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SMART TRAFFIC CONTROL SYSTEM

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Abstract – Designing an automated traffic management system with an emergency priority mechanism based on an ATmega328p Controller is the primary goal of this work. As a result of the population's constant growth, both the use of and the number of vehicles on the road are growing tremendously. The best strategy to regulate traffic at the junction and eliminate the need for physical labor is to employ standard traffic control devices. However, most of the time, when a particular path has more vehicles than the other paths, the standard traffic signals are unable to control the traffic well, which results in crowding and congestion on particular paths. As a result, the paper suggests using ultrasonic sensors to allocate green light based on vehicle density rather than simply allocating a fixed time interval to each road. This new system will also provide emergency vehicles such as ambulances and fire brigades with a priority pass, which is not available in the current system.

Key Words: DF mini player, Internet of Things, Arduino IDE, Blynk Application, Traffic signals, Arduino IDE, Ambulance

1. INTRODUCTION

Everyone deals with a variety of issues in modern life, one of which is traffic congestion. The main causes of traffic congestion are the large number of vehicles, the poor infrastructure, and the unreasonable distribution of the signaling system. The release of harmful pollutants (such carbon dioxide and nitrogen oxides) and time delays caused by the congestion, people may be late for work, education, and emergency vehicles like ambulances, fire brigades and VIP vehicles. As long as engines are running, a significant amount of natural resources like petrol and diesel are wasted without producing any useful results, which indirectly contributes to the rise in pollution. Because of this, innovative systems must be adopted by using sensor-based automation techniques in order to eliminate these issues or at least significantly minimize them. Many times, emergency vehicles such as ambulances, police vans, and fire brigades are unable to reach their destinations owing to traffic congestion. To address this issue, this study presented a mechanism that allows emergency vehicles to escape.

This proposed system was created to manage the time delay of emergency vehicles in high traffic as well as release more vehicles in the desired direction during uncontrolled congestion depending on vehicle density using ultrasonic sensors on the path. According to the signal received from an emergency vehicle using the Blynk app, drivers who are currently waiting at a traffic light will receive a green light to cross the intersection instantly in case of an emergency. This system's enhanced structure is designed to manage time delays and control air pollution during periods of heavy traffic congestion in cities with high population density. Our research-based reference study discusses numerous modern technologies for reducing traffic congestion in major cities.

Fig.1 Traffic congestion in major cities

2. LITERATURE REVIEW

The "Density Based Dynamic Control System" paper by Amit Kumar Bhakata was published in 2016. His goal was to create a "Density Based Dynamic Control System" that would automatically alter signal timing in response to the amount of traffic at any given intersection. The three most important factors for analyzing road traffic are flow, speed, and traffic density. The author suggests, in his concluding paragraph, using destination information to calculate the load traffic on the road in order to lessen congestion.

"Priority Based Traffic Management Systems" is a published article by Gerard P. Michon from 1985. The primary objective of VANET is to make traveling with passengers safe and comfortable. A Road Side Unit (RSU) is a point of access that is used in conjunction with vehicles or that counts the number of vehicles on the road in order to disseminate information. Road traffic congestion is a serious problem, and the timing of the traffic light is predetermined or fixed in the traffic light and independent of the volume of traffic.

Satya Priya Biswas (2017): "Intelligent Traffic Monitoring System through Auto and Manual Controlling using PC and Android Application" published paper. The density of vehicles on the road will be calculated by the Priority Based Signal Management in the Traffic System to ensure uninterrupted traffic flow. In order to assign priority to the lanes with the highest traffic density according to demand and control traffic smoothly, the system also suggests Priority Based Traffic Light Signaling.

3. PROPOSED SYSTEM

A. *Objectives*

The goal of implementing this smart traffic system is to have vehicles at the intersection beep every minute, and the traffic lights on each side change for a set amount of time. Even if there are no vehicles on a specific side, the traffic lights will illuminate for a set period of time. As a result, time is wasted, and vehicles on the other side must wait for the process to be completed. To save time, we can implement a system that controls traffic based on the heavy flow of vehicles on any given side. Another goal of this system is to provide an emergency exit for emergency vehicles.

B. *Working of the system*

In recent decades, major cities have experienced a severe problem with traffic congestion. Specifically as traffic volumes approach a road's capacity, traffic congestion problems include incremental delays, vehicle operating costs like fuel consumption, pollution emissions, and stress that results from interference among vehicles in the traffic stream. When there is a small amount of road traffic, the traffic signal still displays the same traffic time, which causes other lanes' traffic to increase and cause traffic congestion. The ambulance, police vans, and fire trucks sometimes arrive at their desired location late due to this issue.

The proposed system is based on embedded systems. In this system, embedded functionality offers virtual communication between the microcontroller and blynk application as well as the physical connection between the microcontroller and ultrasonic sensors. The microcontroller will perform those specified functions depending on the input from the sensor and the blynk application. The ATmega328P microcontroller is a key component of the proposed methodology. The microcontroller will receive the precise vehicle density from the ultrasonic sensors on the traffic junction for determining the traffic density. The microcontroller will assign a signal at the traffic light based on the vehicle density from each lane. If the vehicle density is high, the microcontroller will assign green light to that lane, turning all three other signals red; otherwise, if the vehicle density is low on any lane, the microcontroller will perform the normal function of signal allocation.

