Smart Traffic Junction Using Raspberry Pi

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Abstract. In present situation, use of vehicles is rapidly increasing all over the world, particularly in urban areas. In the recent years, the numbers of vehicles on roads are arising at an exponential rate. This increase is accomplished by the road accidents and signal jumping is the major cause. In future, a traffic control system of smart features is an important issue as the people using the road increase and the existing resources and infrastructures are narrow. An intelligent traffic control system is designed to overcome the increasing demand of all these essentials. A system should be designed to optimize the control of traffic. This paper will express the improvement of traffic reduction largely in a city. Management of traffic is a sturdy case. With several junctions, the difficulty enhances as the traffic state increases. By redefining the threshold values for a real time application, an excellent way of improving the traffic is proposed. By using RASPBERRY PI controller performing the processing of real time data obtained from sensors, Smart traffic junction using Raspberry pi based light control system is implemented as key role. This concept is that incoming vehicles at a traffic junction is outfitted with a retractable barrier. When there is red light at the traffic junction, the barrier rises and widely blocks the incoming vehicles and when there is green light at the traffic junction, the barrier retracts. Thus, this project will control traffic on four-way roads based on traffic control barriers. With this system, there will be less traffic jams, emergency vehicles will reach the destination in time and the country will be developed. So, this intelligent system will help us to control traffic in more autonomous way.

Keywords—Raspberry pi, Traffic management, barrier, intelligent system, emergency vehicle

1. Introduction

The second most popular country in the world is India and it has a fast-growing economy. In today’s high-speed life, traffic congestion is a rigorous matter in our day to day activities. Huge number of vehicles, improper signaling, and insufficient infrastructure are the basic reasons of traffic blocking. Pollution level is also increased as vehicle engines will be in ON condition and also natural resources like petrol and diesel are wasted without proper utilization. In many countries, monitoring and manage of traffic in a city is major concern. Due to increase in number of vehicles, it is better to find a new method to manage congestion at the traffic junction. Apply robotization and keen control techniques will decrease congestion.

2. Methodology

The implemented system of Smart Traffic Junction using Raspberry Pi consists of following major steps which is shown in figure 1.

\begin{itemize}
  \item[i.] Power Supply
  \item[ii.] Raspberry Pi
  \item[iii.] Switches
  \item[iv.] LED
  \item[v.] DC Motor
  \item[vi.] Barrier Setup
\end{itemize}
2.1. Power Supply

Every electronic circuit operates on regulated power supply. DC regulated power supply can be obtained as given in the following figure 2.

\[ P_{\text{primary}} = P_{\text{secondary}} \]  
\[ I_p V_p = I_s V_s \]

The secondary voltage of the transformer depends upon the turns number in the Primary as well as in the secondary.

\[ \frac{V_s}{V_p} = \frac{N_s}{N_p} \]

2.1.1 Transformer

A transformer consists of two coils also called as WINDINGS. They are PRIMARY & SECONDARY connected together through inductively coupled electrical conductors called as CORE. An alternating voltage is induced in the secondary coil due to varying magnetic field in the core. This variation is due to change in the current. AC current flows through the load when it is applied to the secondary. Energy is transferred from primary circuit to secondary through the magnetic field by considering an ideal condition.
2.1.2. Rectifier
Rectifier is one which converts ac to pulsating dc. Bridge rectifier is used here to provide high Transformer Utilization Factor

2.1.3. Filter
Capacitor filter is mostly used because it eliminates maximum amount of ripples and the cost of this filter is less.

2.1.4. Regulator
Regulator is a circuit which provides constant dc voltage and it also avoids the ripples which are not eliminated by the capacitor filter. Here, LM7805 is used which is an integrated circuit provides 5V dc supply.

