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RFID Based Smart Traffic Management and Green Corridor for Emergency Vehicles

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Abstract: ***Transportation has become a global crisis. In the current situation, we have a huge increase in the population. This rise has increased facilities to soothe the needs of human beings. Each family has at least one vehicle, to travel to their destination. With such an increase in the vehicular count, we don't have the infrastructure to meet these rising demands. Not only the adequate infrastructure but also the right management of the vehicles is important. Such is the below-proposed system where a smart IOT based traffic management system is designed. Also, an automatic high-tech green corridor creation mechanism is proposed for the smooth movement of emergency vehicles. The resultant system,upon testing and experiments proves to be more efficient. The time taken without implementing the above system is more than the one taken using the given proposed system.***

Keywords: IoT, RFID, Traffic Management, Green Corridor, Emergency Vehicle.

I. INTRODUCTION

Digital India is an upcoming trend in recent times. To match up with these Trends, we need smart technologies. We need more automated systems to manage various aspects. One such aspect where automation is needed is traffic, which is a big issue coming in recent times. As the population is increasing, the number of vehicles is increasing so we need smart systems that can handle traffic efficiently.

A. Overview

Traffic management has become a worldwide issue, with the increase in population. People often prefer at least two vehicles per family, thus increasing the amount of vehicular count on the road. To manage such an increase, the manual system of traffic management is becoming weak. Hence, we propose the below system for efficient and smart management of traffic management.
In the proposed system, we have tried to use the Digitalization parameter at its best. We have made use of images captured through cameras fitted at the signal junction. Further capturing the images, we have used LBP, HOG, and SVM to find the density of traffic at that junction. The green signal is managed as per the density. For green corridor purposes, we have used the GSM module and linked it with the traffic system. This will create a route for the emergency vehicle and the RFID fit on the vehicle will recognize it and control the signal

1) An increase in population has given a drastic increase in transportation.
2) This has also increased the cost of accommodation near the companies.
3) We have a large number of vehicles accommodating over limited roads and infrastructure.
4) To deal with this, most cities have just widened the road.
However, the need for the hour is-

"SMART STREETS INSTEAD OF BIGGER STREETS"

II. LITERATURE SURVEY

Sheena et.al used a combination of techniques like inductive loops, ultrasonic sensors, video/image processing techniques, IR sensors, and a fuzzy logic system to calculate the density of the traffic at the signal junction. The disadvantage is that sensors might damage and will result in less accurate results. [1] Sabeen Javaid et.al had governed the traffic by using cameras and sensors. They have also made use of RFID tags for density calculation. The problem was that the sensors weren't giving accuracy.[2]A. Chattaraj et.al have made use of Ultrasonic sensors. These sensors have limited testing distance and inflexible scanning methods.[3]A. Chattaraj et.al made use of RFID tags for calculating density and guiding traffic. The system is not able to make a green corridor for emergency vehicles.[4] Priyanka Nalawade et.al has used RFID as a source to manipulate the green signal using a microcontroller.

They have used special RFIDs for emergency vehicles, which when detected makes the signal green thus allowing the vehicle to pass. But they have not made any provisions for the traffic between two traffic signals.[5]Tejas Naik et.al have used RFID for density calculation. They have also included additional points wherein they send RFID information to the server for future use. If an emergency vehicle is detected, the signal changes to green and an emergency message is displayed. Again, we do not see any passage for the emergency vehicle. [6] Biru Rajak et.al have used RFID to make green corridors for emergency vehicles. Also, they have used the GSM module wherein the route from source to destination is -sent to emergency vehicles and the same is sent to the traffic server, who in turn makes all the signals in that route green. Once a vehicle with a particular RFID (emergency vehicle) passes the signal, it starts resuming its normal operations. This system is efficient, and we have made our system somewhere based on their implementation with some additional features like density calculations and displaying using screens.[7]Devashish Prasad et.al have used MUL Junction 2 videos to create data sets and applied Local Binary Patterns (LBP), Histogram of Oriented Gradients (HOG), and Support Vector Machine (SVM) based approach for traffic density estimation. They calculated the density of traffic and using this result we can adjust the (timer) of the signal accurately.[8] Rashid et.al has used TSI (Time Spatial Image) for density calculation. They did a detection and classification method that shows an analysis of TSI obtained from frames of a video. They have classified the vehicle into different classes and the method used is a bit time-consuming.[9]Guohui Zhang et.al have used video-based vehicle detection for reliable traffic management. They have developed vehicle detection techniques where they can collect data from trucks. In our system, we need to classify multiple vehicles, not only trucks, and they have used C#, which is not very comfortable for many people.[10]

