

**DESIGN AND CONSTRUCTION OF  
MICROCONTROLLER BASED CAR OVER SPEED  
DETECTION SYSTEM WITH PLATE NUMBER  
IDENTIFICATION CAPABILITY**

**BY**

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**A PROJECT REPORT SUMMITTED TO THE  
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FULFILMENT OF THE REQUIREMENTS FOR THE  
AWARD OF THE DEGREE OF BACHELOR OF  
ENGINEERING.**

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## **DECLARATION**

I hereby declare that this project report was written by me and it is a record of my research work. It has been not been presented before in any previous application for a bachelor's degree. References made to published literature have been duly acknowledged.

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(Supervisor)

## CERTIFICATION

This project entitled **“DESIGN AND CONSTRUCTION OF MICROCONTROLLER BASED CAR OVER SPEED DETECTION SYSTEM WITH PLATE NUMBER IDENTIFICATION CAPABILITY”** by **MUSA ABDULMAJEED WAILA (EE/14/0409)** meets the regulation governing the award of the bachelor’s degree of the Modibbo Adama University of Technology, Yola and is approved for its contribution to knowledge and literary presentation.

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## **DEDICATION**

I dedicate this project to Almighty Allah for giving me the strength and courage throughout my study, also to my father, mother and siblings for their enormous support, care and finance.

## **ACKNOWLEDGEMENTS**

All thanks and praises be to the Almighty Allah who give me the strength and capability for the completion of this project, overlook my mistakes, pardoned my sins, and took lenient to my disorderly conduct. May the peace and blessing be upon the last prophet (S.A.W) and his house hold. There are many people who have helped me directly and indirectly in the successful completion of my project. I will use this opportunity to thanks those who have contributed to my incapability's toward this project.

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## **ABSTRACT**

Now-a-days we hear news about accidents on highways very frequently. And in most of the cases main reason of accident is over-speed. So in order to avoid such kinds of accidents there should be some system which properly checks over-speeding of vehicles. Current techniques use camera image processing and it leads to people being aware of it and reduce speed there. In this project an approach is used to counter it. Two sensors are used in this project. These sensors detect the vehicle speed. Condition is that, the two sensors should be installed at a certain distance apart. The project is based on Atmega3328P microcontroller. The microcontroller computes the vehicle speed and displays it on the screen. This project is designed and constructed to measure the speed of moving vehicles within the speed range of 20-120km/hr.

## TABLE OF CONTENTS

|  |      |
|--|------|
| DECLARATION.....                                       | ii   |
| CERTIFICATION.....                                     | iii  |
| DEDICATION .....                                       | iv   |
| ACKNOWLEDGEMENTS .....                                 | v    |
| ABSTRACT .....   | vi   |
| TABLE OF CONTENTS .....                                | vii  |
| LIST OF TABLES .....                                   | x    |
| LIST OF FIGURES.....                                   | xi   |
| LIST OF PLATES.....                                    | xii  |
| ABBREVIATIONS AND SYMBOLS .....                        | xiii |
| CHAPTER ONE: INTRODUCTION .....                        | 1    |
| 1.1 Background.....                                    | 1    |
| 1.2 Problem Statement.....                             | 1    |
| 1.3 Aim and Objective.....                             | 1    |
| 1.4 Significance .....                                 | 2    |
| 1.5 Scope.....   | 2    |
| CHAPTER TWO: LITERATURE REVIEW .....                   | 3    |
| 2.0 Introduction.....                                  | 3    |
| 2.1 Vehicle Speed Measurement .....                    | 3    |
| 2.1.1 Evolution of Speed Sensors .....                 | 3    |
| 2.1.2 Speedometer .....                                | 6    |
| 2.2 Road Traffic Monitoring Systems .....              | 6    |
| 2.2.1 Camera-Based Monitoring Systems.....             | 7    |
| 2.2.2 Microwave RADAR-based Systems.....               | 8    |
| 2.2.3 Laser-Based Systems .....                        | 8    |
| 2.3 Ultrasonic-Based Measurement .....                 | 9    |
| 2.3.1 Intrusive Sensors and Road Tubes.....            | 9    |
| 2.3.2 Radio Frequency Identification Transponders..... | 10   |
| 2.3.4 Laser Diode .....                                | 11   |
| Some of the features of a laser light.....             | 12   |

|  |           |
|--|-----------|
| 2.3.5 Photo Sensor .....                                     | 12        |
| 2.3.6 Transistor .....                                       | 13        |
| Some features of BC547 Transistor .....                      | 14        |
| 2.3.7 Smartphone Camera.....                                 | 15        |
| 2.3.8 Liquid Crystal Display (LCD) .....                     | 15        |
| <b>CHAPTER THREE: DESIGN AND CONSTRUCTION PROCEDURE.....</b> | <b>16</b> |
| 3.0 Introduction.....  | 16        |
| 3.1 System Design Concept.....                               | 16        |
| 3.2 The Block Diagram.....                                   | 16        |
| 3.3 Block diagram summary.....                               | 17        |
| 3.3.1 The power supply unit.....                             | 17        |
| 3.3.2 The control unit.....                                  | 18        |
| 3.3.3 The sensor unit .....                                  | 18        |
| 3.3.4 The camera unit.....                                   | 18        |
| 3.3.5 The display unit:.....                                 | 18        |
| 3.4 Hardware Design .....                                    | 19        |
| 3.4.1. Power Supply Unit .....                               | 19        |
| 3.4.2 The Control Unit .....                                 | 24        |
| 3.4.3 The Sensor Unit.....                                   | 24        |
| 3.4.4 Biasing of the Laser Diode.....                        | 25        |
| 3.4.5 BC547 as Switch.....                                   | 27        |
| 3.4.6 The Camera Unit.....                                   | 29        |
| 3.4.7 Taking Pictures .....                                  | 29        |
| 3.4.8 Display Unit .....                                     | 31        |
| 3.4.9 Interface of the LCD to the microcontroller. ....      | 31        |
| 3.5 Software Design.....                                     | 34        |
| 3.5.1 Construction Procedure and packaging .....             | 38        |
| <b>CHAPTER FOUR: PERFORMANCE AND COST EVALUATION.....</b>    | <b>39</b> |
| 4.0 Testing of the Project.....                              | 39        |
| 4.1 Discussion of Result .....                               | 40        |
| 4.2 Cost Analysis .....                                      | 40        |
| <b>CHAPTER FIVE: CONCLUSIONS.....</b>                        | <b>43</b> |
| 5.0 Summary.....   | 43        |

|                                  |    |
|----------------------------------|----|
| 5.2 Conclusions.....             | 43 |
| 5.3 Recommendations.....         | 43 |
| REFERENCES.....                  | 44 |
| APPENDIX I.....                  | 48 |
| APPENDIX I I.....                | 54 |
| Testing and Pin Description..... | 54 |
| ATmega328 Pins description.....  | 55 |

## LIST OF TABLES

|  |    |
|--|----|
| Table 2.1 BC547 Transistor Pin Configuration .....                         | 14 |
| Table 3.1 Summary of power supply.....                                     | 20 |
| Table 3.2 Capacitor selection for crystal oscillator (from datasheet)..... | 22 |
| Table 3.3 The Interface module of LCD to the Microcontroller .....         | 31 |
| Table 4.1 Result analysis.....   | 40 |
| Table 4.2 List of Components and cost evaluation .....                     | 41 |
| Table 5.1 Features of Atmega328p.....                                      | 54 |
| Table 5.2 Atmega328 Pins Description.....                                  | 55 |

## LIST OF FIGURES

|   |    |
|---|----|
| Figure 3. 1 Block diagram of the system.....                        | 17 |
| Figure 3.2 Complete power supply circuit.....                       | 21 |
| Figure 3.3 Oscillator circuit (Clock).....                          | 22 |
| Figure 3.4 Microcontroller circuit.....                             | 24 |
| Figure 3.5 Connection of the Laser light.....                       | 25 |
| Figure 3.6 circuit diagram of APDS 9002 Photo Sensor.....           | 26 |
| Figure 3.7 BC547 NPN Transistor Circuit.....                        | 26 |
| Figure 3.8 BC547 NPN Transistor.....                                | 27 |
| Figure 3.9 Connection of digital pins of the microcontroller .....  | 28 |
| Figure 3.10 Connection of Laser Diode to Sensor .....               | 29 |
| Figure 3.11 Mosfet Description.....                                 | 30 |
| Figure 3.12 The Interface module of LCD to the Microcontroller..... | 33 |
| Figure 3.13 Circuit diagram of the entire project.....              | 34 |
| Figure 3.14 Arduino IDE software.....                               | 36 |
| Figure 3.15 System software flowchart.....                          | 37 |

## **LIST OF PLATES**

|  |    |
|--|----|
| Plate 1: Constructed System.....       | 47 |
| Plate 2: Cased Constructed System..... | 47 |

## **ABBREVIATIONS AND SYMBOLS**

|        |   |
|--------|---|
| GPS    | Global Positioning System                               |
| LCD    | Liquid Crystal Display                                  |
| LASER  | Light Amplification by Stimulated Emission of Radiation |
| RADAR  | Radio Detection and Ranging                             |
| RFID   | Radio Frequency Identification Transponders             |
| LPR    | License Plate Recognition                               |
| SAR    | Synthetic Aperture Radar                                |
| SRTM   | Shuttle Radar Topography Mission                        |
| LED    | Light Emitting Diode                                    |
| DC     | Direct Current  |
| RISC   | Reduced- Instruction- Set Computer                      |
| PCB    | Printed Circuit Board                                   |
| EEPROM | Electrical Erasable Programmable Read Only Memory       |
| SRAM   | Static Random Access Memory                             |
| CPU    | Central Processing Unit                                 |
| MCU    | Micro Controller Unit                                   |
| GND    | Ground  |
| SMP    | Switched Mode Power Supply                              |
| RAM    | Random Access Memory                                    |
| ROM    | Read Only Memory  |
| EPROM  | Erasable Programmable Read Only Memory                  |

|     |                                    |
|-----|------------------------------------|
| DAC | Digital to Analog Converters       |
| ADC | Analog to Digital Converters       |
| AC  | Alternating Current                |
| IDE | Integrated Development Environment |
| PCB | Printed Circuit Board              |

# **CHAPTER ONE: INTRODUCTION**

## **1.1 Background**

In present day scenario vehicles play a vital role in transportation system and the use of vehicle is also increasing exponentially due to the population growth and their needs [1]. Over speeding has been classified as one of the major contributing factor in all fatal motor-vehicle crashes. A small increase in travelling speed before braking can result in a large increase in the impact of speed and the risk of fatal injury. Even small differences in the impact of speed will make a large difference to the probability of serious injury [2]. Generally, over speeding is the result of bad behavior of drivers. As the accident rates are increasing, it is important to develop and implement a system which can automatically detect and report over speeding to the traffic control authorities as early as possible [3].

