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Smart Traffic Signal Using SoundSensor

[1]Prof. Gaganambha, [2]Akshatha B, [3]Ananya K S, [4]Lohith M, [5]Manu N E

[1]Assistant Professor, Electrical and Electronics Engineering Department

[2345]Students, Electrical and Electronics Engineering Department

[12345]Vidya Vikas Institute of Engineering and Technology, Mysuru, Karnataka

Abstract: Nowadays traffic congestion in the urban areas is becoming very difficult due to enormous increase of automobiles. So in order to rectify this problem we presented a nice way to regulate the vehicles in crowd and a junction area, which eliminates the involvement of humans in its operation. Traditional traffic signal system only gives instructions to stop. However, if someone is breaking the signal then this system is not able to catch them and there are chances of taking bribe. Therefore, to increase the security of traffic signal, to reduce human efforts, and to avoid the bribery we are introducing smart traffic signal system through this project. Smart traffic signal based on the Arduino & infrared sensor, in which infrared sensors are placed at one side of road in such a way so as to cover particular necessary area of road from where the vehicles are waiting in the signal. Then it compares the density of the all the four tracks and it gives green signal to which track have a more density of vehicles. If all the track has same density, then normal flow of signal is maintained. If the signal is red and any vehicle breaks the signal, then the infrared sensor detects it and Arduino microcontroller take immediately action to buzzer alarm to warn the vehicles which cross the signal line mark. In addition, another feature is implemented called "Punishing Signal". It uses special decibel meters connected to traffic signals across the city. When the decibel exceeded a 85dB, the signal timer would reset itself, forcing the people to wait longer at the signal. This is meant to 'punish' them for their impatience with the message that if they honk more; they will have to wait longer. "Honking is a bad habit and an act of traffic indiscipline. Unfortunately, many of them indulge in reckless honking. Honking causes noise pollution, hurts the eardrums, increases heart rate, creates traffic confusion and causes stress, that system have reduce the noise pollution and the avoiding the human error in the signal changing and reduce or control the traffic jumping at the time of red signal is displayed.

Index Terms – Sound Sensor, Arduino, honking noise, noise pollution, smart traffic light

I. INTRODUCTION

The traffic signal was first discovered in 1912 by a Detroit policeman named Lester Wire like two-color, red- and green light with a buzzer to warn pedestrians ahead of the impending transition. After that, in 1920, this basic design was updated by William Potts to include the tri-colored red, yellow, and green lights widely used today. This simple, three-color icon has allowed for nearly a century with little change, using modern technologies such as automatic timers, diode lights and motion sensors. Traffic signals are mainly developed to ensure the correct flow of traffic, provide an opportunity for pedestrians or vehicles to cross a junction and helps in reducing the number of collisions between vehicles entering intersections from opposite directions. Traffic signals should be considered when they would alleviate more problems than they create. A warranted signal properly operated may provide for more orderly movement of traffic, and reduce the occurrence of certain types of collisions. Unwarranted signals can result in increased crashes, delays and congestion. And main reason for signal to reduce the traffic accident Traffic is one of the major modern-day problems in every big city in the world. Recent study of World Bank has shown that average vehicle speed has been reduced from 21 km to 7 km per hour in the last 10 years.

The traffic congestion problems are increasing day by day because of the increasing number of vehicles with limited infrastructure. Under this situation, the existing traffic light systems, which are timer based, are not

able to control traffic. To solve this problem, a real time traffic control system is needed which will control the traffic signal according to traffic density. For effective traffic management and signal control, it is important to know road traffic density. Based on this density value time delay of signals can be set up dynamically. The existing traffic signal system is implemented with delays where the signal transition time slots are fixed and do not depend on current traffic flow. The existing traffic system needs to be upgraded to solve the severe traffic congestion problems.

Our system will be very useful for solving most of the traffic congestion problems occurs today. One of the primary applications of sound sensors in smart traffic signals is the detection of emergency vehicles such as ambulances, fire trucks, and police cars. These vehicles often use sirens to navigate through traffic quickly. Sound sensors placed at strategic locations can detect the frequency and intensity of sirens, allowing the traffic signal system to prioritize the passage of emergency vehicles. When an emergency vehicle approaches, the system can automatically adjust signal timings to create a clear path, reducing response times and improving safety.

Sound sensors can also be used to monitor overall traffic conditions. By detecting the volume of ambient traffic noise, these sensors can provide insights into traffic density and flow. For instance, a high level of sound intensity might indicate heavy traffic, prompting the traffic signal system to adjust signal timings to alleviate congestion. Conversely, a lower noise level could signal lighter traffic, allowing the system to optimize signal cycles accordingly.

The sensors continuously collect data on ambient sound levels and specific sound frequencies. This data is transmitted to a central traffic management system, which analyses the information to determine the appropriate signal adjustments. Advanced algorithms process the sound data, distinguishing between different types of sounds and their sources. Smart traffic signals equipped with sound sensors can also communicate with other traffic management systems, such as those controlling adaptive traffic signals or providing real-time traffic updates to drivers. This interoperability ensures a cohesive approach to traffic management and enhances overall system efficiency.

