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INVENTIVE TRAFFIC CONTROL SYSTEM

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Abstract – Due to increase in population all over the world, there is a great increase in number of vehicles. In the past few years, traffic problems have increased suddenly. The traditional hardware based traffic control system is based on fixed time slots consisting of 3 lights: Red, Yellow and Green. Therefore the waiting time is more in the existing system. Thus to reduce it and have an efficient traffic system we introduce use of sensors along with embedded technology. The timing slot between the 3 lights will be decided dynamically on the basis of traffic detection in any area. Therefore this is an Intelligent as well as Inventive Traffic Control System. It also has the facility to pass the emergency vehicles such as ambulance, etc. It also reduces the waiting time. This has further scope and few limitations.

Keywords – Congestion control, Traffic control, Emergency detection, Traffic Jam.

I. INTRODUCTION

Urbanization and Industrialization has led to increase in population leading to growth in traffic. Traffic management has become a great challenge. Increase in traffic leads to various issues such as burdensome traffic jams, infringement of traffic rules, long waits, and loss of resources like fuel. Thus necessarily we need to have a fast, efficient and flexible traffic control system .The problems of traditional traffic light Controller are as follows: -

A. Wastage of Time in Heavy Traffic Jams: With enormous increase in number of vehicles on road, heavy Traffic jams usually occur at the main junctions especially in the evening, after office hours. The main effect of this is increased waiting time of the crowd on the roads. The solution to this problem is variable time delay settings for red, yellow and green signals at distinct junctions. The delay for junctions that have greater volume of traffic should be set longer than the delay for the junction that has low traffic.

B. Requirement to wait at no traffic: People have to unnecessarily wait at specific junctions, even when there is not much traffic. Because the traffic light remains red for the pre-set time period, the road users should wait until the light turns green. The solution to this problem can be obtained by developing a system which detects traffic flow on each road junction and set timings of the signals according to the traffic analysis.

C. Emergency vehicle stuck in traffic jam: The emergency vehicle, such as ambulance, fire brigade etc. generally reach the destination very late because they are often stuck in the traffic jam. This happens because the road users wait for the traffic light to turn to green light. This is very critical problem because it can cause the emergency case to become complicated, risking someone's life.

II. LITERATURE SURVEY

Traffic Congestion is a condition on transport system when use increases, and is characterized by slower speeds, and increased vehicular trafficking. Mathematically, congestion is usually looked at as the number of vehicles that pass through a point in a slot of time. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, this results in some congestion. As demand approaches the capacity of the road, extreme traffic congestion sets in. When vehicles are stopped for periods of time, this is known as traffic jam. Traffic Congestion is a major issue of transportation system in most of the cities of developing Countries. This fact is best favorable for those countries where population is increasing at a tremendous rate. Various disadvantages observed are wasting time of passengers, delays: which may result in late arrival for employment, wasting fuel leading to air pollution, higher chances of collisions due to least spacing between vehicles. In recent years there is phenomenal growth in human population leading to growth in vehicle population. As a result, many of the carriageway roads and intersections are operating over the capacity and average journey speeds which are approximately lower than 10 Km/h at the peak hour. The vital challenges still exists which are management of constantly increasing vehicles, annual growth of 7–10% in traffic, roads operating at higher capacity, less travel speed at some central areas in peak hours, insufficient or no parking space for vehicles, limited number of policemen. Currently a video traffic surveillance and monitoring system is used in most of the cities. It involves a manual analysis of data by the traffic management team to determine the traffic light duration in each of the junction. It will communicate the same to the local police officers for the necessary actions.

III. COMPARITIVE STUDY

For congestion detection several technologies have been proposed such as inductive loop, magnetometer, visual camera, radar, conventional traffic signals, Microcontroller based traffic signals, etc.

Inductive Loops

The main motive of introducing the use of inductive loops is analysis of traffic speeds. They can be easily placed on the roadbed work at all traffic speeds and are effective at estimating traffic speeds up to some level of accuracy. Installation and maintenance are big challenges while using inductive loops. Adding on to these disadvantages, they are also susceptible to high error rate in detection and transmission of traffic information. Thus for greater accuracy there can be a more enhanced technology to determine the traffic speeds.

Magnetometer

Another technology used is a magnetometer. This technology works upon the magnetic properties. It detects any moving object by analyzing the change in the magnetic field. The magnetometer detects the change in the earth's magnetic field when a magnetic object like a car crosses it.

Visual Camera

Cameras are used as input sensors which collect real time traffic condition data and analyzed these conditions to provide real time outputs. In bad weather conditions they are not working.