## **1.2 Problem Statement**

The main causes of accidents are vehicle over-speeding, driving under the influence of alcohol, distraction while driving as a result of phone usage either to text or calling someone, ignoring traffic signals and poor lane discipline etc. The vehicle speed detection system is developed to help law enforcement agents to determine when a vehicle has exceeded a specified speed limit.

## **1.3 Aim and Objective**

To develop a system that can help road traffic personnel know the approximate number of vehicles passing at a particular road, to track speed limit violators on our roads, in order to take proper action.

## **1.4 Significance**

The goal of this car speed detection system is to identify vehicular movement with their speed, and hence controls the number of accidents. The information aid enforcement personnel create laws, speed limits in order to increase safety. The result of the solution will be the reduction in the number of accidents on minor and major roads cutting down costs of human lives as well as financial costs from accidents.

## **1.5 Scope**

This project is designed and constructed to measure the speed of moving vehicles within the speed range of 20-120km/hr. This can help the road personal to get accurate data on a particular road. The system cannot be able to control the driver behavior or reduce the speed of the vehicle to the expected speed.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.0 Introduction**

This Chapter presents more specific discussions on the speed warning system such as history, classifications of vehicle speed tracking, monitoring systems and definition as well as features and applications of these systems.

### **2.1 Vehicle Speed Measurement**

#### **2.1.1 Evolution of Speed Sensors**

Most speedometers operated off the rear driveline but some used a front wheel as its input. Since the early years of the automobile, a need to monitor vehicle speed has evolved. As vehicle speed increased and roads improved, the main objectives of a speedometer were to allow the driver to accurately view the vehicle's speed while driving and make the necessary adjustments. Also the driver can be able to read the odometer to verify how many miles or kilometer that the vehicle has covered. The vehicle's speeds are calculated using the vehicle's gear ratio, the circumference of the vehicle's tire which gives the average speed of the vehicle. If during the course of maintenance, the vehicle rear axle was changed or the tire size was changed, the process of matching plastic "speedo" gears are used to ensure accurate speed. This technology is still in existence in most modern vehicles which rely on electronic sensors to perform the job [4]

The operation of most speed sensors is similar and might fall into one of three categories:

- Variable reluctance
- Hall-effect
- Magneto resistive

As a result of the use of modern speed sensors, today's vehicles utilize this technology not only to monitor vehicle speed, but also to monitor component position or rate of speed change on virtually any moving part of the automobile. They can be mounted on the vehicle in a variety of locations to perform different tasks. The variable reluctance wheel speed sensor is basically a permanent magnet with wire wrapped around it. It is usually a simple circuit of only two wires where in most cases polarity is not important. The physics behind the operation include magnetic induction. A toothed ring on the wheel passes by the speed sensor and disrupts this magnetic field. The disruption in the field causes the wheel speed sensor to produce a sinusoidal voltage signal. The frequency and amplitude of the voltage signal are proportional to the speed of the wheel. The amplitude of the wheel speed signal is also directly related to the distance between the wheel speed sensor coil and the toothed ring [5]

Magnetic speed sensors rely on a magnet as the sensing element to capture rotational or linear speed. They are typically used as gear tooth speed sensors or incorporated into stroboscopes or tachometers. The technology types for magnetic speed sensors include magneto resistive, inductive, variable reluctance and Hall Effect. In a magneto resistive sensor, the resistance of the sensing element is a function of the direction and magnitude of an applied magnetic field. In an inductive sensor an oscillator circuit generates a radio frequency electromotive force that radiates from a ferrite core and coil assembly. The field is directed at the sensor face. When a metal target enters the field, eddy currents are induced into the surfaces of the target. This causes a reduction in the amplitude of the oscillator circuit and change in inductance. Variable reluctance speed sensors are typically self-generating and require no external power. When a magnetic surface is passed in close proximity to the sensor, a small voltage is induced. In a Hall Effect sensor, a current is passed through a semiconductor

material. When a magnetic field is applied perpendicularly to the surface of the semiconductor, a voltage is developed. This Hall voltage is proportional to the applied field intensity, driving the magnetic speed sensor [6].

Analog variable reluctance speed sensor is a passive sensor and requires no outside power source. The sensor generates a sinusoidal output voltage proportional to target speed and air gap. Analog signal is generated in response to fluctuation in magnetic field resulting from interruption by ferrous targets. This sensor can be configured for use in very high temperatures and high speed. The output voltage, depending on air gap and the target surface speed, ranges from a few milli-volts at the slowest target surface speed to several volts at the highest target speed. [7]

The Delta speed sensor is an inexpensive, non-contact Doppler radar speed sensor suitable for a wide variety of speed measurement applications. Small size and lightweight as well as requires only a small power source, making it useful in situations requiring portability or remote sensing. The sensor may be placed on a moving vehicle to measure vehicle ground speed. It also may be fixed in a stationary mounting to measure the speed of a moving object, which can be anything from a wire passing under the sensor to a vehicle a thousand feet away. The output of the sensor is a pulse with frequency proportional to measured speed. The cumulative number of pulses may be used to determine distance travelled or the length of a moving surface. Besides, it can be used with many different types of electronic hardware, such as timer, counters or digital tachometers, and can be integrated into electronic control or data acquisition systems [8].

### **2.1.2 Speedometer**

Regular car speedometers can never know the exact speed of a vehicle without knowing how quickly the wheels rotate combined with the precise circumference of the tyres. Optical speedometer system is installed on the underside of the car, to see the surface of the road to move beneath it and determines the speed of the car as well as the mileage. But using this system to calculate mileage might be easily foiled by a mounted sheet, to fool the system into thinking the road is not moving, thus stopping mileage increment [9].

Deductive reckoning is one method widely used in vehicle navigation. Vehicle navigation using the Global Positioning System (GPS) has been of increasing interest over the past decade and GPS navigation is frequently installed in today's high-end luxury cars and in many commercial vehicles. It utilizes three distinct inputs to predict position: a set of starting coordinates, the direction of travel, and the speed of travel [10]. The ADXL202 dual-axis accelerometer can be used to develop accurate speed estimates for this navigation system. The method for determining velocity uses an accelerometer to sense the time interval for both front and back wheels to encounter a bump in the road while moving straight ahead. Whether one is driving on a local road or a highway, there will always be imperfections in the road. These imperfections translate into bumps and jolts sensed immediately by the car's wheels, and ultimately by its passengers. In order to track the speed by sensing these bumps, an accelerometer is used to identify their magnitudes and timing [11].

## **2.2 Road Traffic Monitoring Systems**

A number of vehicle speed monitoring and tracking systems exist in the market, most notably the Light Amplification by Stimulated Emission of Radiation (LASER)

speed gun, Radio Detection and Ranging (RADAR) speed gun, speed camera system and fleet monitoring system. Law enforcement in the last decade has moved increasingly to newer technologies such as Global Positioning System (GPS) based vehicle tracking system to catch speeding motorists and improve road safety as well as for fleet management applications. These newer technologies are likely to supplement rather than replace traditional speed monitoring and tracking systems. Some of the conventional traffic monitoring systems and vehicle speed measuring techniques has been presented in the following sections.

### **2.2.1 Camera-Based Monitoring Systems**

Camera based systems use video image processing techniques in order to identify the moving vehicles and traffic flow parameters. Images are grabbed using video cameras [12]. A series of image processing algorithms are used on the raw images in order to digitize them. Vehicle speed data are extracted with image processing technique. The cost of installation and maintenance of the video cameras are high. The performance of the camera-based traffic monitoring systems is unsatisfactory in foggy weather conditions or poor visibility, or other environmental conditions, e.g. reflection coming from the wet pavements, shadows etc. The speeds of the vehicles passing within a time interval are recorded by grabbing images of the passing vehicles using a digital television camera connected to a computer [10]. Using this system, a vehicle's speed is computed from the relationship between the number of frames and the two positions of the vehicle at a specific time interval. TRIP II system has been reported for obtaining the vehicle speed on the roads by employing image processing technique in traffic monitoring. This technique automatically detects and measures the speed of the moving vehicles passing through the camera thereby allowing the system to collect the

information on the vehicles, determine the speeds of the vehicles and other associated information. It has been estimated that a detection accuracy of better than 99% can be achieved through image processing technique [2].

### **2.2.2 Microwave RADAR-based Systems**

Microwave radars are used to estimate the speeds of the moving vehicles on roads. Typical microwave radar transmits electromagnetic energy at a constant frequency and uses the Doppler principle considering the difference in frequency between the transmitted and received signals, which is proportional to the speeds of the moving vehicles. Another type of microwave radar transmits a frequency-modulated continuous wave with varied time-dependent transmitted frequency. The speeds of the vehicles are estimated using the microwave radars. The radars estimate the time taken by a vehicle to move between two positions. However, they are not able to estimate the speeds of the moving vehicles accurately. A microwave radar apparatus operated in a non-coherent mode has been reported for observing road traffic located at Logan airport in Boston. The apparatus comprises of a conventional rotating antenna and a pulsed magnetron transmitter. The vehicle speeds are obtained by tracking individual vehicles over successive antenna scans for a specific period of time. However, the speed determination technique is not suitable in congested traffic conditions or when one vehicle tries to cross the other speeding vehicle on the road [13]

### **2.2.3 Laser-Based Systems**

Traffic monitoring system includes laser-based systems, which are used for counting, classifying and measuring speeds of the moving vehicles on the roads. One advantage of these systems is that these do not need installation work on the floor of the roads/highways; rather, they are installed on overhead positions of the roads/highways

Laser-based systems are durable and reliable for the measurement of the speeds of the moving vehicles. The main disadvantage of the system is that the systems require a pre-structured traffic on the roads [3].

## **2.3 Ultrasonic-Based Measurement**

Ultrasonic-based sensors are used for detecting the vehicles and speeds of those moving on the roads. Typically, these sensors are mounted on an overhead structure on the roads and transmit sound waves at 25 KHz to 50 KHz. It has both transmitters and receivers of sound waves. According to the principles of ultrasonic-based detectors, a part of the transmitted energy is reflected back from the vehicles to the receivers. The difference between the transmission and reception of the sound waves is calculated, the vehicles are detected and their speeds are estimated. The disadvantage of the ultrasonic-based sensor technology in measuring the speeds of the moving vehicles is that the technology is expensive. Another disadvantage of this technology is it is very sensitive to noise and environmental conditions of the roads [5].

