job of his / her vehicle. The system suggested is also smart enough to discover the trustworthy owners. Whenever the system grasps a run, an attempt is made to authorize the holder. In case of failure of status authorization, the system powers off the motor directly and prevents robbing of the car.

In [10] proposed system hire Hair function - based cascading classification, which is an authentication user - facing machine learning algorithm. The algorithm is first drilled with the appropriate quantity of favorable and negative images and the characteristic is removed. The empiric system uses the individual's image and compares the removed characteristic to the licensed user when there is attempting to enter the car. In the end, the prototype system conclusion is satisfied and profit against the car theft problem.

In [11] have introduced a tracking system for independent perform vehicles (UAV) as well as any ground vehicles that use the global GPS and global packet radio (GPRS) positioning system.

In [12] produce a system to control on traffic and car stolen. Depend on the count of cars, if the traffic intensity has puffed and discovered by IR sensor, a green light is powered on and cars cross conventionally. If a RFID reader reads a brand of an ambulance, the signal is powered to green directly. If a RFID reader reads a brand of a robbed car, directly a message is sent to police monitoring room using GSM. When robbed car is discovered in the traffic automatically the signal lights powered to red color and shares the site to the police.

3. SYSTEM PARTS AND SYSTEM DESIGN

In this chapter will talking about the system parts ant the system that was designed and implemented in order to protect the car from theft, as well as the results obtained after the practical operation of the performing system will be discussed.

3.1. ARDUINO MICROCONTROLLER

An Arduino is a microcontroller is a board with a software package for programming it to been embedded system. The device consists of an open hardware design for an AVR controller and an on - board I / O support. The computer software includes a default programming language based on a variety of programming languages and the boot loader which works on the board. [13]. In other meaning, an Arduino is a small computer which can programmed to Proceedings outputs and inputs between the microcontroller and any other external components can have connected with the board. The board of Arduino executes the code writing. The Arduino board can only control and react by means of electricity (direct voltage), thus allowing specific components to interact with reality. Sensors that convert some aspects of the physical world into electricity so that it's sensed by the Arduino board or drives that get the electricity from the board and turn it into something that changes the world. Sensor examples include switches, accelerometers and sensors for ultrasound distance and actuators are subjects such as lamps and LEDs, speakers, motors and displays. [14]. Modulation of the pulse width is a process used in many applications. An Arduino is one of the easiest ways to do this. This application note will examine what Pulse Width Modulation is and explain how to use two different methods to perform Pulse Width Modulation. This can be done in several ways by the Arduino. Figure.3.1 shows some Arduino families [15].

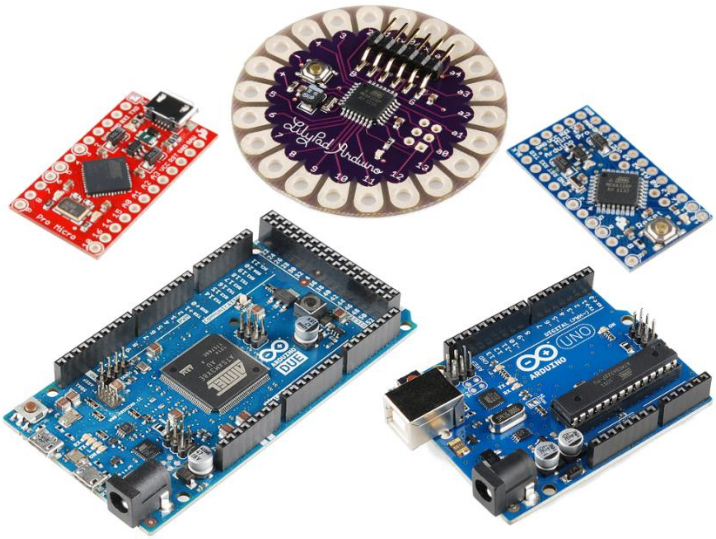

Figure 3.1: Arduino families [15].

Arduino power reflects his ability, as well as its high motor control, LEDs and many other electronic components, to communicate with other electronically elements such as switches and sensors and to use them to obtain various data including temperature or light intensity. Arduino projects can either be run independently by connecting to a computer and handling one of the programs on the device [16].

3.2. ARDUINO UNO MICROCONTROLLER

Arduino is an open source electronic board comprised of an open - source electronic circuit with a single computer - programmed microcontroller to simplify the use in interdisciplinary projects of interactive electronics. Arduino is primarily used in interactive e-project design or in the construction of different sensors for the environment (e.g., temperature, wind, pressure, etc.). On the PC, Arduino can be connected to various programs. The programming code of Arduino is based on the language of open source scripting, and its code is similar to the language of programming C++. It is one of the simplest languages in the programming of microcontrollers, the open-source controller is intended the structure of microcontroller and programming language are open where the manufacturing company allow all people can be modifying, re-structure, and even develop them for the best [17].

It is the most common and most widely used in construction projects, and it is easy for beginners and students to make numerous experiments. It is used in the microcontroller programming of the Atmel microcontroller ATmega328 company. This circuit allows connecting electronic components like sensors through 14 digitally in / out connections to the controller directly. For PWM (Pulses - Width Modulation) six of them can be used. The circuit is also provided with a 16MHz crystal oscillator, a USB port and a separate power input for communication with the computer. The Figure.3.2 shows the Arduino UNO microcontroller.

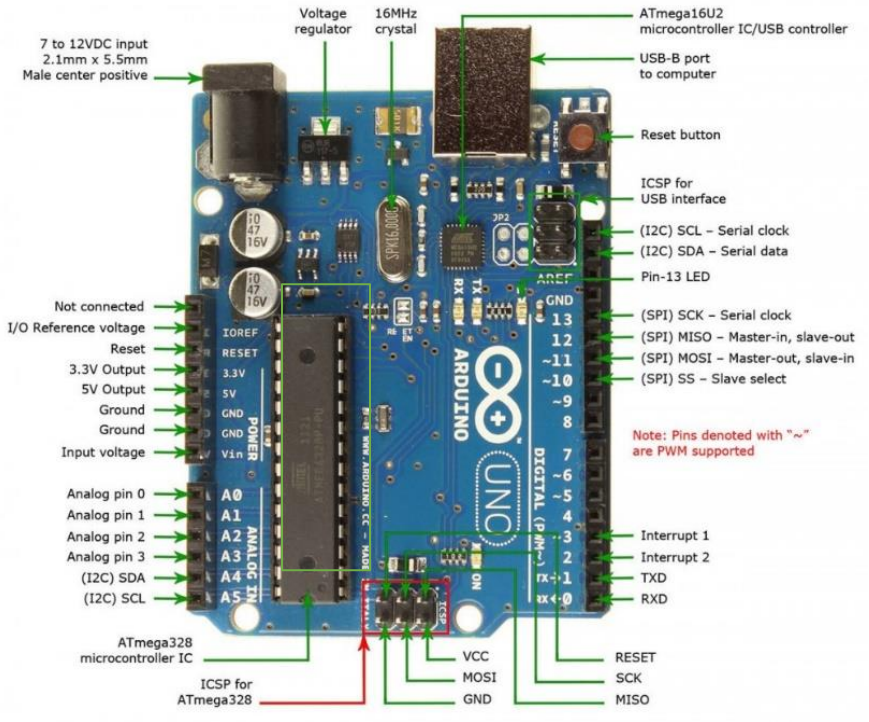

Figure 3.2: Arduino UNO Microcontroller [18].

Table 3.1: Features of Arduino UNO

Microcontroller	**ATmega 328**
Operating voltage	5V
Recommended voltage level	6-20V
Digital I/O pins	14 with 6 for PWM
Analog input pin	6
DC current per I/O pin	40 mA
DC current for 3.3 V pin	50 mA
Flash memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

3.3. ATMEGA328P MICROCONTROLLER

The ATmega48P/88P/168P/327P is an AVR Enhanced RISC architecture based low power CMOS 8bit microcontroller. The ATmega48P /88P/168P 328P can perform powerful instructions in one clock, which approach 1 MIPS per MHz to allow the system to optimize power consumption versus processing speeds, the Figure.3.3 shows the completed block diagram of microcontroller.

