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Smart City Signal Management and Theft Vehicle Detection System

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ABSTRACT

The population of the world is rising tremendously. When the population increases, there is also a significant rise in the number of vehicles on the road, leading to increased traffic congestion and accidents. It is necessary to clear the traffic during heavy traffic congestion and to provide a special route to the emergency vehicle entering the road junction. To resolve this, a traffic clearance system based on RFID is being proposed which controls traffic and provides a clear path to the emergency vehicle. The proposed system is implemented experimentally using Microcontroller and LED. A signboard also shows the distance to the arrival of an emergency vehicle, which is determined using localization methods. Instead of installing GPS in every emergency vehicle, the RFID Tag is used. The use of GPS requires a clear line of sight with respect to the earthbound satellites as well as costly and power-hungry. The arrival distance of the vehicle is determined based on the signal strength obtained; Also the model finds the stolen vehicle based on the unique id of the vehicle.

Keywords : RFID , Micro controller, Traffic Light, Localization

I. INTRODUCTION

Most countries around the world face the traffic light intersection issue, which causes collisions between emergency vehicles and other public vehicles. In India specifically, the traffic control system was not fitted with the correct approach in case of emergency. This will make it difficult for emergency vehicles such as ambulances to reach the destination on time due to the congestion in traffic. In addition, the situation is getting worse when emergency vehicles have to wait for other vehicles at crossings with traffic lights to give way. It causes time delay and can impact emergency situations. Furthermore, collisions with other vehicles from other directions may occur at intersections when emergency vehicles were required to bypass the red lights. The proposed traffic light control system based on radio frequency, almost mitigate all difficulties faced by emergency vehicles. Because of question, literature review while undertaking research project is essential for related problems. The literature review will include information on current technologies and

methodologies used on this topic by other research peers around the world.

II. RELATED WORK

In order to receive the radiated signal from the vehicle approaching that intersection, an Omni-directional radio antenna and receiver is positioned at the intersection[1].In the emergency vehicle, a coded transmitter using frequency shift keying is given and, when actuated, a coded signal is transmitted to a traffic signal light supplied with a receiver. Once a verified signal has been received, the receiver causes the signal light to indicate a steady red in all directions[2].The system contains an intersection's real-time status monitor that is relayed to a control panel for transmission to emergency vehicles as well as to a central dispatch office. [3]The system also offers audio warnings at an intersection to protect pedestrians who may not be able to see visual alerts or who may not be able to hear the emergency vehicle approach for different reasons. In[4], a practical target tracking system based on the Hidden Markov Model in a distributed signal processing framework has been proposed. In [5], Sk Riyazhussain et al. Proposed a raspberry pic controlled traffic system which computes the density of the vehicles. In [6], GPS and GSM based traffic model was proposed, which find the longitude and latitude of the ambulance. The disadvantage of this this system is the delay for sending and retrieving messages sent via GSM module, therefore an effective GSM module must be incorporated.

III. METHODOLOGY

A. OBJECTIVES

Traffic congestion is a critical issue that occurs on roads that make traffic busy because of vehicle-filled roads. Traffic congestion threatens traffic flow in urban areas and smooth traffic is prevented. A growing urban area creates complex traffic problems in everyday life. The construction of the transportation management technology system that is used to control the traffic phenomenon is necessary. Traffic signal control is done in two ways, manual method of control and automatic method of control. Traffic polices available at the intersection of roads maintain the smooth flow of traffic in manual regulation. The signboard, light, and whistle were used by the traffic police to control the traffic, this is the traditional method followed for so many years. The traffic police have to use Communication devices walkie talkie and other communication devices to regulate traffic at emergency vehicle arrival and make the path for that vehicle. In automatic method, Timers and electrical sensors which are connected to the microcontroller control automatically traffic light. Each phase has a constant numeric function loaded with the timer at the junction of the traffic light. Depending on the timer settings, the traffic lights are automatically ON and OFF.