### **2.3.1 Intrusive Sensors and Road Tubes**

Most of the traffic control systems use intrusive sensors, which includes inducting loop detectors, micro-loop probes and pneumatic road tubes for their high accuracy of vehicle detection (> 97%). Moreover, above-ground sensors like video image processing, microwave radar, laser radar, passive infrared, ultrasonic and passive acoustic array are being used. All of these sensors include high equipment cost. The accuracy of these sensors depends on the environment conditions.

### **2.3.2 Radio Frequency Identification Transponders**

Radio Frequency Identification Transponders (RFID) are used in order to obtain individual travel time based on vehicle re-identification. Moreover, License Plate Recognition (LPR) systems based on image processing techniques are used for measuring the vehicle travel time when a vehicle crosses two sensors. Furthermore, global positioning system devices are used for obtaining the position and speed of the vehicles with high accuracy for gathering traffic information. There are some existing speed adaptation systems such as RFID-Radio Beacons, which works to transmit data to receiver in the vehicle with local speed limits, school zones, variable speed limit or traffic warnings. This system is used for slow (or low-speed) vehicles running only in the restricted zones.

### **2.3.3 Microcontroller Unit**

A microcontroller or microcontroller unit (MCU) is a small computer on a single metal-oxide semiconductor chip. It is a compact integrated circuit design to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory, input and output peripherals on a single chip. The basis of a microcontroller includes the

- CPU which is the brain of the system. It fetches data, decodes it and at the end completes the assigned task.
- The memory: the memory in the microcontroller stores all programs and data. Microcontrollers are built with certain amount of RAMS or ROM (EPROM, EEPROM) or flash memory for storage of program source codes.
- Input/output Ports: I/O ports are basically employed to interface or drive different appliances connected to the system.

- Serial ports this ports gives serial interfaces amid microcontrollers and various other peripherals such as parallel ports.
- Timers: a microcontroller may be inbuilt with one or more timers or counters. It controls all counting and timing done by the microcontroller.
- ADC (analog to digital Converters); ADC is employed to convert analog signals to digital signals so that it can be processed by the microcontroller.
- DAC (digital to analog converters); DAC executes opposite function of the ADC. It converts digital signals to analog signals so that it can be understood.

There are different types of microcontrollers produced by different companies which include PIC microcontrollers, AVR microcontrollers, ARM microcontrollers, 805X family microcontroller, PIC microcontrollers. Microcontrollers can also be classified according to their bits, memory architecture and instruction sets [14]

The type of microcontroller used in this project is ATMEGA328P.

#### **2.3.4 Laser Diode**

A Laser diode is a semiconductor device similar to a light-emitting diode in which a diode pumped directly with electrical current can create lasing conditions at the diodes junction. Laser diode can directly convert electrical energy into light. Driven by voltage, the doped p-n transition allows for recombination of an electron with a hole. Due to the drop of the electron from a higher energy level to a lower one, radiation, in the form of an emitted photon is generated. This is spontaneous emission. Stimulated emission can be produced when the process is continued and further generate light with the same phase, coherence and wavelength.

Some of the features of a laser light

- Monochromaticity: a laser beam is more or less in single wavelength. The line width of laser beams is extremely narrow.
- Directionality: Ordinarily natural light sources emit light in all directions. On the other hand, in laser, all photons will travel in the same direction. Therefore, laser emits light in only one direction. This is called directionality of the laser diode.
- Coherence: the process of electrons moving from higher energy levels to lower energy level or vice versa is termed electron transition. In ordinary light source, electron transition occurs naturally. In laser, the electron transition occurs artificially. It occurs in specific times. All the photons emitted in laser have the same energy, frequency, or wavelength. Hence it has single wavelength or color.
- High intensity: the intensity of a wave is the energy per unit time flowing through a unit normal area. In laser light, the light spreads in small region of space and in small wavelength range. Hence, laser light has greater intensity when compared to the ordinary light [15].

### **2.3.5 Photo Sensor**

A photo sensor is an equipment used to discover the distance, absence, or presence of an object by using a light transmitter, often infrared, and a photoelectric receiver. This project utilizes APDS 9002 photo sensor. It is a low-cost analog-output ambient light photo sensor in lowest cost miniature chipLED lead-free surface mount package. It consists of a spectrally suited phototransistor, which peaks in human luminosity curve. Hence, it provides an excellent response that is close to the

response of human eyes. It provides a design-alternative to the HSDL-9000 digital output ambient light photo sensor is suitable for portable applications with its ultra-small package design. When there is an illumination on the surface of the sensor, it outputs an output voltage and it did not output any value when there is no source of light close to it. The value of the output value is directly proportional to the intensity of light reflecting on it [16]. Some of the features of APDS 9002 Photo Sensor includes

- Excellent responsivity which peaks in the human luminosity curve
- Close responsivity to the human eye
- Miniature chipLED lead-free surface-mount package
- Good output linearity across wide illumination range
- Low sensitivity variation across various light sources
- Guaranteed temperature performance: -40° C to 85° C
- VCC supply 2.4 to 5.5 V
- Lead-free package
- Analog output value [17].

### **2.3.6 Transistor**

A Transistor is a device that regulates current or voltage flow and acts as a switch or gate for electronic signals. Transistors consist of three layers of a semiconductor material, each capable of carrying a current. The semiconductor material is given special properties by a chemical process called doping. This project uses BC547 transistor. It is a NPN transistor hence the collector and emitter will be left open (Reverse biased) when the base pin is held at ground and will be closed (Forward biased) when a signal is provided to base pin. BC547 has a gain value of 110 to 800,

this value determines the amplification capacity of the transistor. The maximum amount of current that could flow through the Collector pin is 100mA, hence we cannot connect loads that consume more than 100mA using this transistor. To bias a transistor we have to supply current to base pin, this current ( $I_B$ ) should be limited to 5mA [18].

When this transistor is fully biased then it can allow a maximum of 100mA to flow across the collector and emitter. This stage is called Saturation Region and the typical voltage allowed across the Collector-Emitter ( $V_{CE}$ ) or Base-Emitter ( $V_{BE}$ ) could be 200 and 900 mV respectively. When base current is removed the transistor becomes fully off, this stage is called as the Cut-off Region and the Base Emitter voltage could be around 660 mV.

Table 2.1 BC547 Transistor Pin Configuration.[19]

| Pin Number | Pin Name  | Description                        |
|------------|-----------|------------------------------------|
| 1          | Collector | Current flows in through collector |
| 2          | Base      | Controls the biasing of transistor |
| 3          | Emitter   | Current Drains out through emitter |

#### Some features of BC547 Transistor

- Bi-Polar NPN Transistor
- DC Current Gain ( $h_{FE}$ ) is 800 maximum
- Continuous Collector current ( $I_C$ ) is 100mA
- Emitter Base Voltage ( $V_{BE}$ ) is 6V
- Base Current( $I_B$ ) is 5mA maximum

- Available in To-92 Package [20]

### **2.3.7 Smartphone Camera.**

A smartphone a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, Internet access, and an operating system capable of running downloaded apps and ability to take quality pictures using the device camera. Some of the features of a smartphone camera include.

- Bright aperture
- Decent amount of megapixels
- Large screen to be viewed
- Optical image stabilization
- Ultra wide angle lenses which gives a wider view of a scene
- High dynamic range.
- Focus and shutter response. [21]

### **2.3.8 Liquid Crystal Display (LCD)**

LCD stands for **Liquid Crystal Display**. LCD components are “specialized” for being used with the microcontrollers, which means that they cannot be activated by standard IC circuits. They are used for writing different messages on a miniature LCD.

In this project, LCD display is an output module which is being controlled by ATMEGA328P. [22] Some features of liquid Crystal Display (LCD) includes

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Consists of two rows and each row can print 16 characters.
- Can work on both 8-bit and 4-bit mode. [23]

## **CHAPTER THREE: DESIGN AND CONSTRUCTION PROCEDURE**

### **3.0 Introduction**

This chapter deals with the orderly presentation of the steps involved in the design and construction of a microcontroller based vehicle over speed detection system with plate number capturing capability. In this chapter the design procedures and analysis was fully discussed. This includes the block diagram, the hardware analysis and design, the implementation of the hardware, the software designs, and the overall construction of the system.

### **3.1 System Design Concept**

The system design is divided into two parts which includes the hardware design and the software design. The hardware design deals with arranging the components with the required values to achieve the desired goals. The software design deals with coding the program that will control the action of the system. The software program gives and receives command from the hardware, then processes the information and gives out useful information to the user. The hardware includes the visible part of the system while the software includes the set of instructions controlling the operation of the system.

### **3.2 The Block Diagram**

The block diagram is a set of blocks which represents units that works together to achieve the desired goal. Some of the major block units of the system include the power supply unit, the control unit, the display unit, the camera unit, and the photo sensor units that detects the passing vehicles. The systems block diagram is as shown below. The direction of the arrow shows the direction of signal flow within the system.