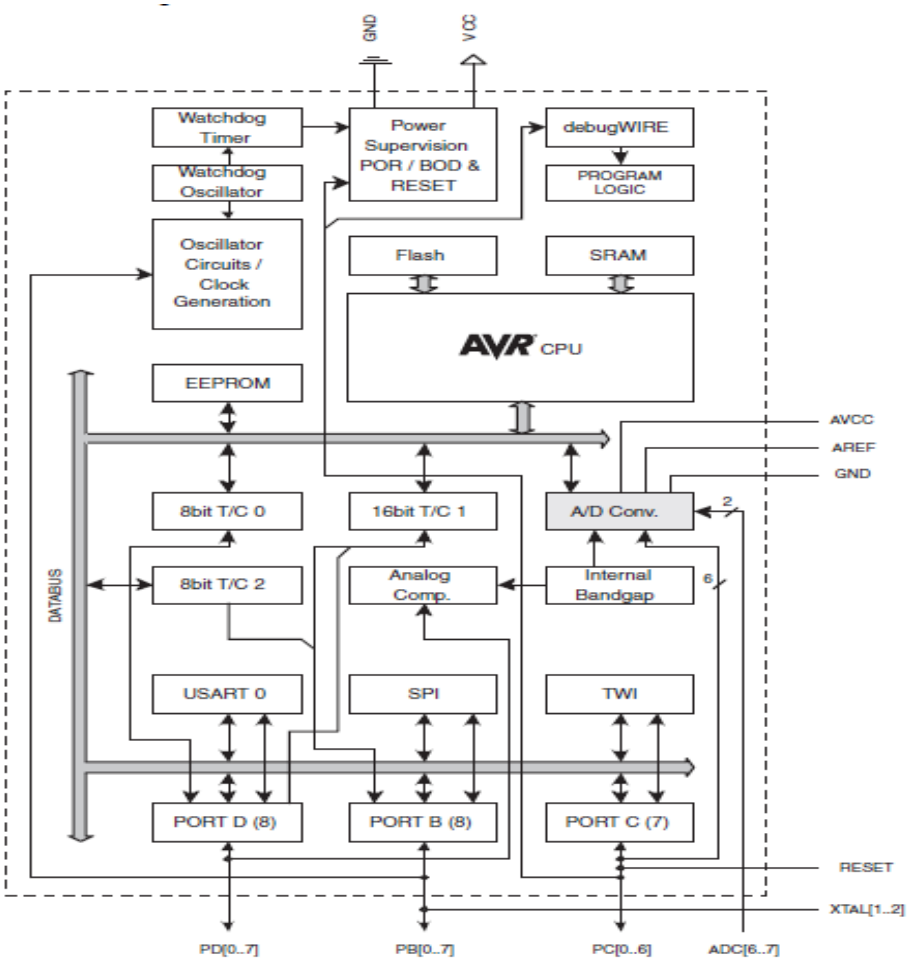

Figure 3.3: The completed block diagram of microcontroller [19].

The AVR core offers a wide range of instructions in 32 working registers for the general aim. every 32 registries are linked directly to the Arithmetic Logic Unit (ALU) so that 2 separate registries be approached by One instruction in one cycle of a clock. A result is the most efficient Code to be implemented by passes of conventional CISC microcontrollers up to ten times faster. The ATmega48P/88P/168P/328P has In - System Programming Read - During - Write Capabilities The following features: of 4K/8K/16K/32 K bytes,

- The EEPROM bytes are 256/512/512/1K.
- SRAM 512/1K/1K/2K.
- 23 I / O line to general aim.
- 32 works registers to general purposes.
- 3 timers.

- Interrupts, serial programmable USART internal and external interrupts.
- 2-wire serial interface with the byte - oriented.
- Serial port for SPI.
- A 10-bit 6-channel ADC (8 channels in packages TQFP and QFN / MLF).
- An internal oscillator watchdog timer programmable.
- Five modes of energy saving selected by software.

The idle mode stops the CPU and allow the continuation of operation with SRAM, timer / counters, USAR TV, 2 wire serial interface, SPI port and system interrupt. The down mode power saves records but blocks all of until further interruption or hardware restarts, other chip processes The Oscillator will be disabled. The asynchronous timer is running in Power - Save mode so that the user can keep the time base as the rest of the equipment sleeps. In order to minimize switching noise during ADC conversions, the ADC Noise Reduction mode stops the CPU and all I / O modules except asynchronous timer and ADC. The crystal / resonator Oscillator runs in standby mode while the remaining device sleeps. It enables rapid start-up and lower energy consumption. An ATmega48P/88P/168P/328P AVR is supported by a complete suite of tools for program and system development including: C-Compilers, Macro Assemblers, Program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits. The primary purpose of the CPU core is to ensure the correct execution of the program and thus allow the CPU to access memories, perform calculations, monitor peripherals and manage interrupts [19]. The Figure.3.4 shows the block diagram of AVR architecture.