Table I
Literature Survey

Sr. No.	Paper Name	Research
1	Smart Traffic Management System with Real-Time Analysis (2019)	We have implemented a density calculation mechanism for the same purpose
2	Smart Traffic Management System Using the Internet of Things (2018)	The sensors weren't giving accuracy.
3	Density-Based Smart Traffic System with Real-Time Data Analysis Using IoT (2018)	These sensors have limited testing distance and inflexible scanning methods
4	An intelligent traffic control system using RFID (2014)	The system isn't able to make a green corridor for emergency vehicles.
5	Dynamic Traffic Control System using RFID Technology A Systematic Review (2017)	The system isn't able to make a green corridor for emergency vehicles
6	RFID-Based Smart Traffic Control Framework (2018)	The system isn't able to make a green corridor for emergency vehicles
7	An Efficient Emergency Vehicle Clearance Mechanism for Smart Cities (2019)	We have created this system as our base and also included additional parameters
8	HOG, LBP and SVM based Traffic Density Estimation at Intersection (2019)	Using the results, we can adjust the timer of the signal accurately.

III. IMPLEMENTATION

A. Objectives

The basic objectives of this system are to provide an optimized, efficient, less time-consuming system for traffic management. Also, the green corridor for emergency vehicles reduces its time to reach the destination. With smart traffic implementation, the manual work of the police officers will be reduced to a larger extent, thus moving towards a 'Digital Age'.

1) Traffic signals are operated as per volume.
2) Different priorities can be given to vehicles-Special priority to emergency…..etc.
3) Saves time of travel against the previous system of manual control.

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B. Proposed Idea

This project has 3 basic modules-

1) Density calculation using HOG, LBP, and SVM
2) Green corridor for emergency vehicles
3) Displaying 'E' on the LED counter screen when an emergency vehicle is arriving
a) The fig 1 shows the High level design of the system.
b) The Camera captures the video and sends it for classification
c) The arduino sets the timer as per density calculated
d) When a Emergency vehicle sets the route from Source to Destination, the signals on that route are set to Green
e) If the RFID reader reads the type of vehicle as "Emergency", then the signal resumes normal operation.