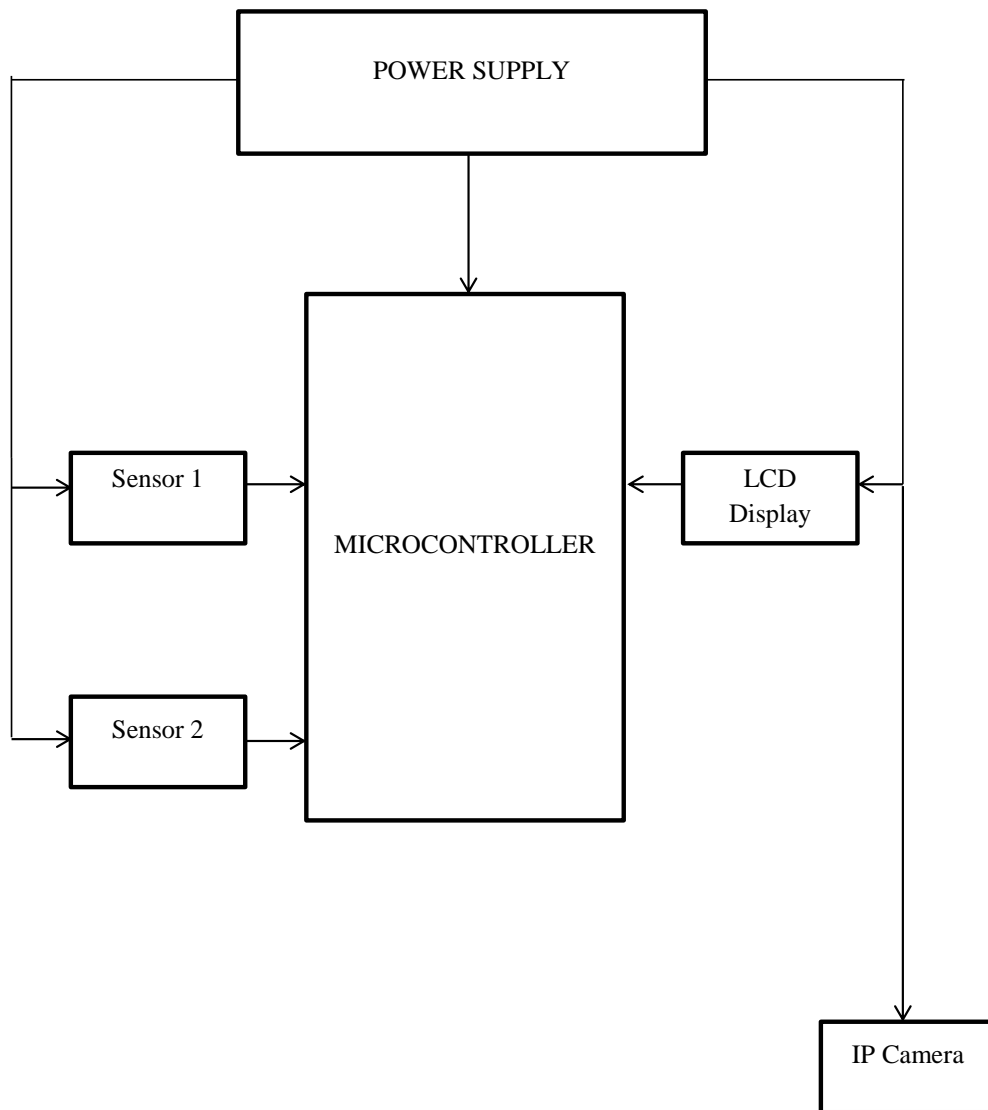


Figure 3.2 Block diagram of the system

### 3.3 Block diagram summary

#### 3.3.1 The power supply unit

The power supply section is the power house of the system. The unit provides the required power to the various sections of the system. The unit ensures each part of

the system receives the required amount of power needed to function properly. The system is battery powered as it is a mobile system.

### **3.3.2 The control unit**

The control unit is the brain of the whole system. It controls the actions of the units attached to it. The type of controller used is a microcontroller integrated circuit. The unit receives input data from the sensors and gives out an output to the camera, the display unit. The control unit is the central processing unit of the whole system.

### **3.3.3 The sensor unit**

This unit comprises of two sensors that detects the vehicle. Two sensors were positioned to determine the speed of vehicles. The type of sensor used is a laser light and as well an optical coupling. The system calculates time elapses for a vehicle to move from the first sensor to the second sensor.

### **3.3.4 The camera unit**

The camera unit is responsible for taking the vehicle number of any over speeding vehicle and stores it in the data base of the system. Whenever a vehicle exceeds the specified speed limit, the system will activate the camera to take the picture of the vehicle.

### **3.3.5 The display unit:**

The display unit is the user interface that allows the user to obtain some information from the system .The display unit shows the speed of any vehicle passing by. The type of display used in the system is the Liquid Crystal Display (LCD).

The LCD communicates with the microcontroller. It obtains data and then displays it to the user.

### **3.4 Hardware Design**

The hardware design deals with the design analysis and calculations of the various sections of the system. The hardware includes the physical parts of the circuit which can be seen and be touched. The reasons for the choice of the components were also discussed. Some of the major sections of the system hardware design includes the power supply, the control section, the detection and the display sections which were as discussed below.

#### **3.4.1. Power Supply Unit**

As stated above, the power supply is the power house of the system. It provides power to the various parts of the system in a required proportion. Some of the various sections that requires power includes the display, the sensors and the control sections. Since the system will be mounted on the road side, it requires a battery power source which powers the various sections. The system is powered through a replaceable 12V battery power supply. The factor considered in designing the power supply is the maximum power consumption of the various sectors. Three different power supply were provided to power the main system and the two different sensors that detects the presence of the vehicle. The summary of the power supply is as stated in the table below.

Table 3.1 Summary of power supply

| <b>COMPONENTS</b> | <b>TYPICAL CURRENT</b> | <b>OPERATING VOLTAGE</b> | <b>MAXIMUM CURRENT</b> |
|-------------------|------------------------|--------------------------|------------------------|
| LCD               | 130mA                  | 5V                       | 260Ma                  |
| LED               | 5mA                    | 5V                       | 10Ma                   |
| Atmega328p        | 250mA                  | 5V                       | 450Ma                  |
| Total             | 390mA                  | 5V                       | 730Ma                  |

From the above table, the power supply should be able to supply a current of about 730mA at a constant voltage of 5V. For the laser diodes, the power supply is a single 4.2V dc battery which was attached to each sensor to forward bias the diodes. In the main circuit, a voltage regulator was used to regulate the output voltage to 5V. The voltage regulator used was L7805 5V voltage regulator.

The circuit requires +5V DC supply. A 12V battery was used and was regulated to the required voltage using LM7805 regulator. The L7805 is a voltage regulator IC that maintains the output voltage at a constant value of 5V irrespective of the variation in the input voltage above the specified value. L7805 is a member of the 78xx series of fixed linear voltage regulators used to maintain fluctuations.

In this circuit, the L7805 maintains a constant output voltage of 5V which is needed by the circuit to function properly. Some of the features of the regulator according to the datasheet includes

- Input voltage range of 7V-35V dc.
- Current rating of 1A and 1.5A peak current.
- Output voltage range of  $V_{max} = 5.2V$  and  $V_{min} = 4.8V$ .

- Internal thermal overload and short circuit limiting protection.
- Junction temperature maximum of 125 degree Celsius. [24]

The L7805 is a three terminal integrated circuit as shown in the figure above. The three pins includes the input, ground and the output. The positive voltage supply is applied to the input terminal. The ground is common to the input and output terminal and it is connected to the negative terminal of the battery. The output voltage is obtained at the output terminal of the integrated circuit. The positive voltage of 5V is tapped from the output terminal and the ground terminal. Since the minimum voltage required by the IC to operate is at 7V, the circuit is powered with a 12V battery. The battery supplies the required voltage and current to the system. An LED was connected to the output terminal of the IC to serve as a power indicator. The positive terminal of the LED was connected in series with the output terminal via a current limiting resistor of 220Ω. The LED lights on whenever the system is connected to the power.

The completed power supply is as shown in the diagram below.

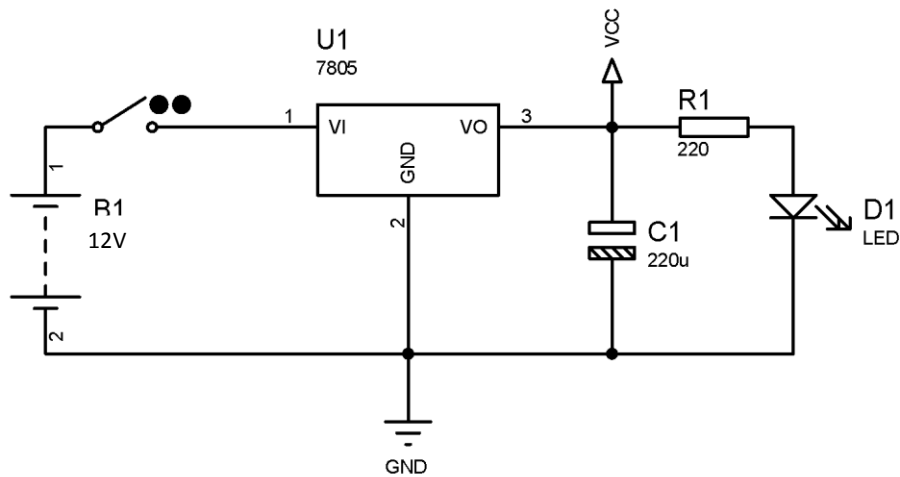


Figure 3.2 Complete Power Supply Circuit

An oscillator is an electronic circuit that generates repeated waveforms. The exact waveform generated depends on the type of circuit that is used in generating them. For the high speed performance required for this project the crystal oscillator is used.

The crystal oscillator is responsible for producing the clock signal required by the circuit (microcontroller). Two capacitors values are normally chosen from the range of values from the datasheet of the microcontroller (ATmega328p) and the standard table below to increase the stability of the oscillator and increase the startup time.

Table 3.2 Capacitor selection for crystal oscillator (from datasheet).

| Mode | Frequency | C1       | C2       |
|------|-----------|----------|----------|
| LP   | 32 kHz    | 33Pf     | 33Pf     |
|      | 200 kHz   | 15Pf     | 15Pf     |
| XT   | 200 kHz   | 26 -68pF | 26 -68pF |
|      | 1.0 MHz   | 15pF     | 15Pf     |
|      | 4.0 MHz   | 20 -30pF | 20 -30pF |
| HS   | 4.0 MHz   | 15pF     | 15Pf     |
|      | 8.0 MHz   | 15-33Pf  | 15-33pF  |
|      | 20 MHz    | 15-33Pf  | 15-33pF  |
|      | 25 MHz    | 15-33Pf  | 15-33Pf  |

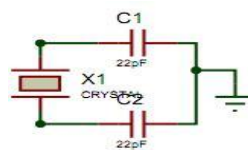


Figure 3. 3 Oscillator circuit (Clock)

The internal frequency of operation required for an instruction to be executed is given by:

$$f_{INT} = \frac{f_{QUARTZ}}{8} \dots \dots \dots (3.1)$$

Where:

$f_{QUARTZ}$  is the crystal frequency

$f_{INT}$  is the internal clock frequency of the microcontroller

$$T = \frac{1}{f_{INT}} \dots \dots \dots (3.2)$$

Assume a crystal oscillator Cx1 of 16MHz for this project. The required capacitor values C1 and C2 should be between 15-33pf (from table 3.3). Hence, a 22pf capacitor is chosen for this project.

From equation (1)

$$F_{int} = \frac{F_{quartz}}{8}$$

Where:

$F_{quartz}$  is the crystal frequency

$F_{int}$  is the internal clock frequency of the microcontroller

$$\begin{aligned} F_{int} &= \frac{16MHz}{8} \\ &= 2MHz \end{aligned}$$

From equation (3.2)

$$\begin{aligned} T &= \frac{1}{F_{int}} \\ &= \frac{1}{2MHz} \\ &= 0.5\mu s \end{aligned}$$

which is the period for executing an instruction.