Placing GPS in a wireless node is a direct way of obtaining location information about those nodes in the Ad hoc mobile network. However it is expensive and power-hungry to install GPS on the mobile device and requires a clear line of sight for earthbound satellites. The proposed system uses RFID tags in an emergency vehicle to overcome those challenges.

B. PROBLEM STATEMENT

In existing traffic light control system uses a manual control method and automatic control method of traffic light switching by image recognition. Localization of emergency vehicles using the particle filter method is implemented for the emergency vehicle arriving at 4kms away from the traffic light placed in four-way cross junction. The localization used to display the arrival of the emergency vehicle to the public, who are all passing at the intersection of the road. Also, the traffic light switches ON to GREEN for emergency vehicles arriving at 1000 meters away from the junction and switches ON RED signal to other three ways. In order to display

the vehicle arrival and traffic light control switching, sensors are placed at two places in each path of the four-way cross, one at 1000metre and another at 4000metre away from the junction.

C.MATHEMATICS OF PARTICLE FILTERING TO LOCATE VEHICLE

Let state X_t be the location of the vehicle to be localised in a path at the time t. Focusing to estimate posterior probability distributions, $p(x_t| r_1,r_2.....r_t)$ of potential states using the received signal strength. The calculation performed recursively using particle filter

$$p(x_t| r_1,r_2.....r_t)= p(r_t|x_t)\ p(x_t|r_t...r_{t+1})$$

$$\frac{}{p(r_t|r_1....r_{t+1})} \qquad (1)$$

Considering the Markov assumption ,

$$p(x_t|x_{t-1,...}x_0,r_{t-1},...r_t)=p(x_1|x_{t-1}) \qquad (2)$$

$$p(x_t| r_1,r_2.....r_t)= p(r_t|x_t)\int p(x_1|x_{t-1)})p(x_{t-1}|r_{1,...}r_{t-1)}dr_{t-1}$$

$$\frac{}{p(r_t|r_1....r_{t+1})} \qquad (3)$$

Prediction:

$$p(x_t|r_1,....r_{t-1})=p(r_t|x_t)\int p(x_1|x_{t-1)})p(x_{t-1}|r_{1,...}r_{t-1)}dr_{t-1} \qquad (4)$$

Updation:

$$p(x_t| r_1,r_2.....r_t) = p(r_t|x_t)\ p(x_t|r_t...r_{t+1})$$

$$\frac{}{p(r_t|r_1....r_{t+1})} \qquad (5)$$

This particle filter method is regarded as a probability distribution received by samples as particles. The distribution of the received samples updated continuously as the receiving node receives location estimates from the neighbour with some readings like id and RSSI .The server node estimate the location distribution directly with their previous recorded updates.

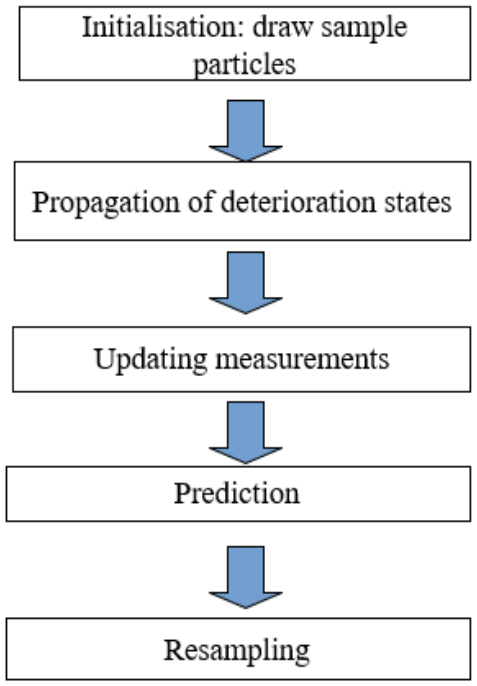


Fig. 1. Flow diagram of particle filtering

Particle Filter updates its probability distribution in two steps

- Estimation
- Correction

Step 1: The filter updates the distribution X based on a system, where the new location of the vehicle is estimated based on its previous location assuming N(0,σ)-Velocity drawn from the normal distribution with a mean 0m/s and a fixed standard deviation σ.
Step 2: When the RSSI reading m is obtained, the particle filter goes correction step, in which the measurement is used to correct the output of the system.