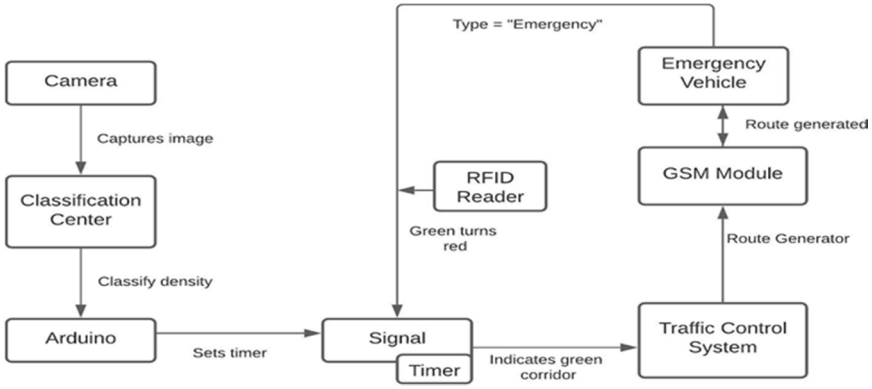

Fig. 1 High Level Design

C. Algorithm

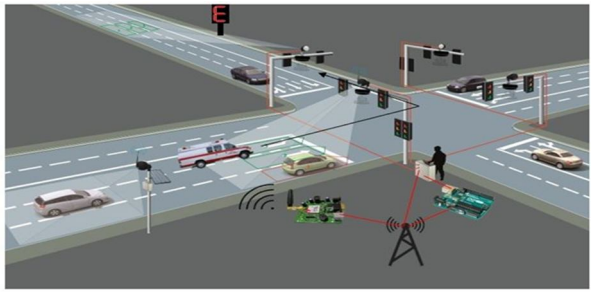

Fig. 2 System Architecture

1) Traffic Signal with Timer

a) For the given module, we have used the Raspberry Pi microcontroller. There is a signal-like implementation with a timer for each signal colour.
b) We have used 3 LED bulbs for showing 3 colours Green, Red, Yellow and a seven-segment display for showing the timer.
c) We have connected the GND of all 3 LEDs to pin 6 of GPIO of the raspberry pi. Positive pins of Red, Yellow, Green LEDs are connected to 8, 10, 12 pins of GPIO respectively.
d) Pinout for 7 segment display is:

- PIN1 or e ---------- GPIO21
- PIN2 or d ---------- GPIO20
- PIN4 or c ---------- GPIO16
- PIN5 or h ---------- GPIO 12
- PIN6 or b ---------- GPIO6
- PIN7 or a ---------- GPIO13
- PIN9 or f ---------- GPIO19
- PIN10 or g ---------- GPIO26
- PIN3 or PIN8 ---------- connected to Ground

e) Now we have imported the libraries required for the implementation i.e. RPi.GPIO. We have set raspberry pi in the board mode and then we set all the pins as OUT pins as we are going to show output to the user.
f) We will set pins HIGH or LOW as per sequence and set numbers on a 7-seg display using hex numbers.

D. RFID Implementation
1) We have connected an RC522 RFID reader to an Arduino and the Arduino is connected to the raspberry pi using a serial port.
2) We will take input from an Arduino and send that bits to the raspberry pi.
3) The RFID reader will read the RFID card and will pass that to the raspberry pi.
4) Initially, when a traffic signal system receives a request and path from an emergency vehicle, it will set all the signals on that path to green and will show "E" on display.
5) If RFID reads the card as an emergency vehicle, it will resume the signal's working to normal i.e it will turn off the green signal and turn on a red signal.
6) If RFID reads the card as a non-emergency vehicle, it will continue showing a green signal until an emergency vehicle comes.

E. Density Calculation
1) Initially, when the traffic signal is red. When the camera captures an image of vehicles at the traffic signal.
2) Then, we select the region of interest (ROI) for that image and divide that ROI into the grid with cells to identify whether the portion contains traffic or not.
3) Then using LBP (Local Binary Pattern) and HOG (Histogram of Oriented Gradients), we will extract features from that image and using those features, we will give input to the trained SVM model to classify into traffic or not.
4) We have trained that model using a QMUL dataset. According to the output of the model, we set a timer of signals of that intersection. This is the normal operation for each signal.
5) It will show a red box where we are getting output as traffic and a green box where output is not traffic.
6) We will set the density for the signal using the approx count of the red box and according to that number we set the time on a timer for the green signal of that particular lane.

II. RESULT AND ANALYSIS

We have made various observations based on the code and its outputs. Some are regarding the density and some are based on the time taken for travelling between two destinations. All the values are made based on certain experiments and assumptions.
Fig. 3 Depicts the Density days graph. It has the density values on the Y-axis and days of the week on the X-axis.This graph shows that the density of traffic at an intersection is lesser on Sunday and increases on working days. Also the density is at its peak level on saturday. The reason for such output is that we see the majority of people travelling for work from Monday to Saturday due to office hours. Also on saturday, some have holidays and hence go out to enjoy their free time. Whereas on Sunday people tend to stay at home and relax.