A laser diode similar to light emitting diode (LED). It comprises of two terminals which includes the anode and the cathode. It is a semiconductor device in which a diode is pumped directly with electrical current which creates lasting conditions at the diodes junctions. Laser diodes directly convert electrical energy into light energy. [15]

### 3.4.4 Biasing of the Laser Diode

Biasing a laser light involves applying the right amount of voltage across its terminal. The anode was connected to the positive terminal of the battery while the cathode was connected to the negative terminal of the battery. A current limiting resistor of  $100\Omega$  was connected in series with the anode of the laser.

The laser light constantly provides illumination for the photo sensor. The laser light and the photo sensor provide the sensor to detect the presence of the passing vehicle. The connection of the laser light is as shown in the diagram below.

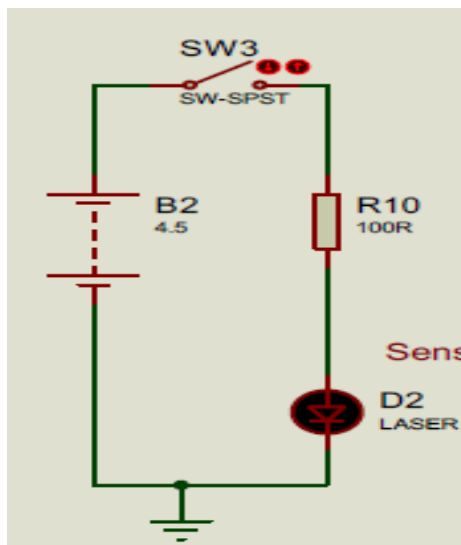


Figure 3.5 Connection of the Laser light.

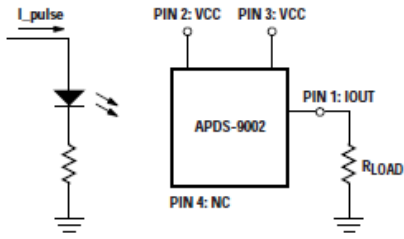


Figure 3.6 circuit diagram of APDS 9002 Photo Sensor. [16]

The output of the photo sensor drives the transistor. The light intensity required to produce an output on the sensor is controlled by the 100KΩ variable resistor. The connection of the photo resistor is as shown below.

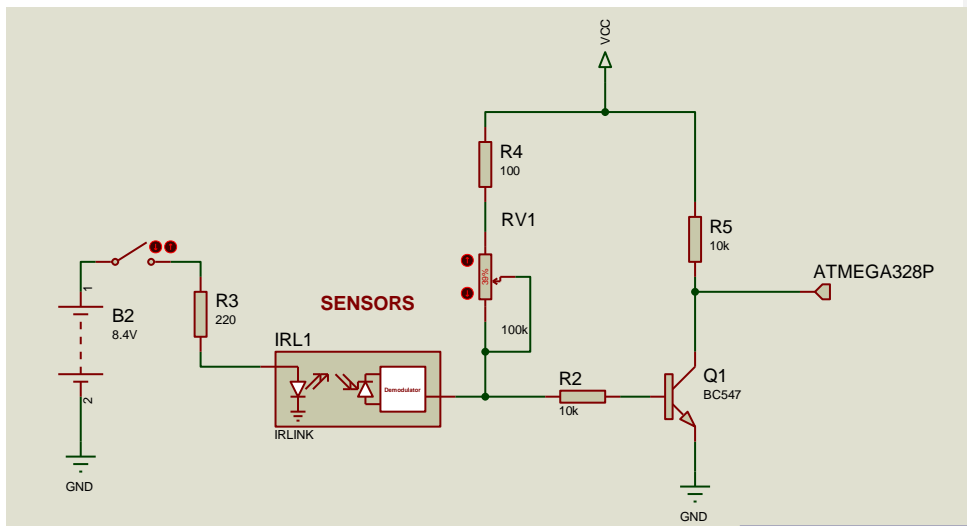


Figure 3.7 BC547 NPN Transistor Circuit

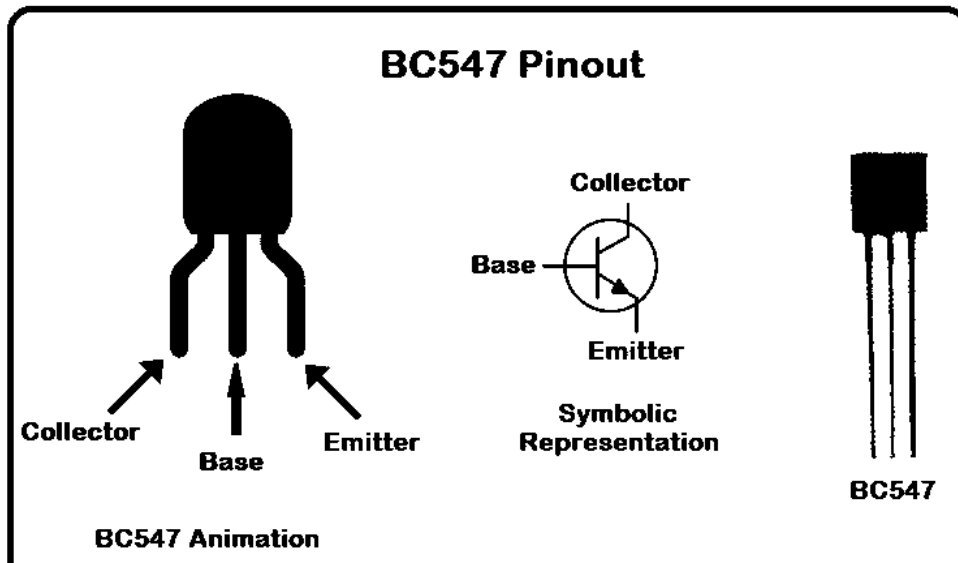


Figure 3.8 BC547 NPN Transistor. [19]

### 3.4.5 BC547 as Switch

When a transistor is used as a switch it is operated in the **Saturation and Cut-Off Region**. The transistor will act as an Open switch during Forward Bias and as a closed switch during Reverse Bias. This biasing can be achieved by supplying the required amount of current to the base pin. Using BC547 as a switch, the biasing current should not exceed 5mA according to the datasheet. In this design, a 10KΩ is used in series with a 100KΩ variable resistor to provide a bias to the transistor. The output of the light sensor provides the bias voltage to the transistor. When there is a light source sufficient enough to produce a bias, the transistor switches on and when the light source reduces the transistor switches off. The value of this resistor ( $R_B$ ) can be calculated using below formulae.  $V_B = I_B R_B + V_{BE}$

Where

$$I_B = \frac{V_B - V_{BE}}{R_B}$$

where  $V_B$  is the output of the light sensor which ranges from 0V to 5V.

The maximum allowed base current is 5mA. Choosing about 80% of the base current which is 4mA the base biasing resistor can be calculated as shown below. According to datasheet, the base emitter voltage  $V_{BE}$  is given as 0.7V. hence,

$$R_B = \frac{V_B - V_{BE}}{I_B} = \frac{5 - 0.7}{4 \times 10^{-3}} = \frac{4.3}{4 \times 10^{-3}} = 1.075 K\Omega$$

Hence in this circuit, a 1K $\Omega$  resistor is used with 100 $\Omega$  variable resistor to provide the biasing voltage to the transistor. [30]

The output of the transistor was then connected to the digital pins of the microcontroller through a collector current limiting resistor of 10K $\Omega$ .

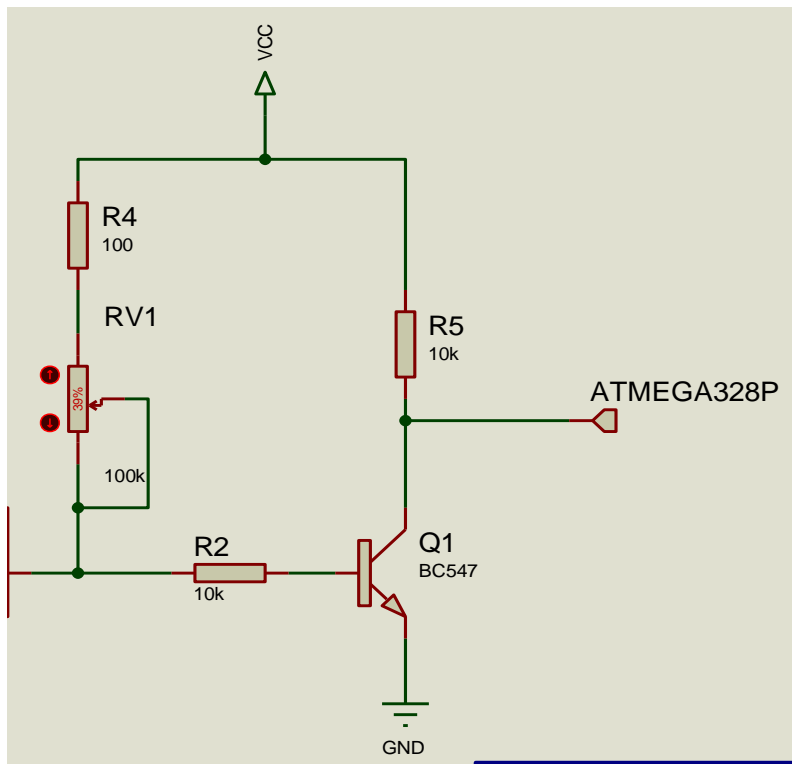


Figure 3.9 Connection of digital pins of the microcontroller to collector.

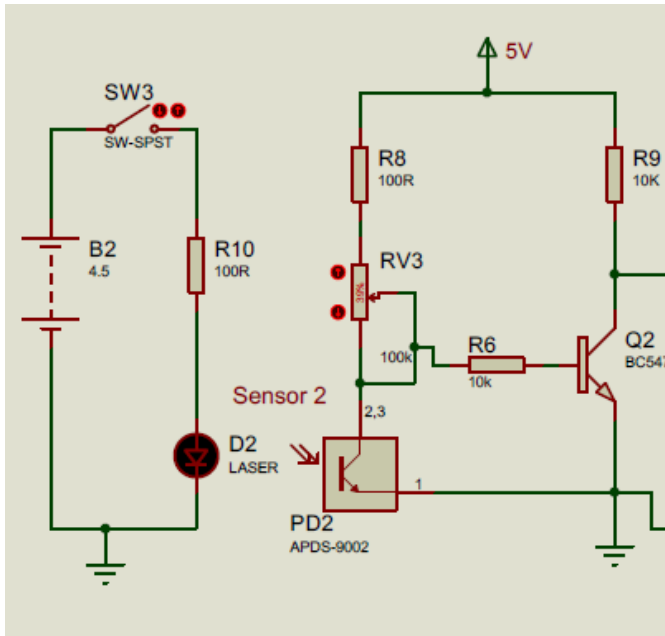


Figure 3.10 Connection of Laser Diode to Sensor

### 3.4.6 The Camera Unit

The camera unit takes the picture of the erring vehicle or the over speeding vehicle. The camera is positioned in such a way that it captures the plate number of any vehicle with a speed above the speed limit of 120KM/hr. The camera used in this project is a smartphone camera. The system activates the camera to take pictures when necessary. The camera was connected to the system through a mosfet configured to function as a switch. The earpiece jack port was used to provide an interface to the smartphone. The interface of the camera to the system was as discussed in the subsequent sections below. [25]

### 3.4.7 Taking Pictures

Normally a smartphone will take a picture when the camera application is opened in the smartphone and the shutter button is pressed. In this system, the phone

sync camera application was used to take pictures and send it to the cloud. Due to the fact that the pictures should be taken automatically, the earpiece jack port and an earpiece cord was used to transmit command to the smartphone to take pictures whenever there is a defaulter. The project through the BUK455 mosfet provides a close circuit for the smartphone to take pictures.