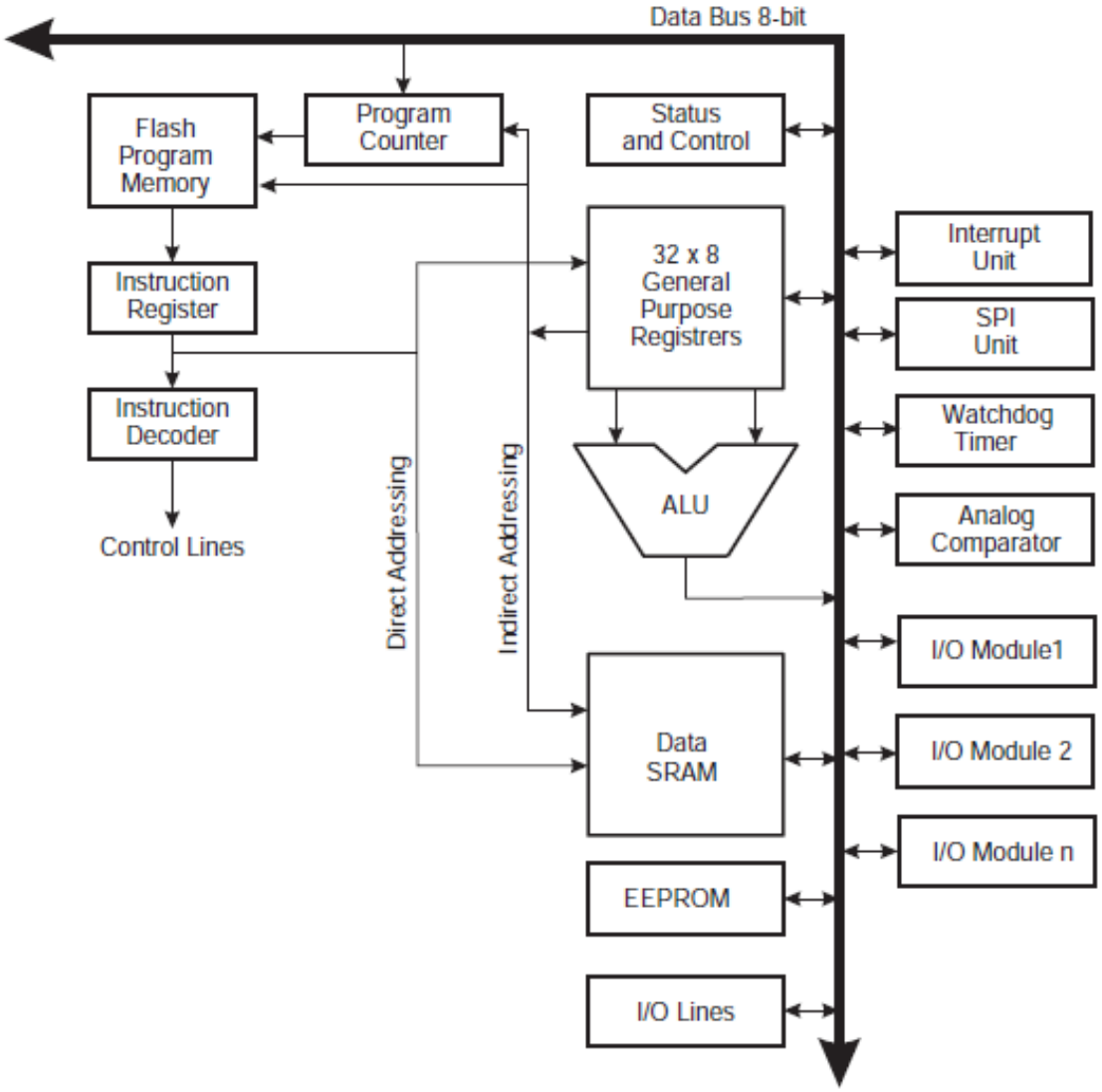

Figure 3.4: Block diagram of AVR architecture [19].

The use of microcontroller provides more benefits to the user, especially the students and amateur or researchers, where the use of the microcontroller provides more effort and expense rather than the design of the electronic circuit and to weld it using accurate controls will be through the lines of programming instead of electronic construction of the electronic circuit all these things Gives the user convenience and provide the amounts where the price of the exact controls, especially this type ATmega328 be very cheap prices, support students and researchers in providing their money that the emergence of accurate controls and their continuous development and permanently due to the need It is not only used for students, hobbyists and

researchers, but also in the industrial magazines and even in the applications of agriculture, such as intelligent watering of plants or in glass houses(green house). Where it has recently appeared in many armor and sensors can be used in the areas of protection, safety and aircraft pathways and in many aspects of vital life. The Figure.3.5 shows the pin's configuration of the ATmega328p microcontroller.

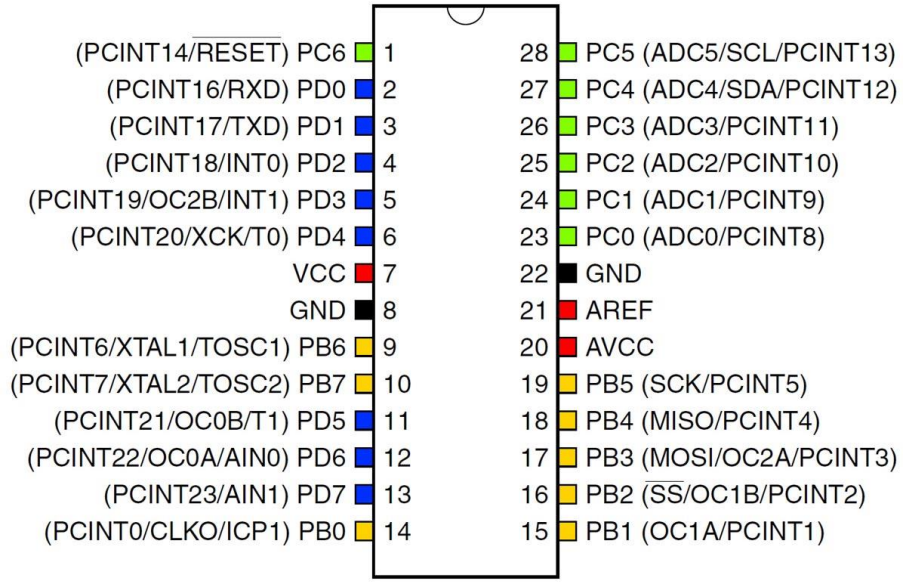

Figure 3.5: ATmega328P pins configuration [20].

3.4. ARDUINO IDE

The Arduino software is really a list of rules that tell the hardware what they should do and how they should do it. What is open – it is easy to write and upload code to the board from the source. It is running on Windows, Mac OS X and Linux. The environment in Java is written by using open source software and processing. This software can be used on any Arduino board. The Arduino IDE (Integrated Development Environment) has 3 main components:

- Command Area: This area contains the menu items like File, Sketch, Drawing, Tools, Help and Icons like the Check Icon for verification, The Serial Monitor, Open, and save Upload Icon to upload your programmed data from Arduino to the IDE.
- Text area: You can use the streamlined version of C++ to create your code, to make it easier to write a programmed sketch. There are mostly two important parts when you write your code:
- The setup function: You have to initialize and assign variables before installation. You set the first condition for your versions and only execute preparatory code once. The configuration routine starts then.
- Void setup () where the code will be executed once. void setup Looping routine: This is the loop which is always running or running your main code.
- Message windows area: This shows the IDE message in the black zone, especially when your code is checked. The Figure.3.6 shows labeled IDE.

Figure 3.6: Labeled IDE [21].

3.5. SHIELDS AND SESNORS

Many of the sensors and shields was using in the establishments of this work, in this section will be describe all the used parts in details.

3.5.1. HC-06 Bluetooth

Serial module Bluetooth, which converts the Serial port to Bluetooth and operates in both modes Master and Slave. The Figure.3.7 illustrate the HC-06 Bluetooth module. The device named after a single number can be used in slave mode and this setting cannot be actually changed. But the user can set a working mode (master or slave) for the device named after an unknown number using AT commands. For instance, between two Arduino boards, one is the maestro, the other is slave. It is a serial port protocol (SSP) Bluetooth module that communicates with Arduino through Serial communication. It requires a 3.6V to 6V power supply. Bluetooth Serial Module replaces the serial port line primarily. This is possible by connecting the Bluetooth master device to the slave device and forming a pair. The RXD and TXD signals are sent and received via this

Bluetooth connection. In the Bluetooth slave module, the MCU must be available to communicate with the Bluetooth adapter of other computers and smartphones:

• The communication must be between Master and Slave.

• The password must be correct.

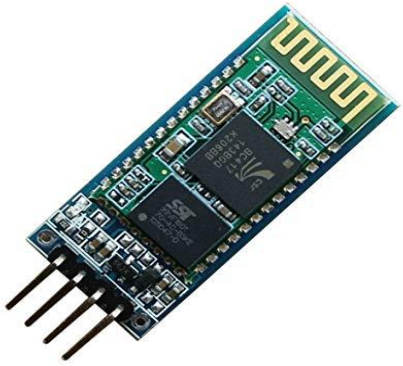

Figure 3.7: HC-06 Bluetooth module [22].

Bluetooth Specifications**:** Bluetooth is a global specification of a small, cost - effective radio solution for mobile computers, mobile phones and other handheld portable devices as well as internet connectivity. The IEEE 802.15 Standard was adopted by the Institute of Electrical and Electronic Engineers (IEEE). Its main strength is that it can handle both data and voice transmissions simultaneously. A Bluetooth supports asynchronous data connections to individual clients and synchronous voice connections also with up to 3 client devices. The range of transmission power from 1 mw to 10 m is provided. If the transmit power is increased to 100 m watt, the range can be extended to 100 m. The data rate for Bluetooth is 1 Mbps. Bluetooth is a small standard (9 mm x 9 mm) that can be connected to computers, printer, mobile phones, etc. A Bluetooth transmits the information normally transmitted via the cable to a receiver at a different frequency. Bluetooth, which will then provide the received information to the computer, telephone or anything. Bluetooth provides the most cost effective way of connecting medium to low - speed devices. It aims at low energy consumption and also offers mobile devices security. The main feature is the provision of standard wireless technology in order to replace the many proprietary cables that link computer devices [23].

