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IOT Based Traffic Signal Control Barricades with Critical Vehicle Passing System

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ABSTRACT—

To design and develop effective traffic signal barricades that enhance road safety, optimize traffic flow, and ensure adherence to regulations, an intelligent traffic management system is essential. A significant challenge in modern traffic control is the inefficient allocation of signal time, leading to unnecessary slow, fuel wastage, and increased pollution. To address this issue, an automated system to be implemented to dynamically conditions. By utilizing sensors to detect the size of vehicles on each side of an intersection, the system can analyze traffic density with signal working accordingly. This ensures nice movement of vehicles, reducing congestion and minimizing idle time. The proposed system is installed at key traffic points and is monitored through a central command unit equipped with a data terminal. The sensors collect traffic data and transmit it to a computing module, which processes the information and relays appropriate signal adjustments. This automated approach not only improves efficiency but also contributes to fuel conservation and environmental sustainability.

Index Terms— Traffic Signal, Barricades, Traffic Flow, Critical Vehicle, Automatic System.

I. Introduction

The daily traffic congestion poses a major challenge for commuters. Navigating through traffic create tension and various health issues. One of the primary causes of traffic jams is the disregard for traffic rules, with signal violations being a significant factor in road accidents[1].Traditionally, traffic management has relied on traffic police and electronic signals. However, to enhance road safety and improve traffic flow, the introduction of a smart traffic barricade system is crucial. This system will help minimize accidents and ensure smooth vehicular movement by enforcing compliance with traffic signals. With its implementation, drivers will be compelled to follow signals, making signal violations nearly impossible and promoting disciplined driving behavior[2].

Smart traffic barricade system is a simple mechanism consisting of rack and pinons, rods, DC battery supply, motor, L298 Motor driver and programmed with help of Arduino Uno. When and critical vehicle. pass with communication with traffic signal. Accordingly the signal changes the traffic light and allow the critical vehicle to pass. It also checks whether any vehicle is under the barricades[3]. To satisfy the above purpose, we have introduced this project of Smart Traffic Barricade System. Reducing Response Times Minimizing delays for emergency vehicles by dynamically altering traffic signal patterns and optimizing routes to provide the quickest possible path to the destination.

Improving Traffic Safety Enhancing the safety of both the critical vehicles and other road users by providing real-time alerts and notifications, thereby reducing the risk of accidents and collisions during emergency situations. Optimizing Traffic Flow Minimizing the impact of emergency vehicle passages on overall traffic by intelligently managing traffic signals and ensuring that non-critical vehicles are informed and guided appropriately. Ensuring System Reliability Developing a robust and reliable system capable of functioning effectively in all conditions, including during peak traffic hours, adverse weather conditions, and technical challenges.