N-channel enhancement mode field-effect power transistor in a plastic envelope. The device is intended for use in Switched Mode Power Supplies (SMPS), motor control, welding, DC/DC and AC/DC converters, and in automotive and general purpose switching applications.

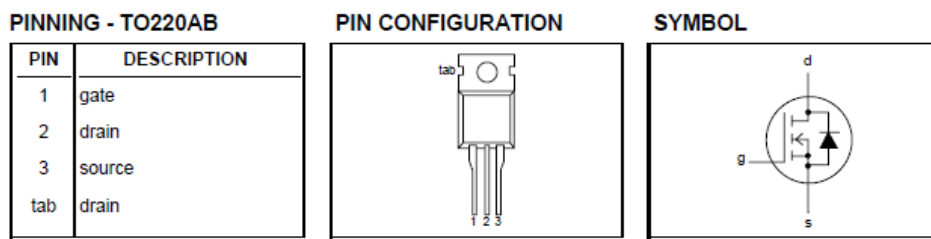


Figure 3.11 Mosfet Description. [26]

In this project, the N-channel mosfet is used as a switch to switch the camera to take a pictures when necessary. According to the datasheet, the mosfet requires a minimum gate threshold voltage of 2.1V and maximum of 4.0V to properly bias the mosfet as a switch. The gate of the mosfet was connected to the microcontroller digital pin 7 which spits an output voltage of 5V. hence a voltage divider was used to reduce the voltage to the required standard that can operate the mosfet. Two 10KΩ resistors were used as a voltage divider to obtain the required voltage value.

$$V_{in} = 5V$$

$$R1 = 10K\Omega$$

$$R2 = 10K\Omega$$

$$V_{out} = \frac{R2}{R1 + R2} V_{in} = \frac{10}{10 + 10} \times 5 = \frac{10}{20} \times 5 = 2.5V$$

Hence the output voltage biasing the transistor was 2.5V which is within the required range of the specified voltage to operate the mosfet as a switch. The mosfet acts as a closed switch when there is a voltage in its gate and as an open switch when there is zero voltage at its gate terminal. With this configuration, the mosfet can be controlled to take pictures using the microcontroller. [26]

### 3.4.8 Display Unit

The display unit serves as the user interface. The results obtained by the system is displayed on the display unit. The speed of any passing vehicle which includes the speed in meter per second and the speed in kilometer per hour is displayed in the display unit. The type of the display unit used in the project is a 16X2 LCD screen. The device displays sixteen characters per line and a maximum of two lines can be displayed at a time.

### 3.4.9 Interface of the LCD to the microcontroller.

The LCD module was connected to the microcontrollers port B which is as well digital pins of the microcontroller. The interface of the module is as summarized below.

Table 3.3 The Interface module of LCD to the Microcontroller

| No. | Symbol | Function           | Connection |
|-----|--------|--------------------|------------|
| 1   | VSS    | Ground (0V)        | Ground     |
| 2   | VDD    | Supply voltage     | 5V         |
| 3   | V0     | Control adjustment | 10K pot    |

|    |       |                         |        |
|----|-------|-------------------------|--------|
| 4  | RS    | Data instruction select | 8      |
| 5  | E     | Enable signal           | 9      |
| 6  | R/W   | Read/Write select       | Ground |
| 7  | DB4   | Data bus                | 10     |
| 8  | DB5   | Data bus                | 11     |
| 9  | DB6   | Data bus                | 12     |
| 10 | DB7   | Data bus                | 13     |
| 11 | LED_K | Led power supply (0V)   | Ground |
| 12 | LED_A | Led power supply (5V)   | 5V     |

A 10K $\Omega$  variable resistor was connected to the VEE terminal of the LCD to control its brightness as stated in the datasheet.

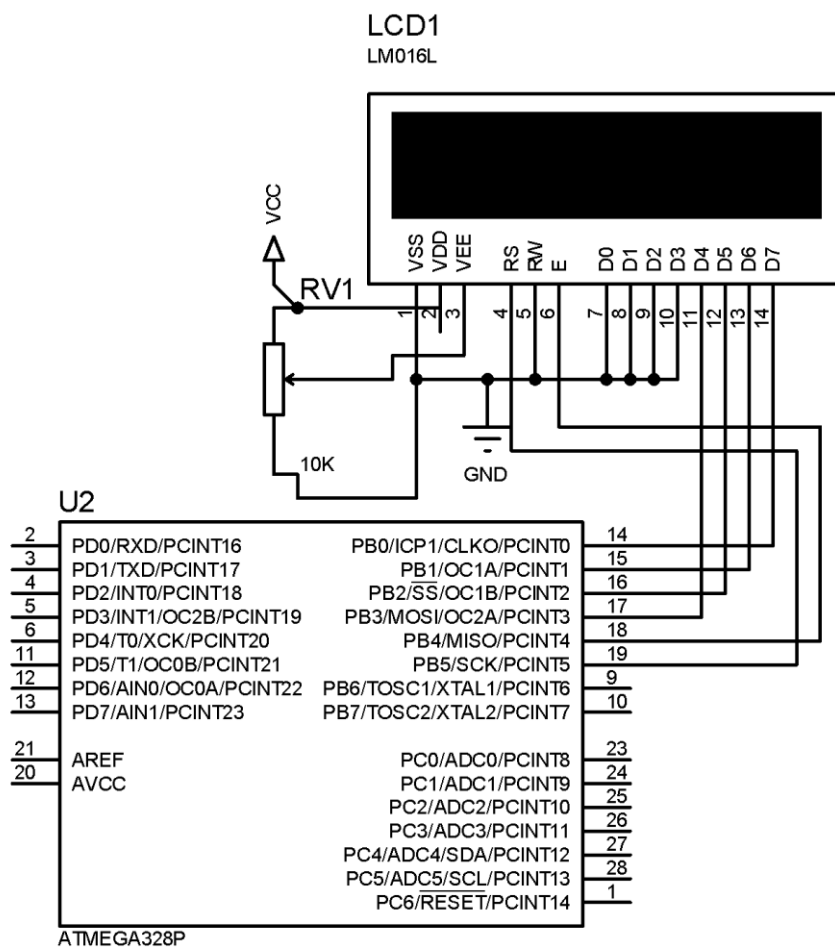


Figure 3.12 The Interface module of LCD to the Microcontroller

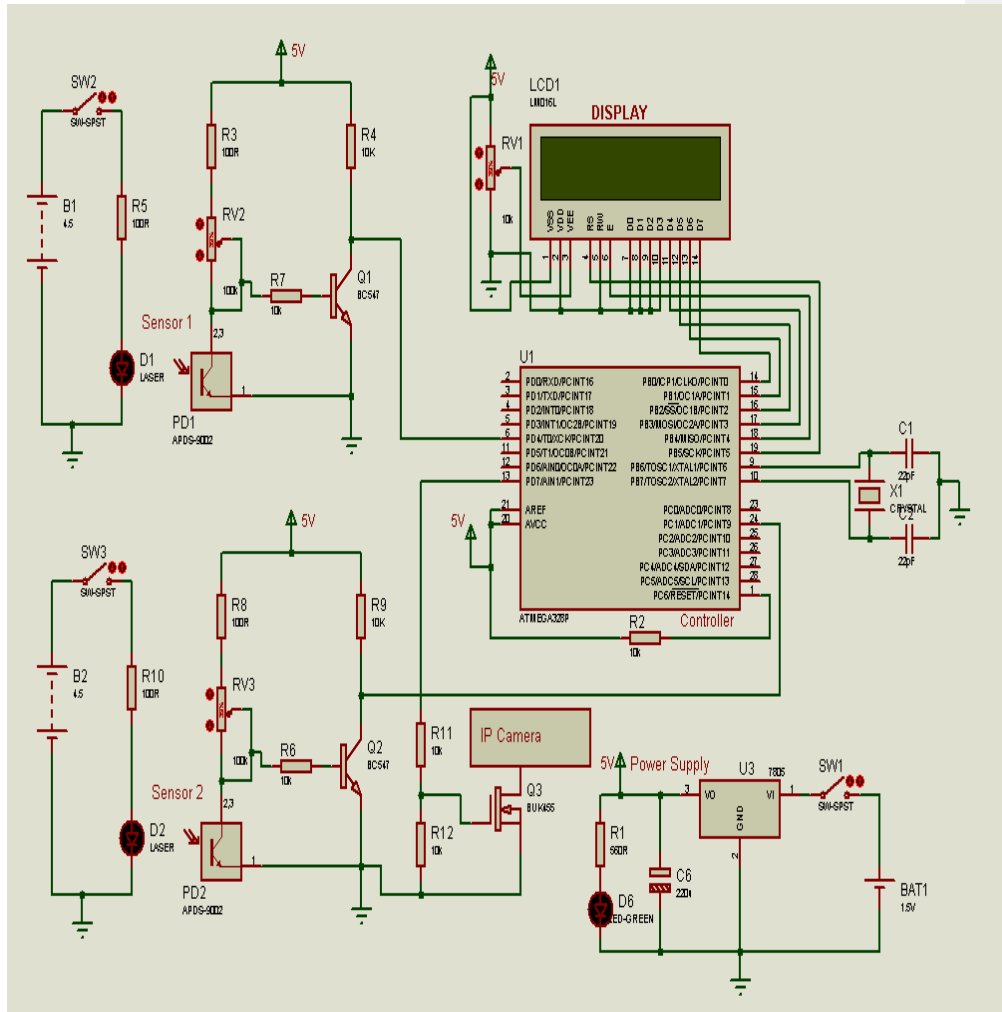


Figure 3.13 Circuit diagram of the entire project

### 3.5 Software Design

This section deals with the program that was written to serve user's purpose. The program controls the operations of the various peripherals attached to it. The program can be written in various programming languages like Assembly language, C language, BASIC and so on. After writing the program, a compiler converts the code into a