Conventional traffic signals

These traffic signals have been programmed with a fixed timer. They do not consider the volume of the traffic on the street before taking a decision of green or red light. Hence if the volume of traffic is large, it may result in accumulation of traffic on the street and the junctions.

Micro controller Based Traffic Signals

The micro controller-based traffic light system allocates green, red & yellow signal time for each path. When the vehicles along one path will move, the other vehicles from the other path will stop at road intersection control. Without any collision microcontroller based traffic signal system direct the movement of vehicles meeting at a road junction. When the time allocated for a specific path has been exhausted, the red light will be ON meaning stop and the next line will be ON (green light) which means the vehicle in that path should start moving. When the time is about to be exhausted, the yellow light will be ON in the third path informing the vehicles in that path to be ready to move, and after some seconds the green light will be ON.

Disadvantage of Micro controller Based traffic system is traffic light timing is fixed.

IV. PROPOSED WORK

Traffic Control Based on RFID

Problems that usually arise with standard traffic control systems, especially those related to image processing and beam interruption techniques are avoided using RFID based traffic control system.

The ITCS comprises of a set of two RFID readers, separated by some distance, in each direction of a road crossing and have a central computer system (CCS) to control them all. As a vehicle passes by a reader, it tracks the vehicle through the RFID tag attached to the vehicle and retrieves its electronic product code (EPC) data. The EPC primarily consists of vehicular identification number (VIN). The VIN is an industry standard and each automobile has 3 unique VIN. Through a table look-up procedure, the VIN may be matched against individual vehicle record and all details like type, weight, length, registration, pollution control status, and the owner's identification can be retrieved.

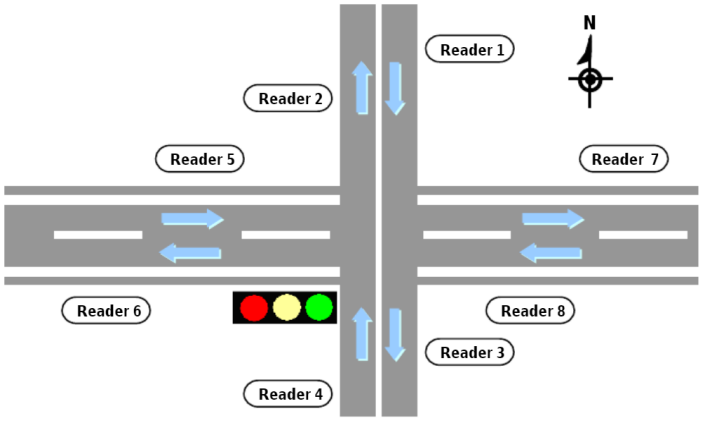

Figure 1:A road crossing with RFID Readers

8 RFID readers are used for each intersection. The road is divided into two lanes. RFID reader in each lane track the vehicles passing through it. VIN number that provides the information regarding the priority of the vehicle and type of the vehicle. Readers collects the information regarding the vehicles approaching towards the junctions. The data obtained is then sent immediately to the CCS by wireless or wired channels, as found convenient at that location. The CCS contains a central database processing system (CDPS) for processing vehicular data and a decision-making section (DMS) for controlling the traffic signals. The flowchart of the system is given in Figure 2 and a diagrammatic representation of the system is given in Figure 3.

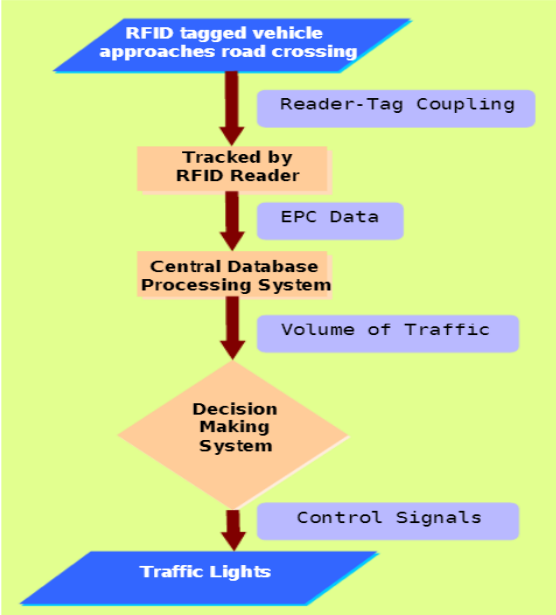

Figure 2: Flowchart of the system

The Central processing unit calculates the volume and speed of vehicles on each road according to information collected by readers. Speed of vehicle is determined by the time taken for it to cover the distance between two readers. If speed of a vehicle is below a specified threshold, it is detected as congestion and the Central Processing System notifies the preceding traffic signal about this. On receiving such information, traffic on that corresponding road is halted for certain duration to avoid congestion on the proceeding road.

