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# DESIGN AND IMPLEMENTATION OF A MICROCONTROLLER-BASED CAR SPEED DETECTOR USING A PHOTO SENSOR

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**Abstract**: *Nowadays, road accidents are a daily occurrence. Most of road accidents happen due to rash driving or reckless driving. Too many people are losing their lives because of other's mistakes. Traffic police must use a handheld radar gun to detect rash driving and aim at the vehicle to record its speed. If the vehicle exceeds the speed limit, nearest police station is informed to stop the speeding vehicle. This is an ineffective process because after detecting one has to inform the same and a lot of time is wasted. So, this project aims to construct an effective device to detect rash driving on highways and alert traffic authorities in case of any speed violation. The process system will check on rash driving by calculating the speed of a vehicle using the time taken to travel between the two set points at a fixed distance. When the project was powered ON, the name and other information were displayed on the LCD. Now if the photosensor is OFF no car speed is detected and displayed and the alarm remains OFF. If a car is detected and it's speed is lower than <60km/h, the LCDs "LOW SPEED" and the alarm remains OFF. Also if the car speed is ≤60/km, the LCDs are "NORMAL SPEED" and the alarm remains OFF, but if the car speed detector is >60km/h, the LCDs are " OVER SPEED", and the alarm turns ON.*

**Keywords:** *Design, implementation, microcontroller-based, car, speed detector, photo sensor*

## Introduction

With the increasing number of vehicles on the roads, monitoring and controlling car speeds has become a crucial aspect of ensuring road safety and minimizing accidents. Speeding is one of the major causes of traffic accidents, leading to fatalities and property loss globally (WHO, 2018). Traditional methods of speed detection, such as radar and laser-based systems, are effective but often expensive and complex to implement. Microcontroller-based systems offer a cost-effective, flexible, and reliable alternative for speed detection applications (Kumar & Malhotra, 2014). This project focuses on the design and implementation of a car speed detection system using a microcontroller and photo sensors. Photo sensors operate based on light interruption, enabling accurate speed measurement by calculating the time taken for a vehicle to pass between two sensor points (Abdulkarim et al., 2020). The microcontroller processes the time data, computes the vehicle speed, and displays the result, making the system suitable for real-time speed monitoring. By leveraging the affordability and

versatility of microcontrollers, the proposed system can be deployed in urban and rural areas to enhance road safety and promote compliance with speed limits.

The aim of this project is to develop a device that detect over speeding of cars or vehicles on road, especially on restriction areas (college, schools, hospitals etc.) and alerts traffic authorities in case of any speed limit violation. In the present conventional system, handheld ultrasonic sensor and camera is used to detect and record a car or vehicle speed which is an ineffective method. The proposed system checks an over speeding vehicle or car by calculating the speed of the passing vehicle using time taken to travel between two set point (at a fixed distance). A set point consists of a pair of sensor such as photodiode sensors and phototransistors. Each pair is installed on either side of the road at a fixed distance. Speed limit is set by the police or road safety authority depending on the traffic at that location. The project consists of an atmega328p that runs on a computer software program called (source code) a source code is a set of computer instructions or commands that controls hardware. The Atmega328p controls all activities of the project while, the speed detected and other information are displaying LCD. The means of alert is by using a buzzer which sounds whenever over speeding is detected.

Most of the fatal accidents occur due to over speeding. It is a natural psyche of humans to excel. If given a chance man is sure to achieve infinity in speed. But when we share the road with other users, we will always remain behind some other vehicle. Increase in speed multiples the risk of accidents and severity of injury during accidents. Faster vehicles are more proved to accident than slower ones. For these reasons, a car speed detector system such as the microcontroller-based car speed detector using photo sensor that automatically detects over speeding and alert the Police or Road Safety officials to take necessary measures to avoid accident is a major priority to overcome these problems. This study is motivated by the documentary of Road Safety devices in some developed countries like the USA, UK, Canada etc. where over speeding detector devices were used to prevent accidents by over speeding cars or vehicles and detect criminals or car theft to recover stolen cars or vehicles.

## Methodology

The method of implementing a microcontroller-based car speed detector using a photo sensor includes Power Supply unit: - The project is powered by AC mains power supply such as 22ov which is then dropped to 12v AC using a step-down transformer. The 12v Ac is then converted to 12 dc using a rectifier circuit to power the entire project. Photosensor unit: - This unit is made up photosensor module that comprises of a photodiode and a phototransistor, which is used to detect the moving car or vehicle. Microcontroller unit: - This comprises the Atmega328P microcontroller that runs on a computer software program called "Source code". A source code is a computer's instructions or command controlling hardware. This unit controls all project activities. LCD Display Unit: This comprises a 16x2 LCD display module 16 x 2, which means it displays 16 characters in a single row, and there are 2 such rows. The LCDs the speed in Km/h and also display other information such as "over speeding" or "Normal speed".