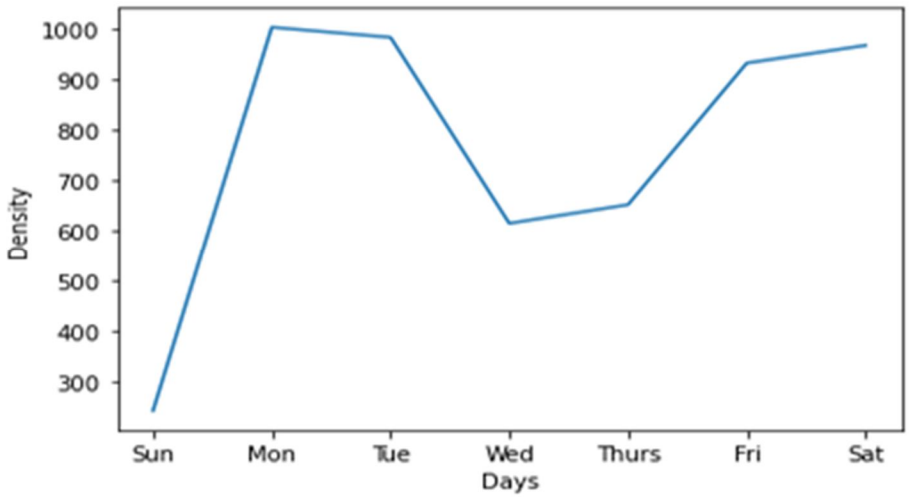

Fig. 3 Density-Day Graph

The fig. 4 depicts the Density Hour graph. It has Density on the Y-axis and hours of the day on X-axis.The graph shows that in the morning we see lesser density of vehicles. The traffic density increases as the hours of the day go ahead. It peaks around the evening time and decreases as we reach the end of the day.

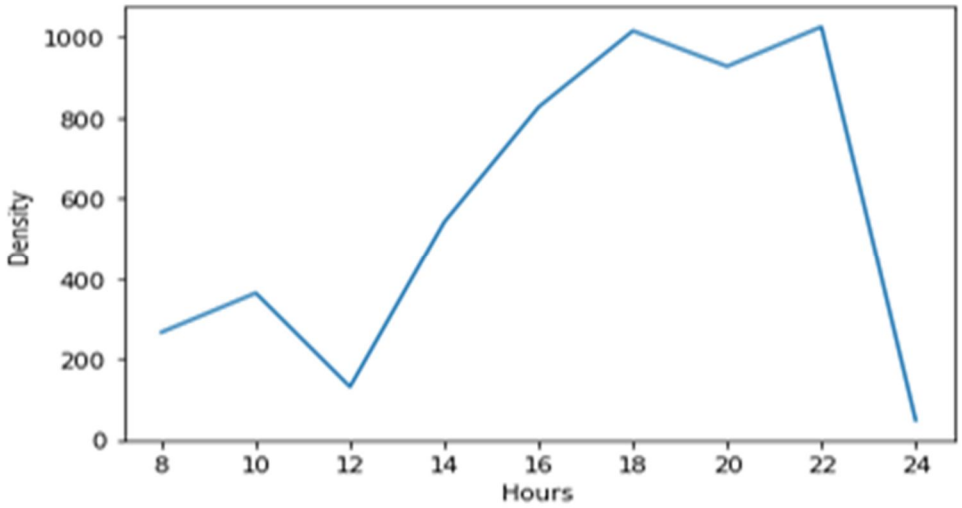

Fig. 4 Density-Hour Graph

III. FUTURE ENHANCEMENT

Some other features that can be incorporated into the system are as follows:

A. If one of the readers in any path fails, the system can still work. In such cases, when the other reader in that path tracks a vehicle, the CDPS checks whether it has just crossed the readers in another path converging at the crossing or not.

B. The two readers in each path are placed on opposite sides. If any road needs to be broadened or any other maintenance work needs to be done, then one of the readers can be temporarily removed and the system made to work on a single reader in that road.

C. If the tags are mass-produced and employed on a large scale, the initial setup cost would come down. However, this would in turn demand more constrained and general-purpose tag design. The tags should be durable, impact-resistant, waterproof as well as the internal batteries (for active tags) should have at least a lifespan of 10 years or more. Advanced security techniques are to be developed to detect intentional tag removal or, to ensure the tag's authenticity in case of tag cloning, spoofing, copying, duplicating, vandalism, etc.