Central Database Processing System

The CDPS consists of two parts:

- A dynamic database where the records of vehicles currently passing the crossing
- The dynamic database where records of vehicles currently passing the crossing are temporarily stored.
- A permanent database which stores the records of all vehicles that have passed the crossing.

The dynamic database is divided into a number of parts. It arranges the EPC data of vehicles according to their path and direction of travel. Whenever a vehicle moves towards or away from the crossing, the two readers in its path detect it and convey the obtained data to the CCS with some time gap in between. The order of response of the two readers determines the direction of travel of the vehicle (whether it is moving towards or away from the crossing). The vehicular data is then sent to any one part of the database corresponding to its path and direction of travel.

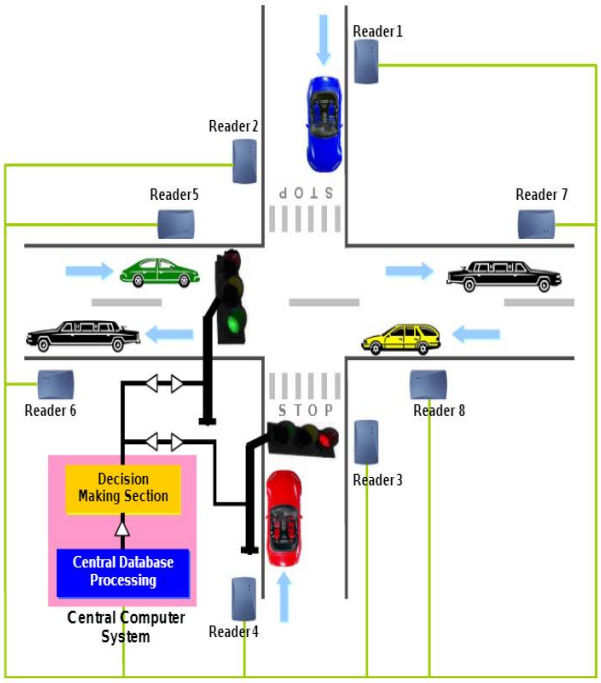

Figure 3: Intelligent Traffic Control System Using RFID

At each instant, the CDPS checks the data in various parts of the dynamic database and computes the volume of traffic for all the roads converging at the crossing. It then sends the computed information to the DMS of the CCS which operates the traffic signals according to the current volume of traffic (showing the green light in the direction of maximum traffic). The volume of traffic is not calculated simply by the number of vehicles but by a complex set of equations which take into account pre-defined factors (obtained by research) like:

- Type of vehicle - Whether it is a smaller vehicle like a scooter or a car, or a larger vehicle like a bus or a truck. Emergency vehicles can be given unrestricted
- Type of vehicle – Whether it is small vehicle like a scooter or a car, or a longer bus or a truck. Emergency vehicles can be given unrestricted passage.
- Priority assigned to the vehicle – Each type of vehicle is assigned a specific priority based on its size, frequency of that vehicle at the crossing, time of the day etc.
- Priority assigned to the path of travel – This factor becomes essential when both the roads intersecting at the crossing are not of the same importance. EX: - Intersection of a National Highway with an ordinary road.
- Time- The time of the day and day of the week plus the time before after office hours.
- Priority assigned to the vehicle - Each type of vehicle is assigned a specific.

- Priority assigned to the path of travel - This factor becomes essential when both the roads intersecting at the crossing are not of the same importance. e.g. - Intersection of a national highway with an ordinary road.
- Time - The time of the day, and day of the week

So, the volume of traffic takes into account the priority assigned to each vehicle at the present time of the day and also the priority assigned to the two roads intersecting at the crossing. Some statistical parameters like inter arrival time or, departure time may also be calculated based on the available data which helps in prospective research.

Once a vehicle has passed the crossing, that is it has gone out of the range of the readers, its data is moved from the dynamic database to the permanent database where it is stored along with its direction of travel, both arrival and departure directions, and time.