## Testing and Results

## Testing

The components, such as resistors, capacitors, transistors, etc., were tested using a digital millimeter. The tests conducted were "short circuit" and "open circuit" tests. A short test is carried out on the individual electronic component to ensure that there is no internal breeching of the components, which may result to the malfunction of a section, if not the entire circuit of the project. An open circuit is also known as continuity test to ensure that there is no break or discontinuity in the internal connection of any component to be used in the circuit.

## Results

The results of the final implementation are:

The following steps explain the results: Initial Condition: In this step, when the switch is on, the word "Automatic Car Speed Detector". Speed within the limit: This step determines the speeds of moving vehicles passing through photo sensors. Speed exceeds the limit: In this step, the speeds of moving vehicles pass through a photo sensor. Also gives alerts by showing over on the LCD screen and sounding an alarm for half a second. The results of tested components used in the circuit is show in table 4.1.

| COMPONENT USED | DESIGN VALUE | STANDARD VALUE | MEASURED VALUE |
|---|---|---|---|
| CAPACITOR | | | |
| C1 | 544PF | 1000PF | 988.21PF |
| C2 | 0.0784PF | 0.1PF | 0.094PF |
| C3 | 0.0784PF | 0.1PF | 0.096PF |
| C4 | 22PF | 22PF | 21.79PF |
| C5 | 22PF | 22PF | 21.63PF |
| **RESISTOR** | | | |
| R1 | 22.49K | 22K | 21.88K |
| R2 | 22.49K | 22K | 21.84K |
| R3 | 12.244K | 12K | 11.87K |
| R4 | 12.244K | 12K | 11.73K |
| R5 | 22.49K | 22K | 21.92K |
| R6 | 12.755K | 12K | 12.02K |
| **CRYSTAL OSCILLATOR** | | | |
| X1 | 16MHz | 16MHz | 15.92MHz |
| PHOTO SENSOR | + 5V | + 5V | + 4.87V |
| **IC1** | | | |
| LM7005 | + 5V | + 5V | +4.95V |
| **IC2** | | | |
| ATMEGTA328P | + 5V | + 5V | |
| TRANSISTOR | | | |

| | | | |
|---|---|---|---|
| Q1 | hfe=200 | hfe=200 | hfe=198 |
| Q2 | hfe=200 | hfe=200 | hfe=199 |
| Q3 | hfe=200 | hfe=20 | hfe=197 |

The results of tested power supply unit of +5v and +12v for output voltage under no-load and full-load conditions were as follows: - Under no –load: the voltage of +5v supply section was measured to be 4.95v, while that of +12v supply was measured to be 11.89v. At full-load: the +5v supply section was measured to be 4.85v and that of the +12v section was measured to be 11.41v.

Therefore, Voltage Regulation (V.R) is given as: -

$$V.R = \frac{VNL - VFL}{VNL} \times 100\% \text{ ----------4.1}$$

Where, VNL = No – load Voltage

VFC = Full-load Voltage

For units operating on +5v

$$V.R = \frac{4.95 - 4.85}{4.95} \times 100\%$$

Therefore, V.R = 2.02%

For units operating on +12v

$$V.R = \frac{11.89 - 11.41}{11.89} \times 100\%$$

V.R = 4.03%

From the results obtained above, the performance of the power supply is satisfactory.

**Table 4.2: Test Result OF Project**

The whole project circuit was coupled together and tested as a single unit and the result is shown in table 4.2

| PHOTO SENSOR | CAR SPEED | LLD DISPLAY | ALARM |
|---|---|---|---|
| OFF | NONE | OFF | OFF |
| ON | ‹ 60KM/h | LOW SPEED | OFF |
| ON | 60KM/H | NORMAL SPEED | OFF |
| ON | 60KM/H | HIGH SPEED | ON |
| NO | 60KM/H | OVER SPEED | ON |

## DISCUSSION

The table 4.2 of the results shows the working process of the micro controller-based car speed detector using photo sensor. When the project was powered ON, the name and other information were displayed on the LCD. Now if the photo sensor is OFF, no car speed is

detected and displayed, and the alarm remains OFF. If a car is detected and its speed is lower than 60km/h, the LCDs "LOW SPEED" and the alarm remains OFF. Also, if the car speed is 60km/h, the LCD "NORMAL SPEED" and the Alarm system remains OFF, but if the car speed detector is 60km/h, the LCD "HIGH SPEED" and the alarm turns ON. Likewise, if the car speed is 60km/h, the alarm remains ON, and the LCDs "OVER SPEED".

## Conclusion

This project is meant to design and implement a microcontroller-based car speed detector using a photo sensor. This aim was achieved at the end because various car speeds were detected and displayed on an LCD display unit. Suppose the car speed is low or normal. In that case, the alarm system remains OFF, but if the car speed is high or overspeeded, the alarm system turns ON to alert the road safety Authority to take necessary measures to avoid accidents. In recommendation the microcontroller-based car speed detector using a photo sensor is designed to detect car speed and display the speed on LCD. It also turns on an alarm system if the car speed limit is exceeded. The project design does not take any measures such as taking photographs of over speeding cars that the road safety authorities could access on order to search and prosecute the offenders later on. Therefore, the following recommendations are necessary to enhance this design.

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