DENSITY BASED TRAFFIC LIGHT CONTROLLER

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Abstract :

Traffic congestion and accidents caused by over speeding vehicles have been a major cause for concern in societies due to their negative effects such as stress to commuters, release of more toxic fumes into the atmosphere, accidents and loss of productive hours. The conventional traffic light uses a fixed logic of allocating the same “go time” to lanes at intersections without taking the density of traffic into consideration. This paper offers an approach for handling traffic congestion. This system uses ultrasonic sensors as counters to measure the traffic density in each lane. These sensors are interfaced with the traffic light through a microcontroller. The microcontroller which was used to implement this is the Arduino Mega with the Atmega 2560 chip. The system was developed to alleviate traffic congestion. This intersection consists of Abak Road, Udo Obio and Udo Eduok Streets. This system was tested and all objectives were accomplished. Results obtained from the implementation of the prototype design show that traffic control using ultrasonic sensors and Arduino Atmega 2560 give better performance and the time taken to clear traffic at an intersection reduced significantly with 60% time saved.

1. Introduction :

Congestion in urban areas has given rise to the gradual increase in automobiles and vehicles due to the migration of people into urban settlements bringing about different pros and cons. One of such disadvantages is the increase in both human and vehicular movement which additionally leads to high traffic on major roads in a city and therefore prompts activity clog in urban zones. Traffic congestion occurs when the use of the road network increases and it is characterized by bad roads in communities and increase in community population. Traffic jams occur at a point when vehicles completely stop for a period of time. Extreme Congestion occurs mostly during workdays and rush hours (morning and evening).

One of the principal reasons why congestion exists on the roads is due to the increase in the number of vehicles. That is, when the number of vehicles outnumber the capacity of the available infrastructure such as good roads, traffic lights and road regulators. As the population of urban settlers increases, the need to acquire personal vehicles for transport increases, and traffic congestion increases as the number of vehicles increases combined with an absence of proper infrastructure. The national government and councils neglect to follow up on the approaching danger of increased congestion until it eventually occurs. The roads of the city do not expand in size alongside an inexorably vehicle dependent populace. An example is a single street with one lane on each side will probably not get developed in ten years after the population has expanded. The authorities frequently neglect to take this into consideration.

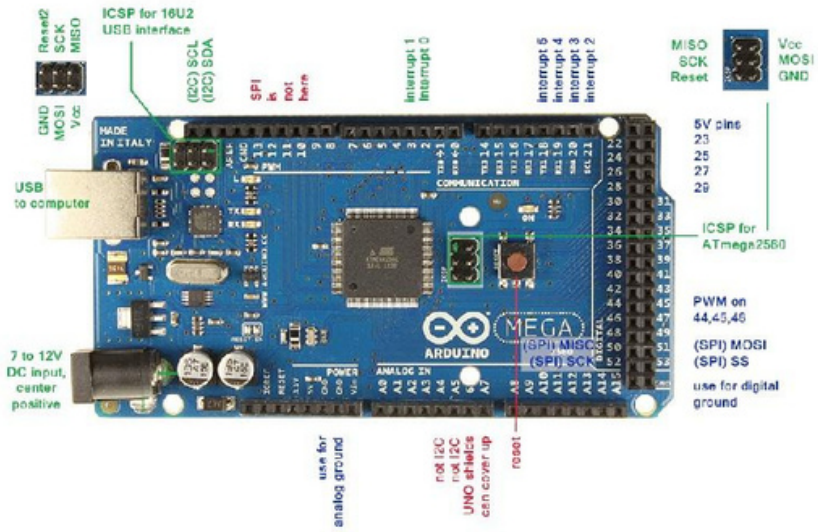
The rapid increase in the number of vehicles without a rapid increase in road networks is the main cause of congestion which is a major concern in the society. While it may be difficult to totally tackle congestion, there are a few different ways to control its future rate of increment like: quick response to traffic- blocking incidence and accidents, removing mischances from major roads quickly by utilizing the service of roving vehicles run by Government Traffic Management Centers (GTMC); This is an incredible strategy for diminishing blockage delays, building of more roads in developing regions and improving on urban region road network, and car-sharing service which would reduce the need to own personal vehicles thereby reducing the number of cars on the road.
It is in view of this challenge that this work is carried out to regulate traffic control and monitor speed limit with additional input that was absent in previous design. The method being proposed here is different from the current design that has a fixed time to control and monitor traffic

irrespective of the traffic flow. The proposed design would depend basically on the density of each lane by optimizing the “go time” allocated to a lane. This is because it will be a waste of productive time and inappropriate time-sharing formula when a congested lane is allocated the same “go time” with a relatively less busy lane at a junction. The proposed design would provide the quickest possible clearance to congested vehicles in all directions at any junction. The design would reduce the frequent occurrence of accidents resulting from the lack of patience by road users.

Materials:

1.Arduino Mega 2560

The microcontroller board like “Arduino Mega” depends on the ATmega2560 microcontroller. It includes digital input/output pins-54, where 16 pins are analog inputs, 14 are used like PWM outputs hardware serial ports (UARTs) – 4, a crystal oscillator-16 MHz, an ICSP header, a power jack, a USB connection, as well as an RST button. This board mainly includes everything which is essential for supporting the microcontroller. So, the power supply of this board can be done by connecting it to a PC using a USB cable, or battery or an AC-DC adapter. This board can be protected from the unexpected electrical discharge by placing a base plate.