After each correction step, the estimated location of the vehicle is derived by finding the mode of particle distribution. The mode is determined by comparing distance from samples, the particle that is closest to all other particles is estimated location at the current time. As the vehicle is under movement, the particle filter can run continuously to keep track of location as vehicle moves.

D. Block Diagram

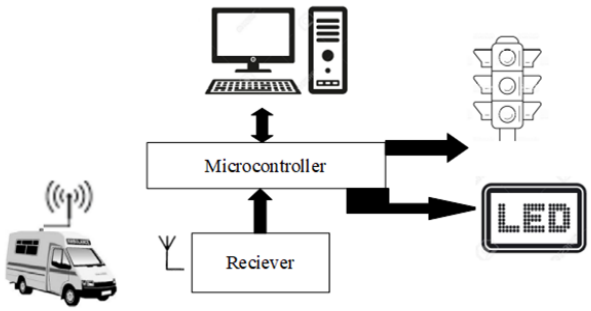
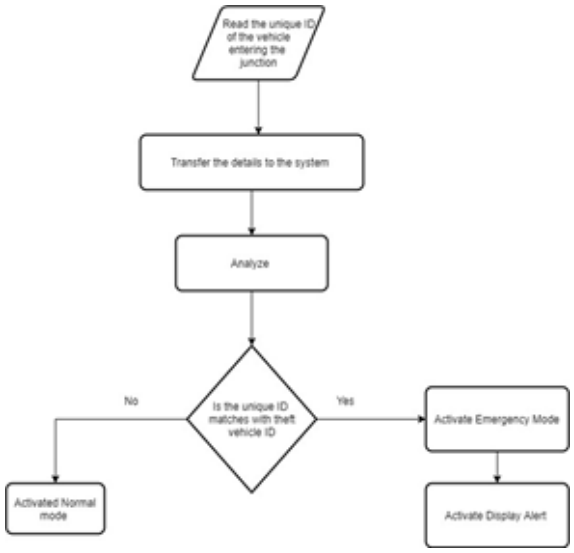


Fig. 2. Block Diagram

The RF signals sensed by the sensor placed at the 4000meters distance from traffic light are forwarded to the next neighbour sensor then forwarded to the microcontroller and server system. The server calculates the distance using the signal strength of the unique id of the emergency vehicle. The vehicle arrival information is displayed in the display board placed at the junction of the road. When the vehicle reaches 1000 meters, the received signal from the sensor is transferred to the microcontroller. It activates the switch ON the traffic light into GREEN for the emergency vehicle, and others change the mode to RED. After the pre-set duration, it turns to normal condition. Passive RFID is placed in an emergency vehicle.

D Theft Vehicle detection module

Within this section, we compare the original RFID tag read by the RFID reader to the stolen RFIDs stored on the system for testing purposes. When a match is made, the traffic signal is turned to red for 40 seconds immediately and alert message will be displayed on the display board at the junction.



IV. FEATURES OF COMPONENTS

A. Micro Controller PIC AT89C51

The standard features of the AT89C51 include 4 K Flash bytes, 128 RAM bytes, 32 I / O lines, two 16-bit parts Timer/counters, two-level interrupt architecture of five vectors, full serial duplex port, on-chip oscillator, and clock circuit. The AT89C51 also includes a static logic to operate at zero frequency, and supports two Power saving modes selectable for applications. The Idle Mode stops the CPU and enables the RAM, timer/counters, Serial port and system interrupt to running condition. The power-down mode saves the contents of the RAM, but freezes the oscillator, disabling all other chip functions until the next reset.