3.5.2. Vibration Sensor

The sensor module is supplied by a board potentiometer integrated with SW-420, with adjustable sensitivity. The LED indicators for power and digital output status are also available on board. The VCC, GND and DO (Digital Output) three pin interface is simple and straight - forward. It supports power from 3.3V or 5V. This module can be used on any digital microcontroller, therefore any popular pic, Arduino or Raspberry Pi microcontrollers are obviously compatible with PICs. The use of this sensor requires a direct interface. If no vibration occurs, the do - pin is low and the LED indicator is lit up. The Figure.3.8 illustrate the vibration sensor.

Figure 3.8: The vibration sensor [24].

The vibration sensor converts the amount of the vibration into an analogue voltage as the increase in vibration leads to an increase in the analogue voltage output from the sensor. This type of sensor comes with three terminals of two terminals used to equip the sensor with direct voltage (GND and 5v) and the third terminal was representing the analogue voltages that's outs from the sensor as a corresponding to the amount of vibration. This analog voltage read by the microcontroller to doing a particular task, the Figure.3.9 shows the vibration sensor value relative to the intensity of the shock.

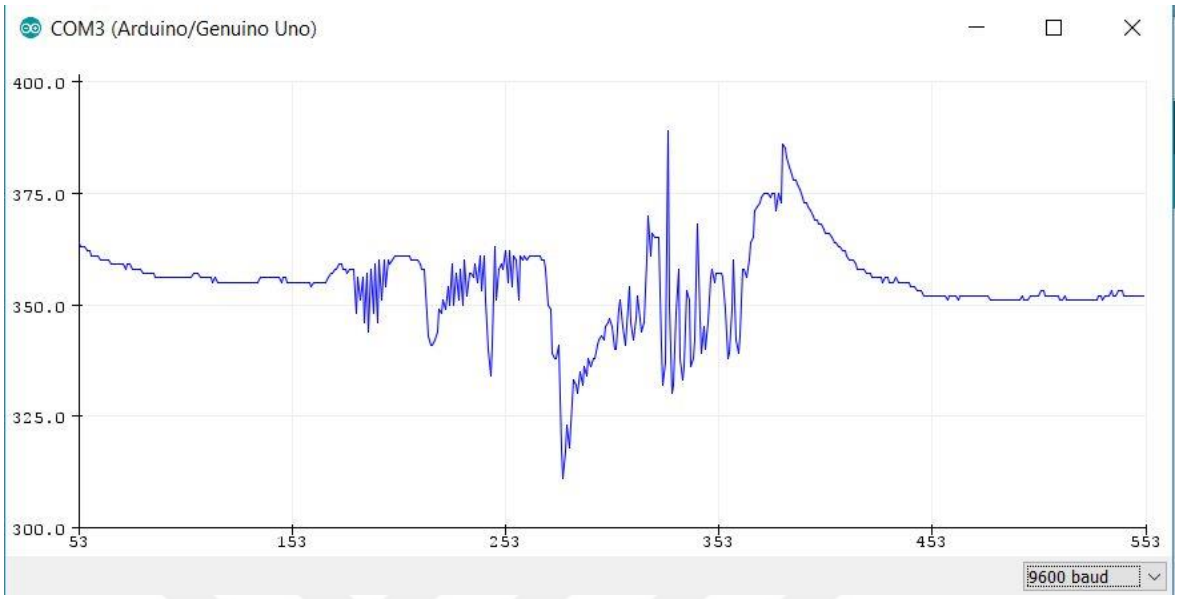

Figure 3.9: The vibration sensor vs shock intensity.

FEATURES,

- The switch is closed by default.
- Output digital
- Voltage of delivery: 3.3V to 5V.
- LED indicator on - board to indicate the results
- Chip LM393 on – board
- Size of board: 3.2 cm x 1.4 cm.

3.5.3. GSM SIM 800MINI

SIM800 is a GSM / GPRS quad band module that operates on GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz frequencies. SIM800 features 12/class 10 (optional) GPRS multi - slot class and supports the CS-1, CS-2, CS-3 and CS-4 GPRS coding systems. SIM800 can fulfill virtually all space requirements for applications like M2 M, Smartphone, PDA and other mobile devices with a small set - up of 24 * 24 * 3 mm. SIM800 features 68 SMT pads and all the hardware interfaces between module and boards for customers. SIM800 has been developed to reduce current consumption to 1.2mA in sleep mode with the energy saving

technique. SIM800 integrates seamlessly a TCP / IP protocol with extended TCP / IP AT instructions that are very helpful for represented data transfer applications in the Figure.3.10 SIM800mini is a cellular miniature module that enables GPRS to transmit, send and receive text message and to make and receive calling. It's ideal for all the projects requiring low cost and small footprint connectors and quadruple band frequency support. Once the power module is connected, it automatically searches for the cellular network and logins. The LED displays the state of the connection on board.

Figure 3.10: GSM SIM 800MINI [25].

Module specifications,

- Voltage of operation: 3.8V - 4.2V
- Supply voltage recommended: 4V
- Consuming power:
  - Mode of Sleep < 2.0mA
  - idle mode less than 7.0mA
  - GSM (medium) transmission: 350 mA
  - Transmission of GSM (peak): 2000mA
- Dimensions of the modules: 25 x 23 mm
- Functionality: UART and AT Commands (max. 2.8V).
- Micro - SIM card socket (bottom side)

- Frequencies supported: Quad band (850 / 950 / 1800 MHz)
- Antenna connector: IPX
- Signal status: LED
- Temperature range of operation: -40 do + 85 ° C.

3.5.4. WI-FI Camera

As shown in Figure.3.11 Wireless monitoring cameras are a type of monitoring camera that uses wireless technology, is connected without wires, and operates using modern technology in communications. Wireless monitoring cameras have several features [26]:

- Do not use wires in their technology.
- Ensure that the signal is not disconnected by cutting or damaging the wire.
- The clarity of the live broadcast of the video.
- You can see it anywhere you are away from where it was installed by your personal phone or laptop or tablet as you can control it remotely.

Figure 3.11: Wi-Fi camera [26].

3.5.5. Arduino Keypad

Matrix keypads Provides host device button statements, usually a microcontroller, with a combination of four rows and columns. Under each key the pushbutton is connected to one end of a line and a column to the next. The Figure.3.12 shows These connections, to find out which button is pushed, the microcontroller must first pull down or high each column (pins 1 - 4) and then search for the status of the four rows (pins 5 - 8). The microcontroller can tell which button is pressed depending on the column status. In all types of devices such as cell phones, faxes,

microwaves, sheets, door clamps, etc., keypads are being used. in this paper the keypad will used in the purpose of car turning ON/OFF.

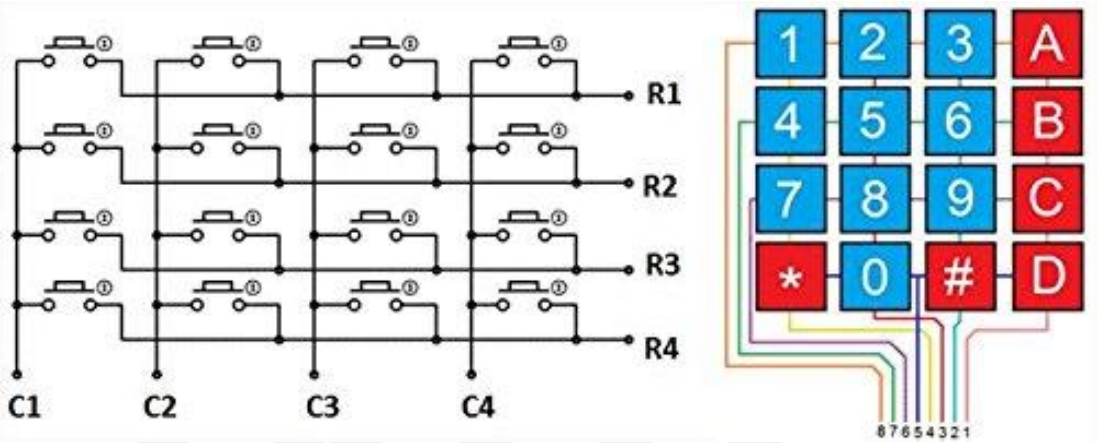

Figure 3.12: The Arduino keypad with connection diagram [27].