IV. CONCLUSION

The traffic scenario in the country is getting worse day by day. With digitization and automated systems coming into use, the proposed system is beneficial for use. It provides optimized and efficient outcomes when deployed. The green corridor method will surely reduce the time needed for the emergency vehicle to reach its destination

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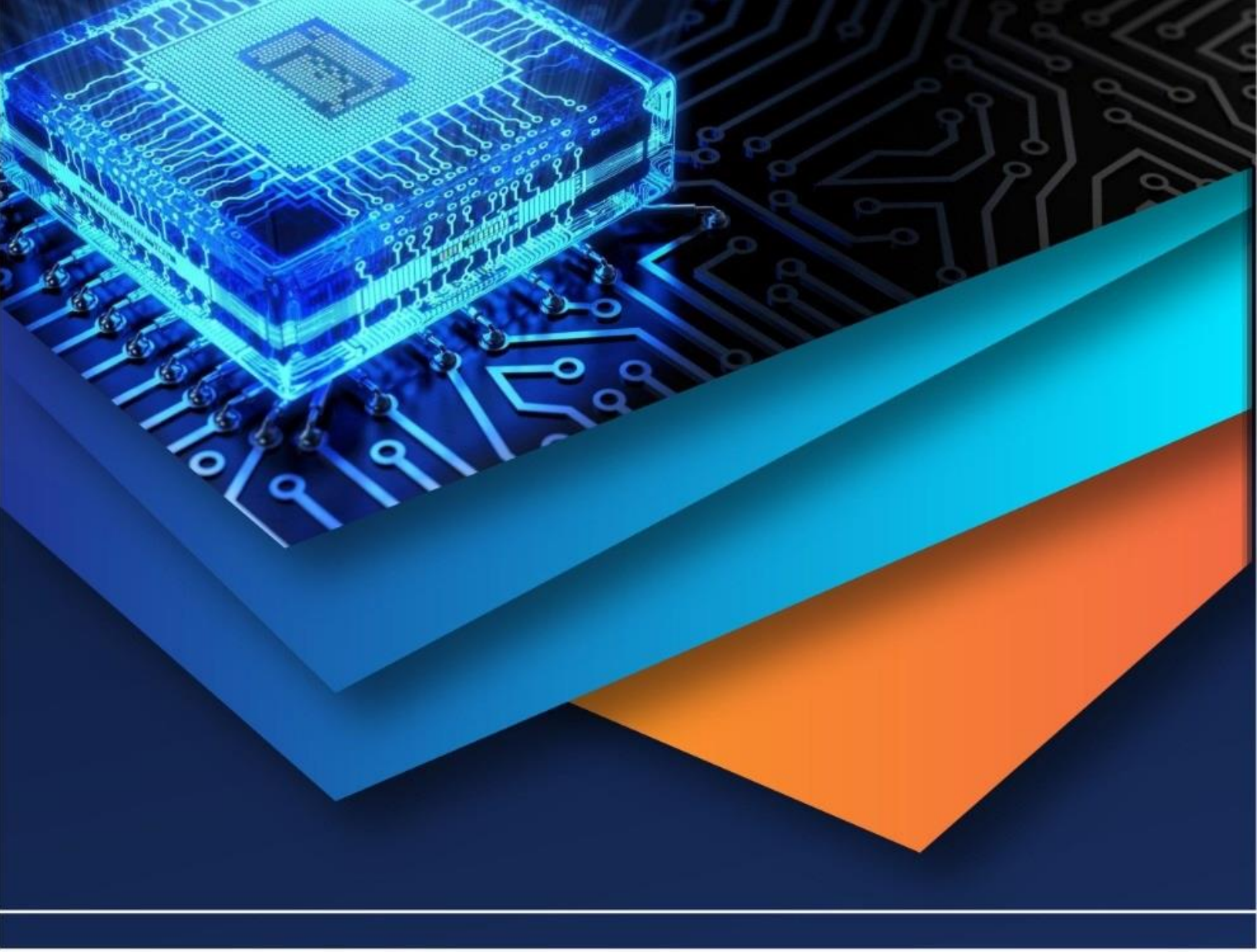

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