Decision Making Section (DMS)

The DMS contains a decision-making algorithm which determines how the traffic lights are operated. The decision-making algorithm takes care of the following factors:

- The volume of traffic as received from the CDPS – Green light as shown in diagram.
- Since volume of traffic can fluctuate very rapidly, it is not possible to alter traffic signals based only on this factor, So, a minimum time is set for which the traffic signals remain constant before checking for the volume of traffic again.
- A maximum time is set after which a constant traffic signal must change
- A maximum time is set after which a constant traffic signal must change irrespective of volume of traffic.
- Some interrupts are incorporated to handle emergency situations like an accident or failure of the system. A notification is sent whenever any emergency situation arises and it cannot be automated and normally requires human intervention.

Each crossing may have a different decision-making algorithm depending on the nature of the two intersecting roads for optimizing efficiency. The various factors like maximum and minimum time for each direction must be determined by statistical analysis and research. However, for a metropolitan city, or traffic control over large coverage area demands too much computation on the part of CCS and that too in real-time with sufficient amount of precision. Thus, running too many algorithms on a centralized system seems quite complex. If the technology becomes mature as well as rewarding, one might think of distributed databases and parallel computing to account for environment specific DMS algorithm. This is a futuristic view which assumes universally acceptable tag deployment and provision of state-wide or, nation-wide full interoperability.

RFID and GPS based Automatic Lane Clearance System for Ambulance

In developing countries like India due to congestion on roads and shortage of efficient traffic control results in to loss of lives due to ambulances getting stuck in traffic jams, where the lives of the patients are depending on the speedy arrival of the ambulances to hospital. Like western countries Indian cities cannot think of having separate lanes for emergency purpose due to shortage of road planning and infrastructure.

To overcome this problem a RFID and GPS based Automatic Lane Clearance System for Ambulance can be used. The main point of this system is to reduce the delay in arrival of the ambulance to the hospital by automatically clearing the lane in which ambulance is travelling, before it reaches the traffic signal. This can be achieved by turning the traffic signal, in the path of the ambulance, to green when the ambulance is at a certain distance from the traffic junction. The transceivers and GPS are used for communication between the ambulance and the traffic signal post.

The system consists of two units Ambulance Unit and Junction Unit. The Ambulance Unit, to be installed in the ambulance, consists of an RFID reader, GPS receiver and a transceiver interfaced with a microcontroller. The GPS receiver continuously receives the GPS co-ordinates of the ambulance by calculating its position using the timing signals from the GPS satellites. When an ambulance leaves the hospital for an emergency case, a RFID card is swiped near the RFID reader, which when authenticated activates the transmission of GPS coordinates through the transceiver.

The Junction Unit, to be installed at the traffic signal post, consists of a transceiver interfaced with a microcontroller. The GPS co-ordinates transmitted by the Ambulance Unit are received by the transceiver. Some co-ordinates of a point at a particular distance are specified in the Junction Unit's microcontroller program, which when crossed by the ambulance turns the traffic signal green.

A suitable delay is given for the signal to remain green till the ambulances passes through the junction. The distance of the point from the signal may differ according to the traffic scenario across different junction and may be programmed as per its need.

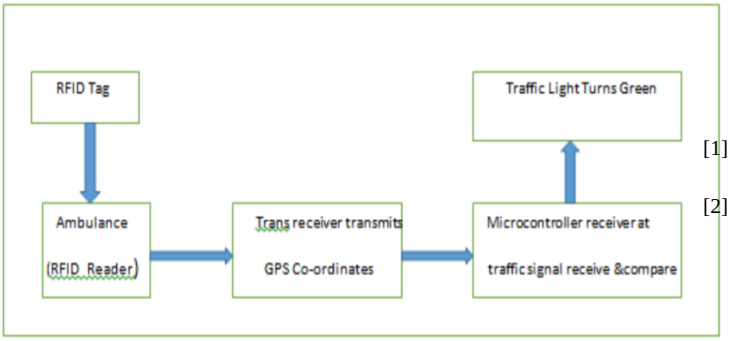

Figure 4: Block Diagram of complete system

V Conclusion

In this paper an architecture for creating intelligent systems for controlling road traffic is proposed. The system is based on simple principle of RFID tracking of vehicles, canoperate in real-time, improve traffic flow and safety, and fully automated saving costly constant human involvement. The advantages ITCS can provide were demonstrated in detail which vouches for its effectiveness in traffic management systems. However, it is a debatable issue that to monitor every vehicle is morally acceptable or, not and whether it is against one of the basic civil rights, privacy. In RFID and GPS based automatic lane clearance system for ambulance, it needs all the information about the starting point, end point of the travel. It may not work, if the ambulance needs to take another route for some reasons or if the starting point is not known in advance.

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