3.5.6. Transistor as Switch

Transistor is the most common application on the transistor in many electronic design applicatio ns when switching to open or close a circuit. That kind of switching operation is referred to as a solid state switch because no movement element is present. In comparison to conventional relays, the relay has considerable reliability and lower costs. It's possible the transistors NPN and PNP may be employed as switches. A power transistor is used by a switching device for some applications, so that a transistor of the high power transistor can be operated with another signal level. Transistor has been used as one of the largest semiconductor devices for huge electronic applications like embedded systems, digital circuits and control systems. Transistors are widely used in both digital and analog domains for various applications such as amplification, logic operations, switching, etc. work focuses on the transistor application as a switch [28]. A three layer, three terminals and two semis - conductor elements is the Bipolar Junction Transistor or simply BJT. These transistors are used in almost many applications for two basic functions like switching and amplifying [29]. The bipolar name indicates that a BJT is being built by two types of carriers. Both charging systems are holes and electrons with positive charging transmission and electrons with negative charging transmitters. [30]. There are three terminals on the transistor, namely base, issuer and collector. The transmitter sends electrons to the base, a heavily doped terminal. The base terminal is slightly doped and the electrons injected into the

collector are transferred. The middle doping at the collector terminal collects electrons from the base. Compared to two areas, this collector is large so that it dissipates more heat [31]. Both BJTs work the same but differs in bias and power supply Polarity in both NPN and PNP types. In the PNP transistor, N-type material is sandwiched between two P-type materials, Whereas NPN transistors are sandwiched between two types of N materials, they can be configured in different types, such as common emitters, collectors and common base configurations. Based on the voltage applied to the transistor base terminal, there are three regions in the transistor, the first region being the saturation region, the second region being the cut - off and the active region being the position of the quiescent point (Q - point) specifying the mission of the transistor in this case, the transistor being used as a switch, the Q - point being in both regions, the Q - point being the ON state being the Q – point the Figure.3.13 shows the transistor operating regions. The switching operation takes place when the voltage between the base and the emitter is sufficiently high (Vin > 0.7 V), the collector voltage to the emitter is approximately 0.7. The current collector Vcc / Rc flows via the transistor. Same as transistor works in the cut-off area, when the input is not supplied with voltage or zero voltage, acting as a circuit that is open. In this type of switching connection, the load is connected with a reference point to the switching output [32]. Thus, when the transistor is switched on, the current flows from source to ground through the load as shown in Figure.3.14.

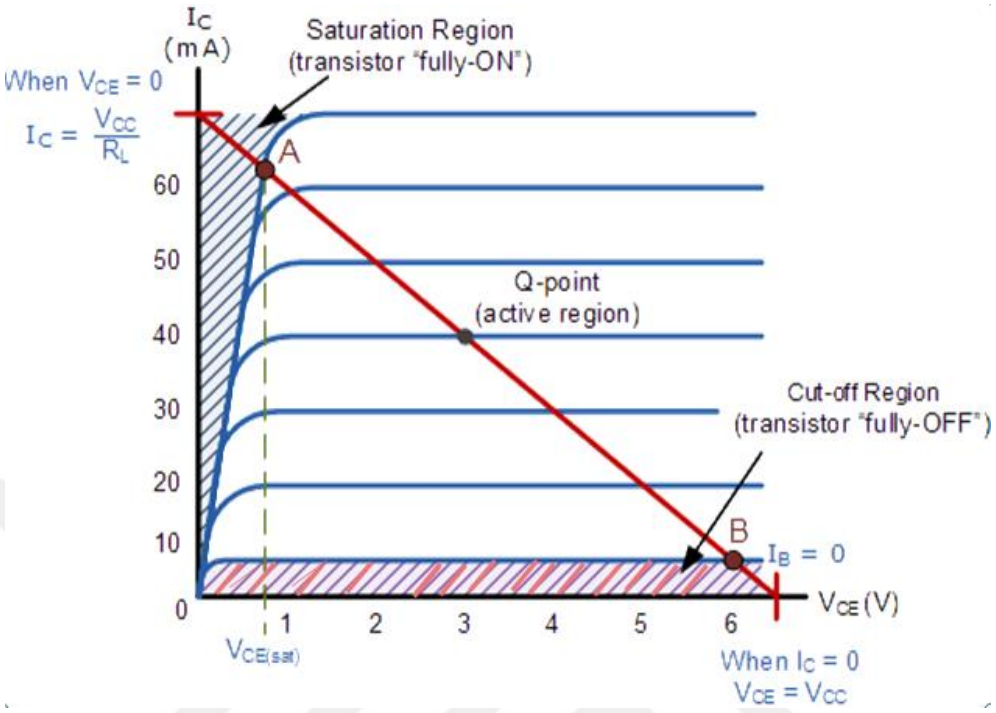

Figure 3.13: Transistor operating regions [32].

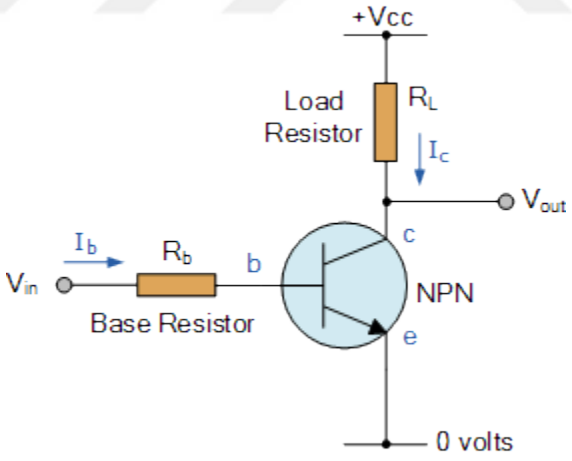

Figure 3.14: Transistor as switch circuit diagram [32].

3.6. WORKING PRINCIPLE

This part including the explanation and clarification of the system that was built to protect cars from theft and contains the lowest steps of work and design as well as the results obtained after the operation of the system.The system was built on the basis of the Arduino microcontroller, vibration sensor and the GSM unit when the thief tries to steal the car and open one of the doors or the operation of the engine this will produce vibration, the vibration sensor will sense the resulting vibration and sends a voltage signal to the Arduino, in this case the Arduino will stop the engine of the car electrically and through the GSM module is sending a message to the owner of the car for the purpose of alert from the theft and at the same time is activated alarm whistle.To make the system more reliable and secure the Bluetooth module was used to monitor the status of the car, when the owner of car tries to operate his car will require him to enter the secret code (i.e. specific password) through the keyboard and send command through the smartphone through Bluetooth otherwise the car will not work at all. In case the thief attempts to tamper with the car and enter the secret code for more than two times, the alarm will be activated and the owner will be alerted by the application that is installed in the smartphone. The Figure.3.15 illustrate the flowchart of the system and the Figure.3.16 illustrate the block diagram of the implemented system.