Hexadecimal (.hex) file which is then transferred into the flash memory of the microcontroller using a programmer. Arduino Integrated Development Environment (IDE) developed by Arduino was used in this project because it comprises of a text editor, C compiler debugger, built in libraries and programmer. Arduino codes are regarded as sketches. This sketch defines what the microcontroller will do. The two main features of the IDE are:

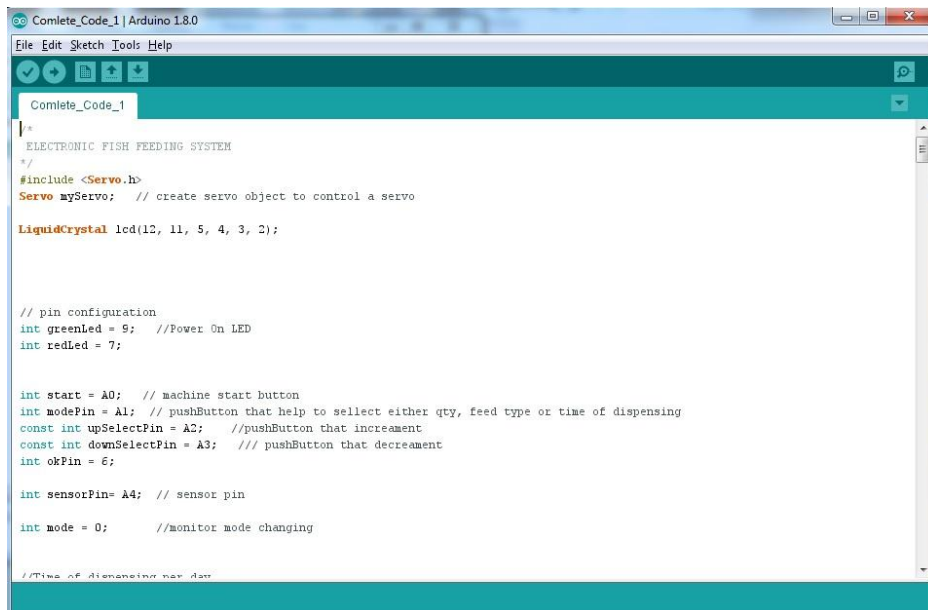
1. VOID setup ():

This feature of the Arduino IDE is only called once at the beginning of the program. One of the example found in the void setup () is: `pinMode(Ledpin, OUTPUT);`. This statement declares the Ledpin as the output in the program.

2. VOID loop ():

This feature is called repetitively as long as the development board has power supply. `DigitalWrite(Ledpin, HIGH);` this is an example of the statement used in the VOID loop. The statement implies that the led pin which is the output is high at that instance.

[27]

The image shows a screenshot of the Arduino IDE software interface. The window title is 'Comlete\_Code\_1 | Arduino 1.8.0'. The menu bar includes 'File', 'Edit', 'Sketch', 'Tools', and 'Help'. Below the menu bar is a toolbar with icons for opening files, saving, and running. The main text area contains the following C code:

```
Comlete_Code_1
/*
ELECTRONIC FISH FEEDING SYSTEM
*/
#include <Servo.h>
Servo myServo; // create servo object to control a servo

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

// pin configuration
int greenLed = 9; //Power On LED
int redLed = 7;

int start = A0; // machine start button
int modePin = A1; // pushButton that help to select either qty, feed type or time of dispensing
const int upSelectPin = A2; //pushButton that increment
const int downSelectPin = A3; /// pushButton that decreament
int okPin = 6;

int sensorPin= A4; // sensor pin

int mode = 0; //monitor mode changing

//Time of Dispensing per day
```

Figure 3.14 Arduino IDE software. [27]

The flowchart for the system is as shown in figure 3.23, it represents the program flow of the microcontroller based over speed detection system. Refer to Appendix A for the C code that implements the flowchart.

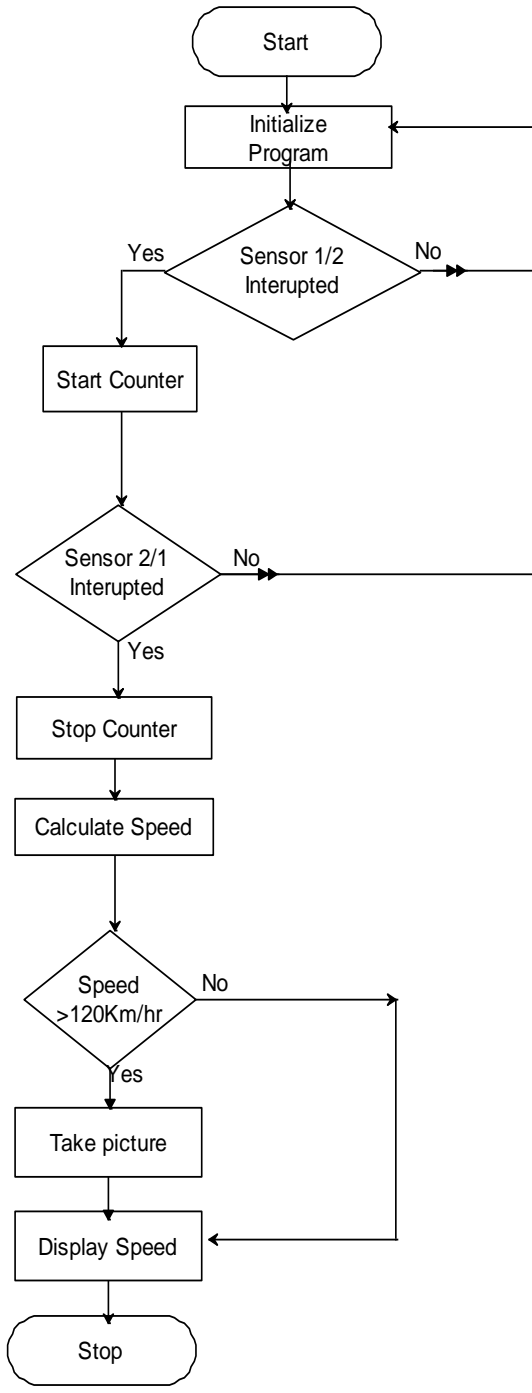


Figure 3.15 System software Flowchart

### **3.5.1 Construction Procedure and packaging**

The construction started with the production of the circuit PCB layout. This was achieved using Proteus 8 Professional software. The layout was printed on a glossy paper and was transferred to plane copper board. This was achieved by placing the printed layout on the copper board. An electric iron was used to transfer the layout by heating. After transfer, the board was soaked in water to remove the glossy paper leaving the track of the layout on the board. The board was placed inside the solution of ferric chloride with warm water to remove copper or etch the part of the board that was uncovered with the track layout. After etching, holes were drilled to allow components terminals to pass through using hand drilling machine.

After the completion of the work, the circuitry was placed in a casing to provide support and avoid damage due to the nature of components used in the construction.

## **CHAPTER FOUR: PERFORMANCE AND COST EVALUATION**

In this chapter, the process of testing both hardware and software is explained and the process of debugging the software is also explained. These testing were carried out in order to check the workability of this project, also the cost evaluation of all the components used in the construction of this project is discussed.

### **4.0 Testing of the Project**

After the construction of the project, the system was tested to ensure that it performs the stated functions. The system was setup on a selected road and vehicles were allowed to pass. The speeds of the passing vehicles were read and recorded from the LCD. A vehicle was made to pass through the system with a speed greater than the desired speed. The system automatically captures the image of the erring vehicle. The following steps were followed to setup the system.

- **Step 1:** The sensors or the vehicle detectors pair were positioned and aligned with each other. Firstly the laser diode was switched on and was aligned directly opposite the photo sensors. The position of the laser diode was adjusted until the LCD displays that the sensor has being aligned. This was carried out for both the two sensors. Also, the two sensors were positioned in a specified distance of 500 meters apart. The 500 meters is the specific distance between the two sensors required to obtain the actual result.
- **Step 2:** A vehicle was then allowed to pass through the sensors posts at a specific speed. The speed of the vehicle was read from the LCD of the system and as well compared to the speed displayed on the speedometer of the vehicle at the time of crossing the sensors.

- **Step 3:** the above step was repeated for various types of vehicles and the speeds were compared and recorded.

#### 4.1 Discussion of Result

The objective of this project of car speed detection is to detect and display the speed of vehicles and as well capture the picture of any vehicle passing through it with a speed greater than the desired speed has been achieved. The summary of the results obtained from testing the system was as illustrated by the results of table 4.1.

When the vehicle is below the set maximum speed, the system only displays the speed of the passing vehicle on the LCD. But on the other hand, when the speed of the vehicle is beyond the set maximum speed limit, the system will activate the camera to automatically capture the vehicle.

Table 4.1 Result analysis

| Vehicle  | Speed<br>(km/hr.) | Images captured |
|----------|-------------------|-----------------|
| Car      | 129               | Yes             |
| Truck    | 57                | No              |
| Tricycle | 45                | No              |
| Car      | 45                | No              |

#### 4.2 Cost Analysis

The cost analysis of the project refers to the cost incurred in the production of the unit quantity of the microcontroller based vehicles over speed detection and plate number

identification. The summary of the expenses incurred during the period of the production are as shown in table 4.2 below.

*Table 4.2 List of Components and cost evaluation.*

| S/N | Components<br>Description     | Rating        | Quantity<br>Used | Cost per<br>unit<br>(₦) | Total cost<br>(₦) |
|-----|-------------------------------|---------------|------------------|-------------------------|-------------------|
| 1   | LED                           |               | 1                | 10.00                   | 10.00             |
| 2   | Electrolytic<br>Capacitors    | 220 $\mu$ F   | 1                | 50.00                   | 50.00             |
| 3   | Battery                       | 12V           | 1                | 200                     | 200.00            |
| 4   | Ceramics<br>Capacitors        | 22pF          | 2                | 30.00                   | 60.00             |
| 5   | Resistor                      | 1K $\Omega$ , | 2                | 10.00                   | 20.00             |
|     |                               | 10K $\Omega$  | 6                | 10.00                   | 60.00             |
|     |                               | 100K $\Omega$ | 1                | 10.00                   | 10.00             |
| 6   | ATmega328p<br>Microcontroller |               | 1                | 1000.00                 | 1000.00           |
| 7   | LM 7805<br>Regulator          |               | 1                | 50.00                   | 50.00             |
| 8   | BC547<br>Transistor           |               | 3                | 50.00                   | 150.00            |
| 9   | Laser LED                     |               | 2                | 350.00                  | 700.00            |
| 10  | Jumper wire                   |               | 10yards          | 30.00                   | 300.00            |
| 11  | Lead                          |               | 10yards          | 30.00                   | 300.00            |

|              |              |  |   |         |               |
|--------------|--------------|--|---|---------|---------------|
| 12           | Copper board |  | 1 | 200.00  | 200.00        |
| 13           | Switch       |  | 1 | 50.00   | 50.00         |
| 14           | 16x2 LCD     |  | 1 | 1000.00 | 1000          |
| 16           | Casing       |  |   |         | 750.00        |
| 17           | Camera       |  |   |         | 6000          |
| <b>TOTAL</b> |              |  |   |         | <b>12,910</b> |

## **CHAPTER FIVE: CONCLUSIONS**

### **5.0 Summary**

The project entitled “Design and construction of a microcontroller based Car over speed detection system” was successfully executed using Laser LED and photodiode, LCD, Microcontroller. In this project, a device was developed that would determine the speed of a moving vehicle and transmit the information to a display unit (LCD). The entire system was coordinated and controlled by a microcontroller, which makes the system to be user friendly. The system was well packaged and its applications were also highlighted. The overall system performance was tested and the results confirmed the accuracy of the system.