II. Methodology

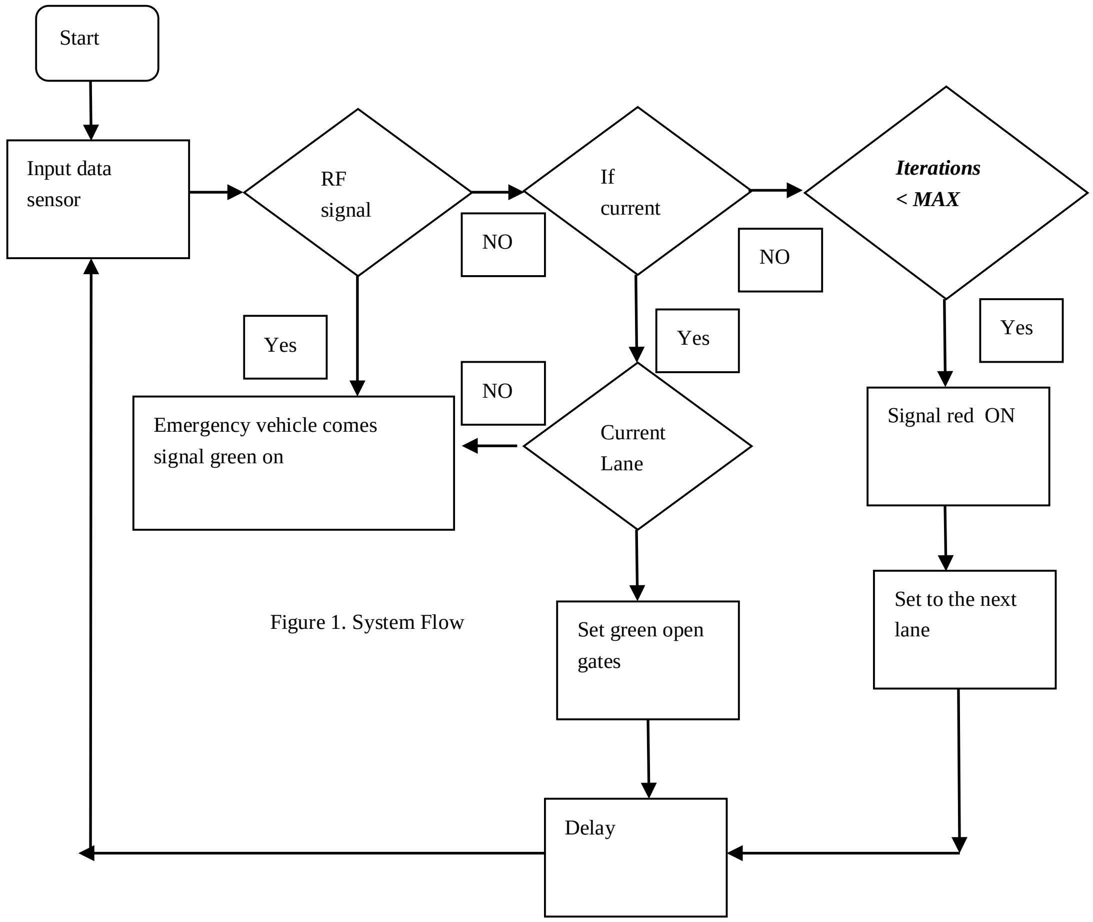

Figure 1. System Flow

The information from the emergency vehicle and the traffic signals is relayed to a centralized command center, where it is analyzed to determine the best course of action. The command center coordinates traffic signals along the vehicle's entire route.

Measurement Techniques: Signal Override: The traffic signals at intersections along the route of the emergency vehicle are temporarily overridden. The signals turn green for the emergency vehicle's direction of travel while turning red for cross traffic. This creates a clear path for the emergency vehicle to proceed without stopping.

Adaptive Signal Timing: The system can adjust the duration of green lights based on the speed and distance of the emergency vehicle. If the vehicle is moving slowly due to congestion, the green light duration is extended to ensure the vehicle can pass through the intersection without stopping.

Dynamic Route Optimization: The system continuously monitors traffic conditions and, if necessary, suggests alternative routes to the emergency vehicle to avoid congestion, accidents, or roadworks. This real-time routing is communicated to the driver through in-vehicle navigation systems.
Traffic Signal Optimization: Evaluate how well the system manages traffic signals to minimize disruption to regular traffic while prioritizing emergency vehicles.
Impact on Non-Emergency Traffic: Assess whether non-emergency vehicles experience increased delays and if so, whether these delays are within acceptable limits.