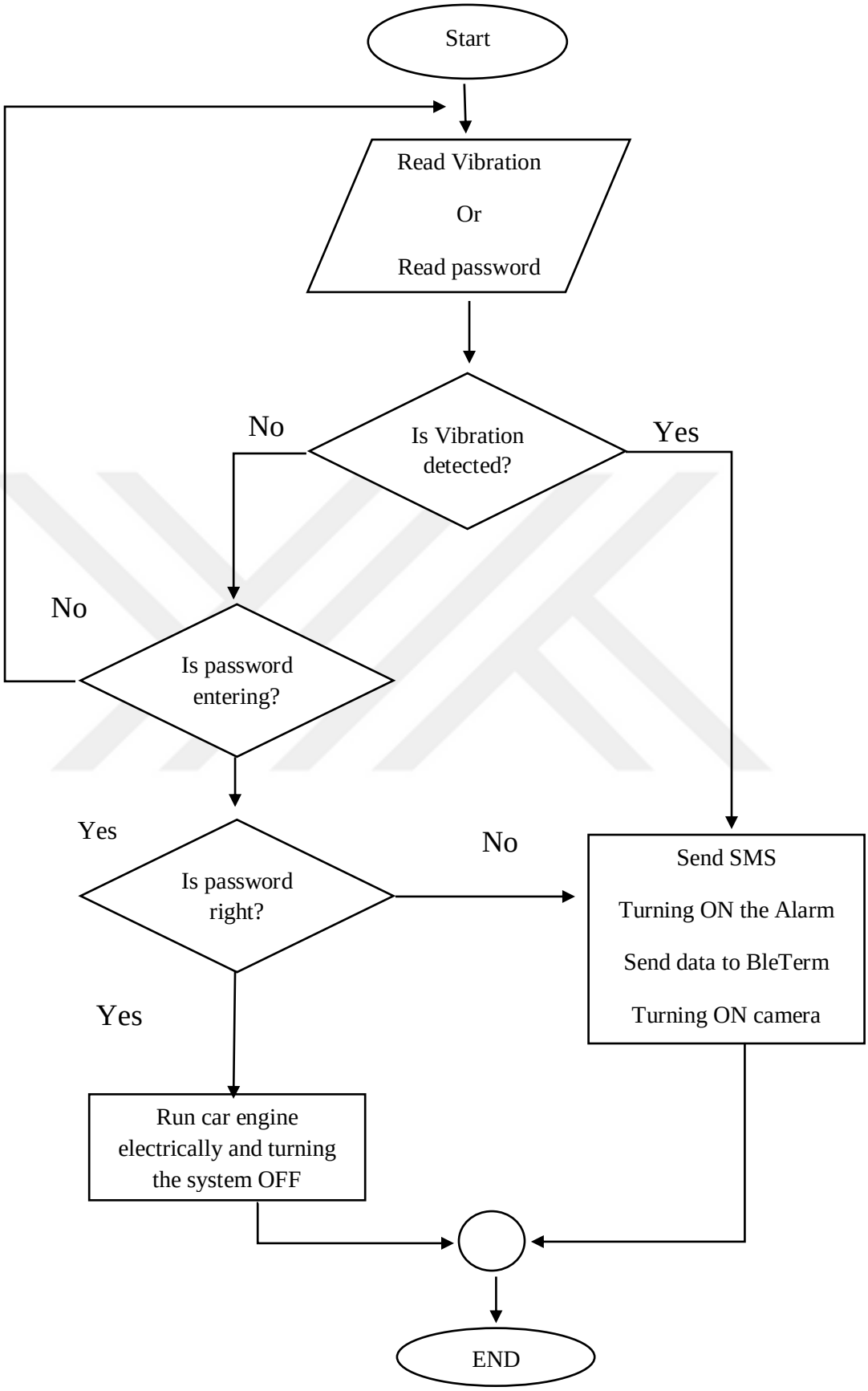

Figure.3.15: The flowchart of the implemented system.

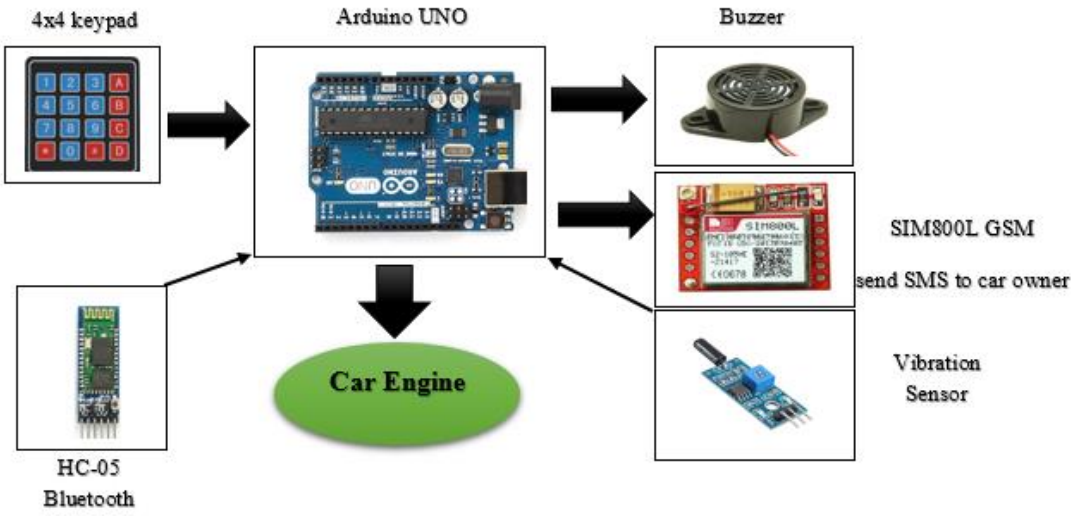

Figure 3.16: Block diagram of implemented system.

The Figure.3.17 and Figure.3.18 shows the implemented system, where the LED represent the car engine and the transistor using as an electronic switch because the buzzer drawn a big amount of power as compared with the power output from the digital output pin of the Arduino UNO so, the buzzer feeding from external source and the Arduino will just give a pulse to the base terminal of the transistor in order to turning the buzzer “ON”. The GSM module was chosen in this work Suffers from the feeding power where, it needs a high current as compared with Arduino UNO current so, the Arduino must be fed from an external source with reasonable DC source, in the work the adapter chosen with 9V and 2000 mA if the adapter current less than the rated current of the GSM module the module doesn’t work correctly, in practice the feeding power will done from the car adapter.

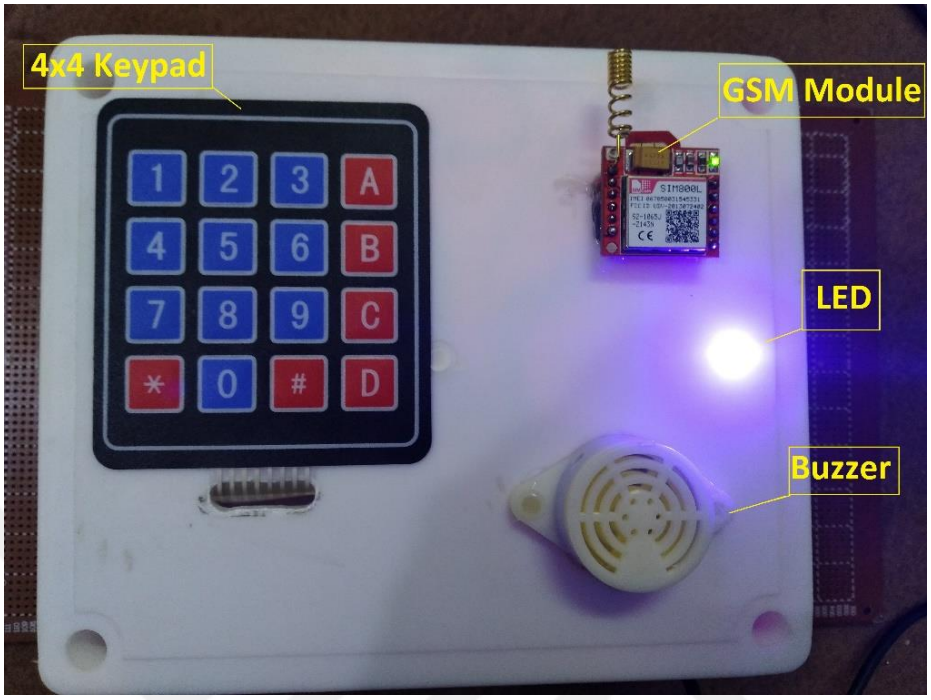

Figure 3.17: The implemented system.