B. Transmitter

The passive RFID placed in the emergency vehicle acts as a transmitter It consists of three parts: antenna used for energy capture and tag ID transfer, Semiconductor chip appended to the antenna, and an encapsulation that maintains tag integrity. The encapsulation protects the chip and antenna against harsh environmental conditions. The life of the passive tag is very high and long life No need of Battery. The approximate range of a RF transmitting system is given by: dt =2Pi hT hR/ λ, where λ is

wavelength of RF signal, and hT are the heights of the emitter and hR are the heights of the receiver.

C. Receiver

The RFID Reader/receiver mounted on the pole is capable of reading an energy field of a few feet, providing the energy for any tag in the vicinity. The RF receiving pole is placed at two places in each of four path of junction.

D. Power source

The power source utilized in the system is LiPo battery which is meant to work on a secure voltage from 3V to 4.2V. The battery discharging at 3V could lead on to non-reversible performance and also harm the battery life. Overcharging the battery after 4.2V results in fire in battery and also there's an opportunity of complete battery failure by exploding. Normally LiPo battery possess higher weight-energy rate, volume-energy rate, high voltage, stay for long because of the low self-discharging rate, Long life span, charging quickly and can be used in parallel.

E. LED DISPLAY

LED display mounted at the junction indicates the distance of the arriving emergency vehicle display that uses 64 LEDs to display alphabets and numbers. A cluster of RGB diodes is driven together to form a full-colour display.

V. EXPERIMENTAL SETUP AND RESULTS

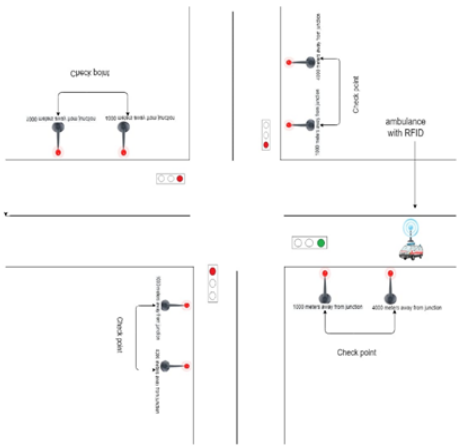


Fig. 4. Traffic Light and Sensors Deployment

Fig. 5. Traffic Light control system

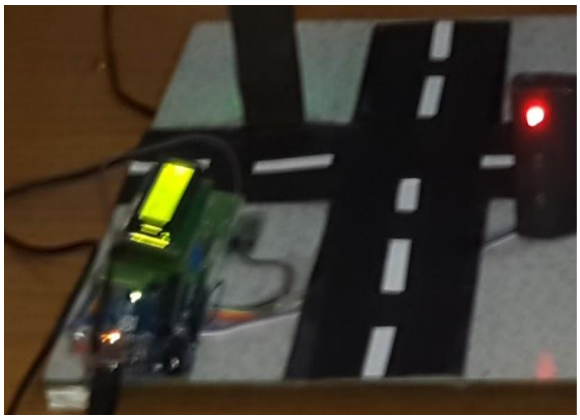


Fig.6. Green Signal ON for Emergency Vehicle

When the RF receiver at the first entry point receives the RF signal and forwards it to the control unit. The system calculates the distance of arrival concerning time and speed, the display board at the junction displays 'Vehicle is arriving at 'n' meters'. When the RF receiver received the transmitted signal from the transmitter to override the normal traffic light condition at reaching the second receiving point, the emergency mode is triggered at the vehicle's arrival. The emergency sequence mode gets started and switches the traffic light on the ambulance path to Green for 30 Seconds and switch on the red signal on the other pathways at the intersection for 30 seconds.

IV. CONCLUSION

The existing system does not aid during traffic congestion or provide a direct route for emergency vehicles. From this, we found that a Localized traffic clearance system using an embedded system offers a

solution to the problem and this can be an effective way to provide a clear path for emergency vehicles within the route and also give solution to trace out the theft vehicle. In the future, it can be enhanced to find out effective traffic route to reach the hospital for more than one emergency vehicle and also it can be enhanced with the use of image capturing of the vehicle instead of received signal strength.

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