Microcontroller	ATmega 2560
Operating Voltage	5 V
›ut Voltage (recommended)	7–12 V
Input Voltage (limit)	6–20 V
Digital I/O Pins	54 (of which 15 provide PWM outpu
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3 V Pin	50 mA
Flash Memory	256 KB (8 KB used by bootloader)
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm

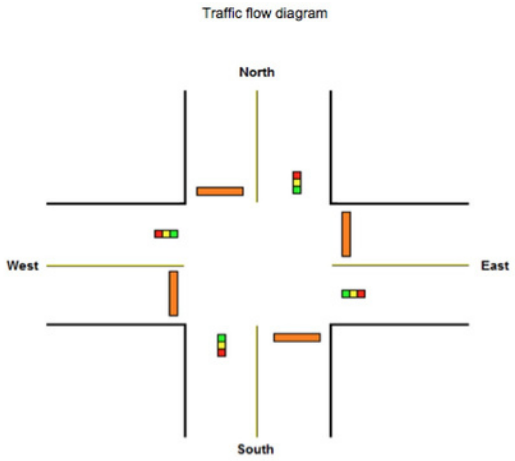
2.Ultrasonic Sensor:

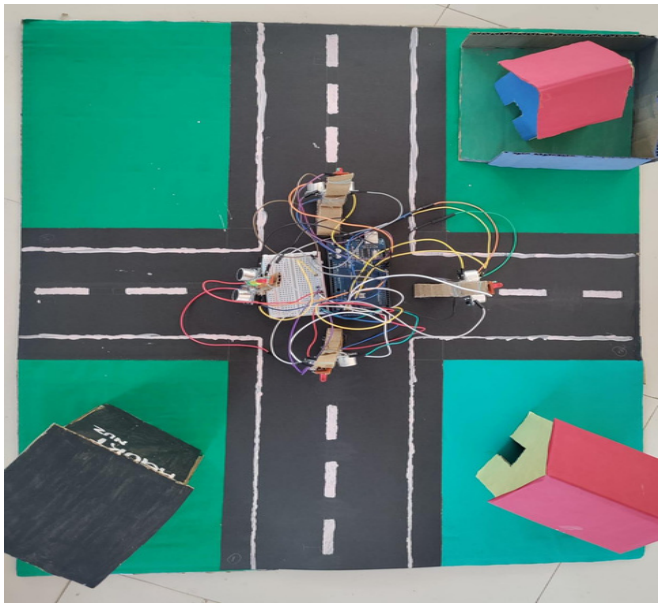
Ultrasonic sensors are electronic devices that calculate the target's distance by emission of ultrasonic sound waves and convert those waves into electrical signals. The speed of emitted ultrasonic waves traveling speed is faster than the audible sound.
There are mainly two essential elements which are the transmitter and receiver. Using the piezoelectric crystals, the transmitter generates sound, and from there it travels to the target and gets back to the receiver component.

3. Result :

The location noted for traffic jams and its road layout must be taken into consideration for any traffic issue to be resolved. This work can be implemented in other places but the location considered for the implementation of this work is the cross road made of Abak Road, Dobio Street and Udo Eduok Street in Akwaibom State, Nigeria. Abak Road is a major lane while Dobio Street and Udo Eduok Street are quite small and they sometimes have low car density.

This location was chosen due to the constant traffic jam. A conventional traffic light is installed at this location but it is obviously not efficient. During traffic control, smaller Streets like Udo Eduok and Udobio were allocated “equal go time” with the Abak Road even when there was no traffic on Udo Eduok and Udobio Streets. This usually caused undue traffic jams on Abak Road and as a result, time wasting leading to the road users trying to outrun traffic lights or over speeding at ready time (yellow light) thereby causing accidents many times.





4. Discussion :

For the operation of the proposed design, the adjacent lanes work together. If low traffic is detected on one lane and medium traffic on the adjacent lanes, the “go time” for both lanes will be according to the highest traffic lane between both of them. Therefore, in the case stated above, those lanes will be allocated 9 seconds “go time” which is for medium traffic.
Based on the configuration of the available traffic light system, which allocate the same “go time” to each lane, assuming the preprogrammed “go time” for each lane is 15 seconds and it takes approximately 1 second for each vehicle to move past the traffic light, then, it would take 60 seconds for all the lanes to be cleared. Using the proposed real-time system in this work for this same scenario, it would take 24 seconds for all the lanes to be cleared which yields 60% time saved.

Applying this model to real life situations will go a long way to reduce traffic to a bearable minimum time interval and caution all drivers to avoid exceeding speed limit which will also eradicate accidents due to over-speeding at cross roads.

5. Conclusion :

The implementation of a smart traffic light system with a density based system will, to a very large extent, reduce road accidents caused by over-speeding vehicles and also lessen traffic

congestion in our society. Though the work has achieved its main objectives of smart traffic control, there is the need for more research and improvements. The following recommendations are hereby suggested:

- A system where WIFI technology should be used as it has a wider range and more functionalities than bluetooth technology;
- The system should be powered by a solar system to promote green energy operations and reduce consumption of electricity from the grid; and
- A surveillance system should be installed to capture the vehicles going beyond the stated speed limit.