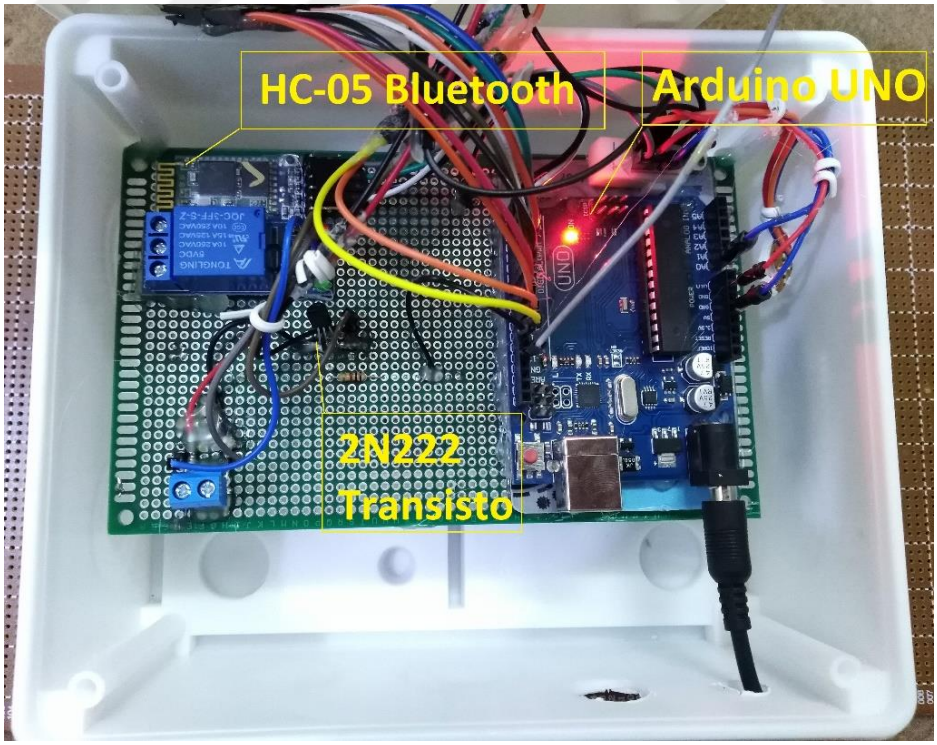

Figure 3.18: The hardware of the implemented system.

The Figure.3.19 illustrate the vibration sensor of the implemented system, where the vibration sensor will be the main module in the detection of vibration resulting from the operation of car engine, which in turn sends a signal to the microcontroller and then the Arduino sent the Alarm message for the vehicle owner, the figure.3.20 illustrated the completed design of the system.

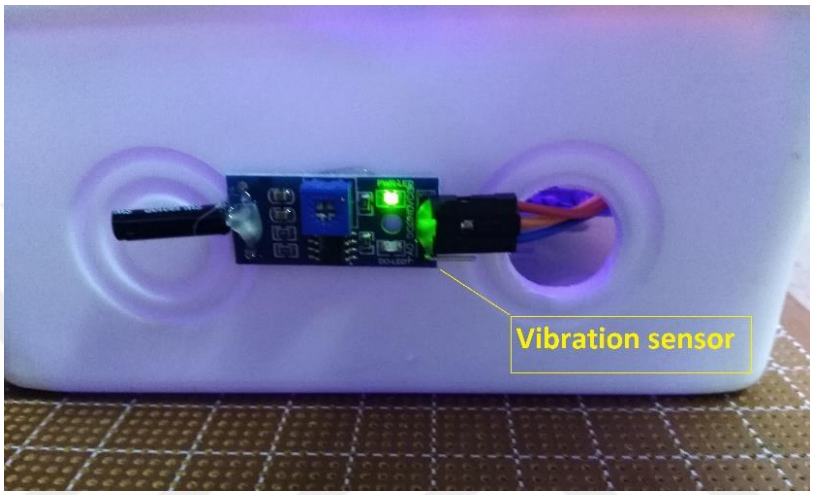

Figure 3.19: The vibration sensor of implemented system.

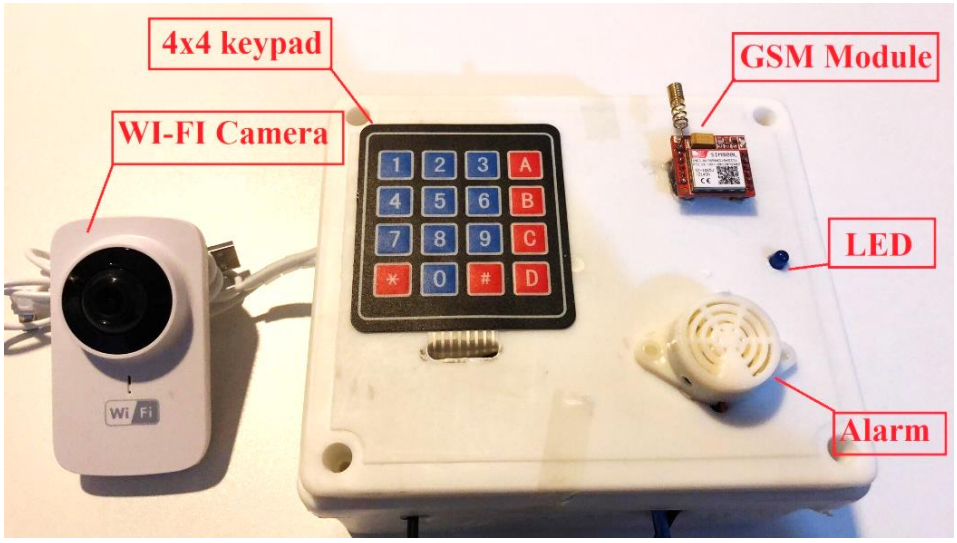

Figure 3.20: The completed design of the system

3.7. RESULT

In this part, the results obtained after running the implemented system will be discussed. The HC-05 Bluetooth module can communicate with the smart mobile phone via the special application called Blue-Term This Android mobile application has been installed in order to connect the mobile phone with Bluetooth of the Arduino, this application allows the user from sending the command (i.e. character or number) to the Arduino and entering the password through the keypad to make the car in standby mode. When the vibration detected the GSM module send SMS to alert the car owner as shown in Figure.3.21, when the password entering wrong more than twice the alarm will be turning ON and alerting message appears on the Blue-Term application to indicates that there is thief try to running the car as shown in Figure.3.22.

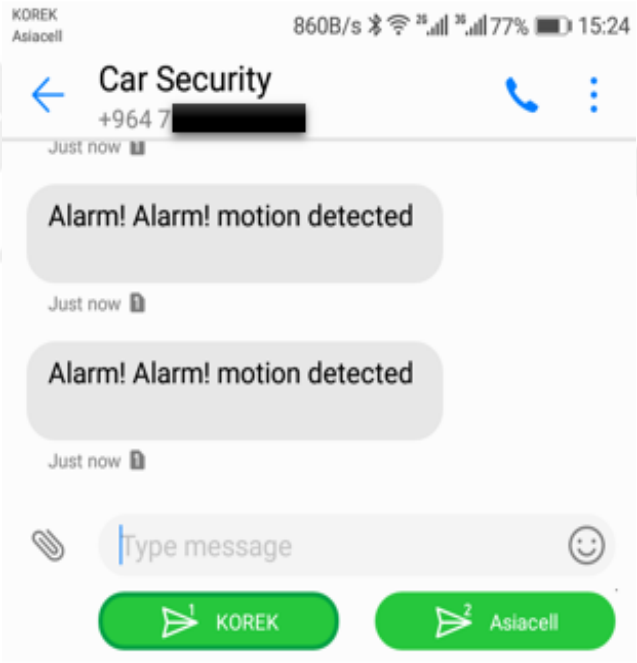

Figure 3.21: The practical test of the implemented system.