The emergency vehicle in the specific lane of traffic is identified by the blynk application from the vehicle handling driver using four sets of buttons that refer to the four lanes. When the driver presses any of the buttons, the value indicates the lane number in his position to the controller. The df mini player is connected to the microcontroller along with the speaker which will announce the message that " Alert!!! An Emergency Vehicle is arriving." at the traffic junction to alert the vehicles drivers. After an emergency vehicle has crossed, the microcontroller will allocate a specific amount of time for each signal based on the output from each lane's ultrasonic sensor. The microcontroller's typical function of allocating signals based on vehicle density will be performed when the interruption process of releasing an emergency vehicle has been completed.

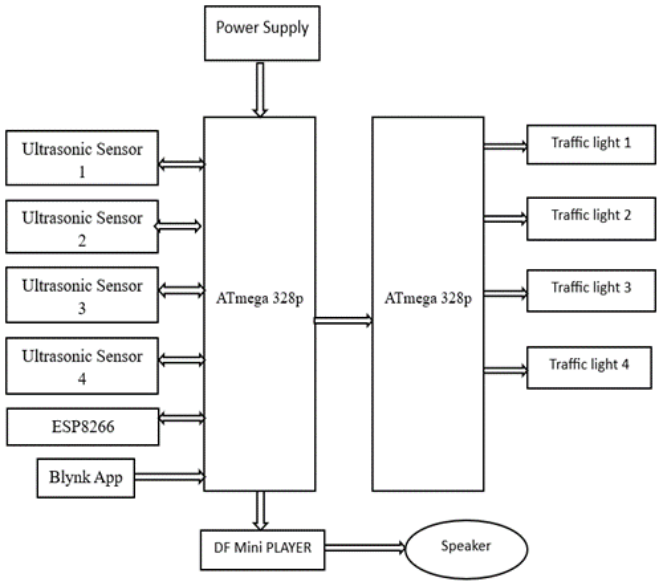

Fig.2 Block diagram of traffic control system

4. HARDWARE DESCRIPTION

A. *ATmega328p microcontroller*

The microcontroller processes the ultrasonic sensor data and determines the traffic density. It communicates with the Blynk app via Wi-Fi to provide real-time traffic updates and control parameters.

B. *Ultrasonic sensors*

The ultrasonic sensor measures the distance between vehicles and detects traffic density. It sends this data to the ATmega328P microcontroller.

C. *DF Player Mini*

The DF Mini Player is an audio module that plays pre-recorded emergency vehicle sirens or alerts. It is triggered by the microcontroller upon detecting an emergency vehicle.

D. *Traffic lights*

The traffic lights are controlled by the microcontroller based on the traffic density. The microcontroller adjusts the signal timings to optimize traffic flow. In case of an emergency vehicle approaching, the microcontroller gives priority to the vehicle by preempting the regular signal sequence.

5. SOFTWARE IMPLEMENTATION

A. *Arduino IDE*

The IDE in Arduino stands for Integrated Development Environment. It is an official software developed by Arduino.cc that is primarily used for editing, compiling, and uploading code to an Arduino device. It is a cross-platform application (for Windows, macOS, and Linux) written in C and C++ functions. The Arduino IDE is an open source software used primarily for writing and compiling code for the Arduino Module. It has a serial monitor, which is primarily used to interact with the Arduino board via the computer, and it is an excellent tool for real-time monitoring and debugging.

B. *Blynk Application*

Blynk is an Internet of Things (IoT) platform for iOS and Android mobile devices that allows users to remotely control devices like Arduino, Raspberry Pi, and NodeMCU. For the purpose of creating a graphical interface or human-machine interface, this application compiles and provides the appropriate address on the widgets that are available (HMI). There are three main parts to the platform.

1. Blynk App - By integrating the different modules offered, the Blynk App enables you to design beautiful interfaces for your projects.

2. Blynk Server The entire exchange of data between the smartphone and hardware is handled by the Blynk Server. It is open-source, has the capacity to run on a Raspberry Pi, and is easily scalable to thousands of devices.

3. Blynk Libraries - In addition to processing all incoming and outgoing commands, it enables communication with the server for all widely used hardware platforms.

As soon as the Button is pressed in the Blynk application, the data is transferred to the Blynk Cloud and eventually finds its way to the installed hardware. Everything happens in a fraction of a second and works the other way around.

6. RESULT

The following results were obtained by combining the aforementioned hardware with appropriate microcontroller programming.

- When there is regular traffic at the intersection, the traffic light remains on as a time delay. When one lane has more vehicles than the other, that lane is given priority, and the signal turns green as soon as the lane is not cleared.
- When the microcontroller detects an emergency vehicle on a specific lane using the blynk application, that lane is given priority and the signals turn green.

7. CONCLUSION

The innovative idea for implementing this system is the use of one sensor per road. Additionally, the information gathered from the sensor readings can be used to allocate more green light time during a particular time of the day for the road with a high volume of traffic. Additionally, the Blynk application is used to provide the controller with input data regarding the lane from which the ambulance is arriving.This system is an approach to machine-to-machine communication using information technology.

8. FUTURE ENHANCEMENT

- In the future, this system might be used to inform people about the traffic conditions in various locations. Radio is a viable option for doing this. The telephone network and data call-activated SIM cards can also be used to transfer data between the microcontroller and the computer. Using this method, the operator can gather recorded data from a distance and transfer it without travelling to his home computer.
- The number of traffic lights can be increased to N, and from one location, the entire city's traffic lights can be controlled.
- The GSM technology in the ambulance system allows for the transmission of patient data to hospitals. As a result, it can offer the patient quick and early treatment.

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