III. Results

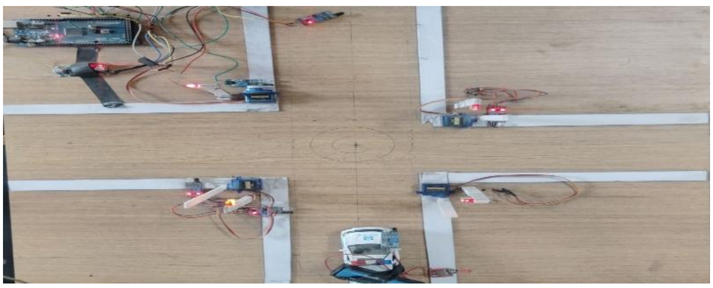

Figure 2. System Model

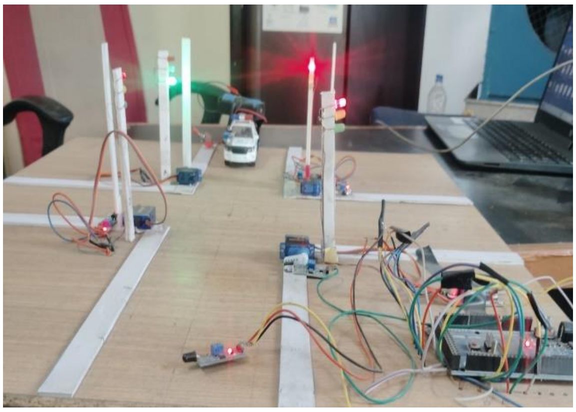

Figure 3. Signal And Barricades

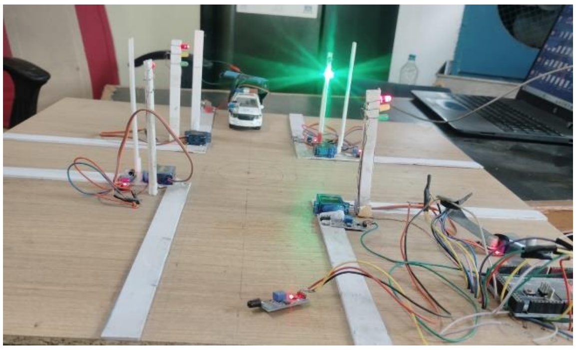

Figure 4. Critical Vehicle Passing System

Start with All Yellows: All red lights are turned off except for the left green, which is also turned off. All yellow lights are turned on for 5 seconds.
Upper Lane Green: Yellows are turned off. The up (upper) green light is turned on, while right, left, and down red lights are activated for 10 seconds.
All Yellows Again: All yellows are turned on while turning off the up green and other red lights for 5 seconds.
Right Lane Green: Yellows are turned off. The right green light is turned on, while up, left, and down red lights are activated for 10 seconds.
All Yellows Again: All yellows are turned on while turning off the right green and other red lights for 5 seconds.
Down Lane Green: Yellows are turned off. The down green light is turned on, while up, left, and right red lights are activated for 10 seconds.
*All Yellows Again:*All yellows are turned on while turning off the down green and other red lights for 5 seconds.
Left Lane Green: Yellows are turned off. The left green light is turned on, while up, down, and right red lights are activated for 10 seconds.

setup() function:

- Configures each light pin as an OUTPUT.

loop() function:

- Calls change Lights() repeatedly.

Change Lights() function:

This function cycles through different traffic phases:

- Phase 1: All Yellow (5 sec)
  - Prepares for a lane change.
- Phase 2: Upper Lane Green (10 sec)
  - Upper lane moves (u_green ON).
  - Other lanes get **red**.
- Phase 3: All Yellow (5 sec)
  - Again, all yellow to warn drivers.
- Phase 4: Right Lane Green (10 sec)
  - Right lane moves (r_green ON).
  - Other lanes get red.
- Phase 5: All Yellow (5 sec)
  - Transition phase.
- Phase 6: Down Lane Green (10 sec)
  - Down lane moves (d_green ON).
  - Other lanes get **red**.
- Phase 7: All Yellow (5 sec)
  - Transition phase.
- Phase 8: Left Lane Green (10 sec)
  - Left lane moves (l_green ON).

- Other lanes get red.

Testing is the main event, which has its own importance in the electronics field. Testing is the process to find the output performance and fault of the circuit in the various forms. The main objective of the testing is to check the output performance as per our assumption.The least carelessness may lead to the major fault in case of electronics circuit and it is depend upon the layout and design of the PCB. Printed circuit board are used to route electrical current and signal through the copper tracks which are primarily bounded to an insulating core.

For the testing of any electronics circuit some common steps are performed. These steps are as follows.

- To check the main power source.
- To tress out the circuit. In which following steps are followed.

1). The tracks are not open.

2).The distances between two tracks are sufficient to avoid capacitance.

3).The track linked with the other related tracks is proper or not.

4).The jumper which goes from one track to another track should not short with the tracks which are in between required two.

- Thus by testing the tracks of the printed circuit board it helps the project for making successful. After testing copper tracks the component were tested with the help of instrument like multimeter, CRO, signal generator etc.
- After mounting the component on the PCB the possibility of the dry soldering was checked to avoid the possibility of shorting those tracks as well as the tracks were checked individually to avoid the possibility of opening those tracks. This testing was carried out with the help of multimeter keeping in range of Ohm.
- After all check the power was supplied and the operation of the circuit it was observed.
- Check the supply voltage and voltages at the points where it is known or expected to be of certain value.
- After testing and confirm the output of the individual circuit we connect all this circuit is as shown in the figure. When we make the circuit carefully connect all the connecting wire and to avoid loose connection soldered and check the continuity of the wires and tracks by the multimeter. And then give the supply to the input side of the circuit and checks all modes on output side of the circuit. After completing all modes and operation are works as per our assumption.

IV. Conclusion

The successful implementation of underscores the importance of integrating advanced technologies into traffic management systems. With ongoing improvements and expansions, CVPS has the potential to save more lives, reduce accident risks, and further streamline emergency response operations across various regions. In conclusion, the CVPS is a promising solution that addresses critical needs in emergency response and traffic management, and its continued development will likely yield even greater benefits in the future.

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