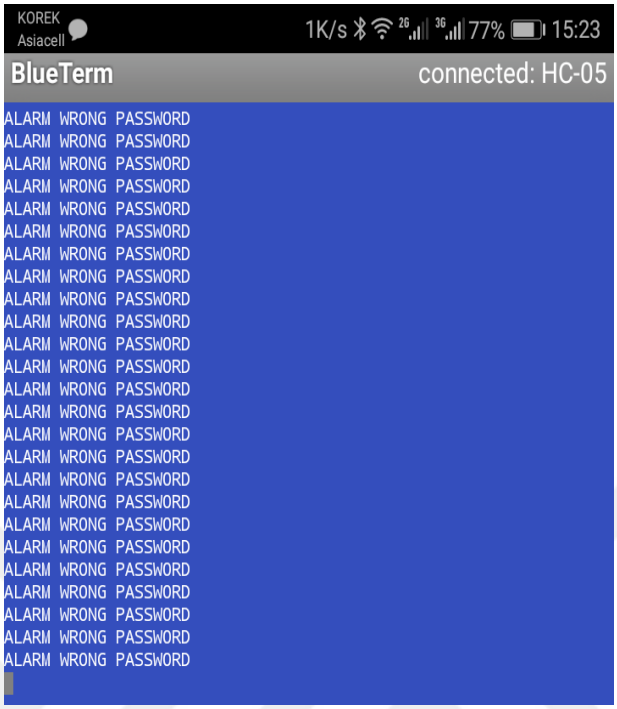

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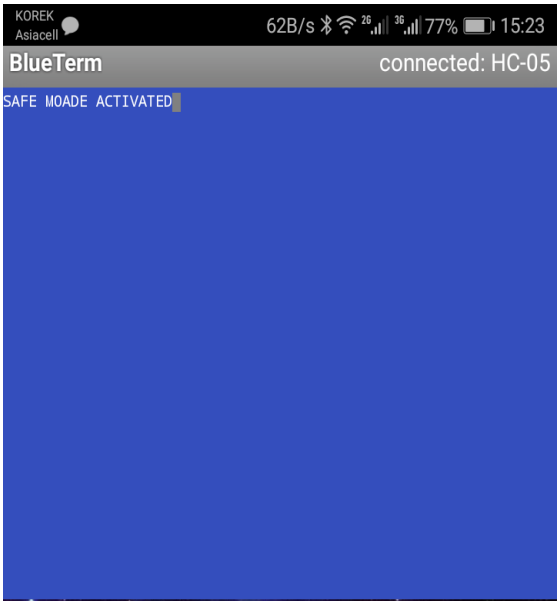
Figure 3.22: The alert message inside Blue-Term application.

In case of system turning ON and nothing occurs the text appears on the Blue-Term application to indicates the car in safe mode as shown in Figure.3.23, in other words all the notifications will be appears on the mobile phone application in addition to the SMS in the vibration detection.



```
SAFE MOADE ACTIVATED
```

Figure 3.23: The safe mode message on Blue-Term.

4. CONCLUSION AND FUTURE WORK

In this section will explain and describe the conclusion of the implemented system and the future development of the implemented work.

4.1. CONCLUSION

Given the recent increase in car theft and the enjoyment of car thieves by modern ways and experience it has become necessary to resort to modern and effective means to reduce car theft. In this work the system was built to protect cars from theft by detecting the vibration resulting from the operation of the car engine, the system based on the Arduino microcontroller and the GSM module, the system was operated and get the results mentioned above after conducting the practical examination and show that the system works well such systems are effective to reduce car theft, all notifications such safe mode, wrong password and motion detection was successfully arrived to the mobile phone of the car owner via SMS and the Blue-Term application.

4.2. FUTURE WORK

In the future, the system was able to prove its efficient performance to monitor the position of a vehicle from anywhere on an experimental basis by using the GPS module. That's easy to doing. The system will ensure vehicle, driver and passenger safety and security. Using database, the distance of travel can be calculated and recorded. It is also possible to use data communication and networking to achieve better performance in this area. For instance, a computer network (PC - based) can indeed be set up to achieve efficient communication instead of GSM technology. Cybernetics and computer networks could also be used to provide the authorities concerned with information quickly. The additional development of the implemented system can be doing by using finger print module instead of the keypad this increase the reliability and security of the implemented system and also can be used the IoT technology to making a tracking for the car.

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APPENDIX A

CODES

Many of the programming scripts were used to create and build this system that the programming system was built on the programming language of the Arduino microcontroller (Arduino open source IDE), as described below.

```
#include <Keypad.h>

#include <Password.h>

#include <SoftwareSerial.h>

SoftwareSerial sim(10, 11);

int _timeout;

String _buffer;

//set mobile phone number

String number = "+9647704335909";

String newPasswordString;

char newPassword[6];

Password password = Password("1234");

int data;

int s=0;

byte maxPasswordLength = 6;

byte currentPasswordLength = 0;

const byte ROWS = 4;
```

```
const byte COLS = 4;
char keys[ROWS][COLS] = {
{'1','2','3','A'},
{'4','5','6','B'},
{'7','8','9','C'},
{'*','0','#','D'}
};
byte rowPins[ROWS] = {9,8,7,6};
byte colPins[COLS] = {5,4,3,2};
Keypad keypad = Keypad( makeKeymap(keys), rowPins, colPins, ROWS, COLS );
void setup(){
Serial.begin(9600);
pinMode(13,OUTPUT);//car engine
pinMode(12,OUTPUT);//buzzer
/*****************************************/
delay(7000); //delay for 7 seconds to make sure the modules get the signal
_buffer.reserve(50);
sim.begin(9600);
delay(1000);
Serial.println("SAFE MOADE ACTIVATED");
}
```

```
void loop(){
   int vib=analogRead(A0);
  data=Serial.read();
   char key = keypad.getKey();
   if (key != NO_KEY){
      delay(60);
      switch (key){
      case 'A': break;
      case 'B': break;
      case 'C': break;
case 'D': changePassword(); break;
      case '#': checkPassword(); break;
      case '*': resetPassword(); break;
      default: processNumberKey(key);
      }
   }
   if(s==1&&data=='3'){
   digitalWrite(13,HIGH);
   s=0;
   }
   if(s>2){
```

```
   digitalWrite(12,HIGH);
    Serial.println("ALARM WRONG PASSWORD");
   }
    if(vib>=29&&vib<=50)
    {
       SendMessage();
       digitalWrite(12,HIGH);//buzzer
       digitalWrite(13,LOW);//car
       Serial.println("ALARM MOTION DETECTED");
       }
}
void processNumberKey(char key) {
currentPasswordLength++;
 password.append(key);
   if (currentPasswordLength == maxPasswordLength) {
      checkPassword();
   }
}

void checkPassword() {
   if (password.evaluate()){
```

```
      s=1;
 } else {
     s++;
   }
   resetPassword();
}
void resetPassword() {
   password.reset();
   currentPasswordLength = 0;
}
void changePassword() {
  String c="2000";
   newPasswordString = c;
   newPasswordString.toCharArray(newPassword, newPasswordString.length()+1); //convert
string to char array
password.set(newPassword);
   resetPassword();
   Serial.print("Password changed to ");
   Serial.println(newPasswordString);
}
 void SendMessage()
```

```
{
  //Serial.println ("Sending Message");
  sim.println("AT+CMGF=1");    //Sets the GSM Module in Text Mode
  delay(1000);
  //Serial.println ("Set SMS Number");
  sim.println("AT+CMGS=\"" + number + "\"\r"); //Mobile phone number to send message
  delay(1000);
  String SMS = "Alarm! Alarm! motion detected";
  sim.println(SMS);
  delay(100);
  sim.println((char)26);// ASCII code of CTRL+Z
  delay(1000);
 _buffer = _readSerial();
}
String _readSerial() {
  _timeout = 0;
  while  (!sim.available() && _timeout < 12000  )
  {
    delay(13);
    _timeout++;
  }
```

```
  if (sim.available()) {
    return sim.readString();
  }
}
```