2.2. Raspberry pi
The Raspberry pi board is small in sizes that perform many tasks similar to a computer. Raspberry pi foundation in UK developed the Raspberry pi board. It is available in the market with an idea of low cost portable computer from 2012. To support learning, encourage experimentation and innovate the students, this board is designed. A program memory (RAM), processor and graphics chip, CPU, GPU, Ethernet port, GPIO pins, X bee socket, UART, power source connector and various interfaces for other external devices are included in raspberry pi board which is shown in the figure 4. SD flash memory is used as mass storage. Raspberry pi board will be booting from SD card which is similar to a PC booting from hard disk.

![Figure 4. Raspberry pi board](image)

2.3. Switches
A switch is a mechanical device which can make or break an electric connection. There are various types of switches.

2.4. LED
A semiconductor diode which emits light when a forward biased voltage is applied and current flows through it is called as Light-Emitting Diode (LED). Electroluminescence is the effect where the incoherent and narrow-spectrum light is emitted from the p-n junction.

2.5. DC Motor
A DC motor is constructed to run on DC electric power. A mechanical force is experienced whenever a conductor carrying current is placed in a magnetic field. The force of direction is given by Fleming's left-hand rule and its magnitude is represented as follows

\[ F = BIL \]  

Where, \( B \) = magnetic flux density, \( I \) = current and \( L \) = length of the conductor.

Torque (\( T = F \times r \)) is produced at circumference of the conductors when equal magnitude and opposite forces acts on left and right conductors. Because of this twisting force, motor starts rotating in anticlockwise direction. The direction of motor can be controlled by simply changing the supply.
terms or interchanging of south and north poles. Figure 5. shows the image of 12V DC motor used in the proposed system.

2.6. Barrier Setup
Traffic barriers (sometimes called Armco barriers, also known in North America as guardrails or guard grills and in Britain as crash barriers) are installed at the junction. Figure 6. Shows the barrier setup. These are also set up in some areas like school, pedestrians’ zone to protect from errant vehicles. Sometimes, collisions occur with barriers. It should be designed in such a way that it should avoid collisions and should protect small vehicle occupants.

3. Results
Due to the demerits noticed during the survey of the existing systems, some of the existing products are to be operated manually, and if in case there is no manpower in the traffic junction to operate manually then there will be of no use, using barriers there is no requirement of manpower, can even avoid many road accidents that happen avoiding the red lights. The aim of the proposed system is to make a developed traffic junction management system with less traffic and ensure the safety of pedestrians from accidents. Also managing the traffic on the road, use as an alternate to traffic polices. Due to this reason, an automated system is developed which is not operated manually having the signalling system which activates when red light is in ON condition in daytime and night time.
This prototype shows a new way to reduce the road accidents that occur by avoiding red lights. The basic concept is that a retractable barrier is placed in each incoming vehicle across the traffic junction. When there is red signal at the traffic, incoming vehicle is blocked and when there is green signal, barrier is opened. Thus this prototype will help in largely reduction of fatal road accidents that occur through jumping of a red light and efficient road traffic management system.

4. Conclusion
In present scenario, there is need of automatic appliances which increases standard of living, reduces the complexity of life. This Prototype may be very well used in where the traffic signal is kept and in many other places where we need to fulfill the need of the automation. Thus circuit proves to be helpful. To control the traffic, this prototype is merged with recognized technologies. Many countries will be developed and has a bright future using the proposed system.

5. Future Enhancement
In future this project can be implemented in many commercial areas. Traffic jams occurred due to red light delays will be reduced and emergency vehicles are easily cleared by using this system. The present system uses a barrier for monitoring the signals and avoids jumping of red lights. By using different sensors for detection of explosions at each barrier as an intersection can improve the efficiency of the system in future. Depending on the geometrical shape of vehicle, categorization is done and large or heavy vehicles such as lorries can be blocked in daytime. By installing a GPS receiver in ambulance, emergency mode can be sophisticated such that base station can find ambulance location if it is required. By using this circuit it can be implemented in various applications, such as industries, hospitals and many commercial areas in future.

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