### **5.2 Conclusions**

The main objective of this project work, which is design and construction of a vehicle over speed detection system was achieved. From the results obtained, the system can be seen to effectively detect and display the speed of a moving vehicle and also send the picture of the vehicle to road traffic officials due to violation of the rule. This will go a long way in reducing accidents on roads; curb the loss of properties attributed to accidents and in earnest save lives.

### **5.3 Recommendations**

In the future, some features could be incorporated to this system. These features include;

- Incorporation of sender and receiver to enable remote operation of the system from law enforcement agencies office.
- Development of a database for automatic running of license plate of defaulters for easy identification of defaulters.

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Plate 1 Constructed System



Plate 2 Constructed System

## APPENDIX I

### Source code

```
#include <LiquidCrystal.h> // includes the LiquidCrystal Library
LiquidCrystal lcd(13,12,11,10,9,8); // (rs, e, d4, d5, d6,

int gatepin1 = 15;// ECHO FRONT
int gatepin2 = 4;
float Km_speed = 0;
int timer = 0;
int speeds =0;
const int camera = 19;
void setup() {

pinMode(gatepin1, INPUT_PULLUP);
pinMode(gatepin2, INPUT_PULLUP);

pinMode(camera, OUTPUT);
digitalWrite(camera, LOW);

lcd.begin(16,2);// lcd type is 16 by 2
lcd.clear();// clear lcd
lcd.setCursor(0,0);//column 0, row 0
lcd.print("Car Over Speed");
lcd.setCursor(0,1);
lcd.print("Detection System");
delay(3000);

lcd.clear();
lcd.setCursor(0,0);
```

```
lcd.print("Abdulmajeed Waila");  
lcd.setCursor(0,1);  
lcd.print("EE/14/0409");  
delay(3000);
```

```
lcd.clear();  
lcd.setCursor(0,0);  
lcd.print("Supervised By:");  
lcd.setCursor(0,1);  
lcd.print("Engr Rilwan Usman");  
delay(3000);
```

```
lcd.clear();  
lcd.setCursor(0,0);  
lcd.print("Searching Sensor1");  
lcd.setCursor(0,1);  
lcd.print("please wait....");  
delay(2000);  
while (!digitalRead(gatepin1)){  
delay(100);  
}
```

```
lcd.clear();  
lcd.setCursor(0,0);  
lcd.print("Found Sensor1");  
lcd.setCursor(0,1);  
lcd.print("Search Sensor2...");  
delay(2000);  
while (!digitalRead(gatepin2)){  
delay(100);  
}
```

```

lcd.clear();
lcd.setCursor(0,0);
lcd.print("Sensors Aligned");
lcd.setCursor(0,1);
lcd.print("Please Wait...");
delay(3000);
lcd.clear();
}

void loop() {

lcd.setCursor(0,0);
lcd.print("waiting for Car");
lcd.setCursor(0,1);
lcd.print("To Measure speed");
delay(100);

  if(!digitalRead(gatepin2)){
timer =0;
while (digitalRead(gatepin1)) // set time switch must be released to exit
  {
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("Please Wait.....:");
    lcd.setCursor(0,1);
    lcd.print(" ");
    delay(30);
    lcd.clear();
    timer++;
  }

speeds = 500/timer;// m/s
Km_speed = (speeds * 18)/5;

```

```

if (Km_speed >= 120){
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("High Speed");
  lcd.setCursor(0,1);
  lcd.print(speeds,1);
  lcd.print("m/s ");
  lcd.print(Km_speed,1);
  lcd.print("Km/h");
  digitalWrite(camera, HIGH); // sets pin 12 HIGH
  delay(5000);
  digitalWrite(camera, LOW); // sets pin 12 HIGH
  lcd.clear();
}
if(Km_speed < 120){
  lcd.clear();
  lcd.setCursor(0,0); // Sets the location at which subsequent text written to the LCD will
be displayed
  lcd.print("Speed: "); // Prints string "Distance" on the LCD
  lcd.print(speeds,1 ); // Prints the distance value from the sensor
  lcd.print(" m/s");
  lcd.setCursor(0,1); // Sets the location at which subsequent text written to the LCD will
be displayed
  lcd.print("Speed: "); // Prints string "Distance" on the LCD
  lcd.print(Km_speed,1 ); // Prints the distance value from the sensor
  lcd.print(" Km/Hr");
  delay(5000);
  lcd.clear();
}
}

if(!digitalRead(gatepin1)){

```

```

timer =0;
while (digitalRead(gatepin2)) // set time switch must be released to exit
{
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("Please Wait.....:");
  lcd.setCursor(0,1);
  lcd.print(" ");
  delay(30);
  lcd.clear();
  timer++;
}

speeds = 500/timer;// m/s
Km_speed = (speeds * 18)/5;

if (Km_speed >= 120){
  lcd.clear();
  lcd.setCursor(0,0);
  lcd.print("High Speed");
  lcd.setCursor(0,1);
  lcd.print(speeds,1);
  lcd.print("m/s ");
  lcd.print(Km_speed,1);
  lcd.print("Km/h");
  digitalWrite(camera, HIGH); // sets pin 12 HIGH
  delay(5000);
  digitalWrite(camera, LOW); // sets pin 12 HIGH
  lcd.clear();
}
if(Km_speed < 120){
  lcd.clear();

```

```
lcd.setCursor(0,0); // Sets the location at which subsequent text written to the LCD will
be displayed
lcd.print("Speed: "); // Prints string "Distance" on the LCD
lcd.print(speeds,1 ); // Prints the distance value from the sensor
lcd.print(" m/s");
lcd.setCursor(0,1); // Sets the location at which subsequent text written to the LCD will
be displayed
lcd.print("Speed: "); // Prints string "Distance" on the LCD
lcd.print(Km_speed,1 ); // Prints the distance value from the sensor
lcd.print(" Km/Hr");
delay(5000);
lcd.clear();
}
}
}
```

## APPENDIX I I

### Testing and Pin Description

ATmega328p is an 8-bit and 28 Pins AVR Microcontroller, manufactured by Microchip. It follows RISC Architecture and has a flash type program memory of 32KB. It has an EEPROM memory of 1KB and its SRAM memory is of 2KB. It has 8 Pin for ADC operations, which all combines to form PortA (PA0 – PA7). It also has 3 built in Timers, two of them are 8 Bit timers while the third one is 16-Bit Timer. ATMEGA328P has an operating range ranging from 3.3V to 5.5V with 5V considered as the standard.

Some of the excellent features of the microcontroller includes the cost efficiency, low power dissipation, programming lock for security purposes, and real timer counter with separate oscillator

The table below shows the summary of the complete features of ATmega328P.

Table 5.1 Features of Atmega328p.

| <b>ATmega328 Features</b> |                |
|---------------------------|----------------|
| No. of Pins               | 28             |
| CPU                       | RISC 8-Bit AVR |
| Operating Voltage         | 1.8 to 5.5 V   |
| Program Memory            | 32KB           |
| Program Memory Type       | Flash          |
| SRAM                      | 2048 Bytes     |
| EEPROM                    | 1024 Bytes     |
| ADC                       | 10-Bit         |

|                        |                        |
|------------------------|------------------------|
| Number of ADC Channels | 8                      |
| PWM Pins               | 6                      |
| Comparator             | 1                      |
| Oscillator             | up to 20 MHz           |
| Timer (3)              | 8-Bit x 2 & 16-Bit x 1 |
| I/O Pins               | 23                     |
| Manufacturer           | Microchip              |

### ATmega328 Pins description

ATmega-328 is an AVR Microcontroller having twenty eight (28) pins in total. All of the pins in chronological order are listed in the table shown in the figure given below.

Table 5.2 Atmega328 Pins Description.[28]

| ATmega328 Pins |                 |            |          |
|----------------|-----------------|------------|----------|
| Pin Number     | Pin Name        | Pin Number | Pin Name |
| 1              | PC6             | 15         | PB1      |
| 2              | PD0             | 16         | PB2      |
| 3              | PD1             | 17         | PB3      |
| 4              | PD2             | 18         | PB4      |
| 5              | PD3             | 19         | PB5      |
| 6              | PD4             | 20         | AVCC     |
| 7              | V <sub>cc</sub> | 21         | AREF     |
| 8              | GND             | 22         | GND      |
| 9              | PB6             | 23         | PC0      |
| 10             | PB7             | 24         | PC1      |
| 11             | PD5             | 25         | PC2      |
| 12             | PD6             | 26         | PC3      |
| 13             | PD7             | 27         | PC4      |
| 14             | PB0             | 28         | PC5      |

ATmega-328 pins are divided into different ports which are given in detail below.

**VCC** is a digital voltage supply.

**AVCC** is a supply voltage pin for analog to digital converter.

**GND** denotes Ground and it has a 0V.

**Port A** consists of the pins from **PA0** to **PA7**. These pins serve as analog input to analog to digital converters. If analog to digital converter is not used, **port A** acts as an eight (8) bit bidirectional input/output port.

**Port B** consists of the pins from **PB0** to **PB7**. This port is an 8 bit bidirectional port having an internal pull-up resistor.

**Port C** consists of the pins from **PC0** to **PC7**. The output buffers of **port C** has symmetrical drive characteristics with source capability as well high sink.

**Port D** consists of the pins from **PD0** to **PD7**. It is also an 8 bit input/output port having an internal pull-up resistor.

**AREF** is an analog reference pin for analog to digital converter. [29]