II. METHODOLOGY

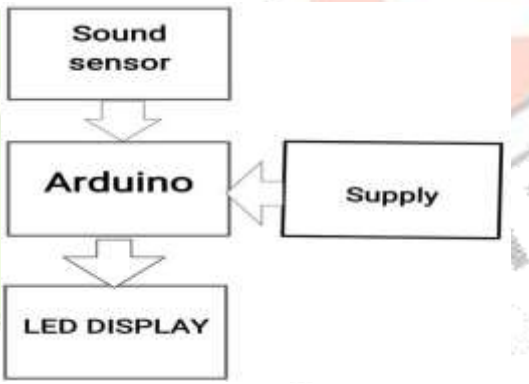

Fig 2.1: Block Diagram

This module allows detecting when sound has exceeded a set point you select. Sound is detected via a microphone and fed into an LM393 op amp. The sound level set point is adjusted via an on-board potentiometer. When the sound level exceeds the set point, an LED on the module is illuminated and output is sent low.

III. COMPONENETS USED

1. Arduino Uno:

The Arduino Uno is a popular microcontroller board renowned for its simplicity and versatility in electronics prototyping and DIY projects. Featuring an Atmega328P microcontroller, it offers 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, USB connection, power jack, ICSP header, and a reset button. Its straightforward interface and open- source nature make it accessible to beginners and experts alike, enabling a wide range of projects from basic LED blinking to complex sensor interfacing and automation tasks. With a vast community providing extensive documentation, tutorials, and

libraries, the Arduino Uno remains a cornerstone in the world of embedded systems and hobbyist electronics.

Fig 3.1: Arduino UNO

2. Tm1637 display module:

TM1637 is a kind of LED (light-emitting diode display) drive controller special circuit with a keyboard scan interface. It is internally integrated with MCU digital interface, data latch, and LED high-pressure drive. Other than that, this IC also has the capability to control the brightness of the display, which means the display can be dimmable if it's required for the project. This device comes in a DIP and SOIC package and can be used for many different applications like display drives of induction cookers, microwave ovens, and small household electrical appliances. Other than the banner feature, the TM1637 has some interesting features that can make the coding process a lot easier. You can serially upload the display data in the IC, and the IC takes care of refreshing the display, reducing the overhead from the microcontroller. Now if you take a close look at the display module, it features a 'colon' that can be used for timer-based projects. The operating voltage for this module is 3.3V to 5V and forthe communication process.

Fig 3.2: Tm1637 display module

3. MIC module (microphone sensor):

This high sensitivity sound detection module detects sounds between 48 and 66 dB and has an analog as well as a digital output

Fig 3.3: Tm1637 display module

4. Battery:

An electric battery is a source of electric power consisting of one or more electrochemical Cells with external connection for powering electrical devices.

IV. IMPLEMENTATION

Firstly, sound Detected Sound sensors (microphones) are installed at intersections to detect and measure the sound levels of honking, traffic noise, and other ambient sounds then it analysis the sound The sound data is analyzed in real-time to determine thetype and duration of sounds, such as honking, revving, or sirens. Traffic Congestion Detection: The sound analysis data is used to detect traffic congestion, accidents, or other

incidents that may affect traffic flow. Signal Optimization: The smart traffic signal adjusts its timing and phasing in response to the sound data, prioritizing traffic flow and reducing congestion. Real-time Adjustments: The signal continuously monitors and adapts to changing traffic conditions, making real-time adjustments to minimize congestion and reduce wait times .Communication: The smart traffic signal can communicate with other nearby signals, traffic management centers, and emergency services to optimize traffic flow and respond to incidents. Data Analytics: The sound data and traffic information are stored and analyzed to identify trends, optimize traffic signal timings, and improve traffic management strategies.

Fig 4.1: Model of smart traffic signal using sound sensor

Fig 4.2 Working of model

V. RESULT AND DISCUSSION

This Arduino Sound Sensor offers to curb noise pollution by sensing excessive noise levels in areas where it is absolutely unnecessary to generate noise. Traffic junction often sees traffic jams and unnecessary honking even when the traffic light shows red and the timer is ticking to zero. So, with the help of our model we can capture the sound decibels and increase the time of the timer. Thereby, it increases the waiting time of commuters. So, with the help of this model, we can able to control noise pollution which is one of the generating factors for problems such as Hypertension, Hearing loss, Sleep disturbances, Anxiety, etc among humans and other living species. In Fig 5.1 the sound measured is below 85dB so there will be no change in the signal time. Fig 5.2shows when the sound measured is above 85dB so there will be increment of 10 seconds in signal time.

Fig 5.1: Result1 (sound measured is below 85Db)

Fig 5.1: Result1 (sound measured is above 85Db)

VI. ADVANTAGES

- Reduced stress and frustration
- Decreased noise pollution from excessive honking
- Raised awareness about the impact of excessive honking

VII. APPLICATION

- Implement the system at busy intersections, roads, or highways prone to congestion.
- Integrate the project into smart city initiatives to enhance traffic management and quality of life.
- Implement the system during festivals, parades, or sporting events to manage traffic and minimize disruptions.

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VIII. CONCLUSION

Less honking is imperative to maintain ecological balance as it will reduce noise pollution and protecting the public's health. Since the dawn of automobile industry increase in honking at the traffic signal has been increasing exponentially and is deprivation hearing capacity, mental and physical health. Analysis of the honking by vehicle is determined by sensors which is manual and can be turned automatic in near future. The data storage and input to the Arduino is faster by wired communication which is error free and reliable as a source. Depending upon the honking the signal time for the 4- way will be determined. The program for each condition has been uploaded in Arduino for the smooth functioning of the signal.

This system when connected to wireless system can have wider spread and detailed data processing can be done with probability of some data loss to occur. Additional features like traffic density, emergency alert can also be integrated in the near future. All these features can improve the proposed system and will provide the controlling distance wider and efficient. To sum up everything that has been stated so far we can say that this

project is the need of the hour to cope up from increasing mental distress and noise pollution caused at the signal due to honking.

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