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Smart System for Real Time Traffic Monitoring and Congestion Avoidance

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ABSTRACT

One of the most important problem which is being faced by the modern world is that the traffic congestion in the cities and towns. The traffic congestion occurs due to many reasons. Road infrastructure plays a very important role and its modification is limited to some extend.so only the intelligent method adoption for the traffic system is feasible. Here in this paper we are using simple and cheap setup for real time traffic monitoring and congestion avoidance at a time and it provides real time information to drivers. For the efficiency and consistency the Open CV coding is used.

I. INTRODUCTION

At present the traffic monitoring and its analysis plays an very important role in the advanced research field. The number on vehicle is increasing hourly bases nowadays. The ratio of vehicle to human being is almost getting close. So the present traffic monitoring and congestion avoidance system which is being used presently is not sufficient. For the traffic congestion avoidance system the pre knowledge of the traffic is important. The pre knowledge includes the traffic density, peak traffic hours, types of vehicles. The traffic congestion have a big role in environmental issues the contribution of it is very high. The main important is the carbon monoxide emission which has so many adverse effects on environment and on living organisms. Inhaling of these gases can cause lung cancer .so this gives additional importance to traffic monitoring and congestion avoidance[1].

Other traffic data like vehicle speed, vehicle type and vehicle number identification are the recent important research and advancement required fields of traffic monitoring and safety . Day by day the number of vehicles on the road is increasing and as a result this results in more environmental problem such as pollution, noise and health issue. Other important problem is traffic congestion and safety. As the number of vehicles are increasing it is possible to develop the existing roads and infrastructure but for that there is a limit beyond that limit it is not possible. So it plays an important role for engineering technology to overcome the scenario. By adopting latest technologies for vehicle management on roads helps to solve the problem to some extents . Mainly the problems caused by vehicles can be defined as hard type and soft type. The hard type problem includes traffic congestion and difficulty in roadway pavement use. The soft type includes the environmental issues caused by traffic and increased vehicle number. The air pollution and noise pollution comes under this. Which cause health and wellbeing of living things and non-living things.

II. SYSTEM OVERVIEW

In this system we are using Raspberry Pi board and other external components such as HD camera and Zigbee module for the setting up of traffic monitoring and congestion avoidance system . Raspberry Pi

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single board computer is used over other single board computers like OLinu Xino , Galileo, Panda Board, Odroid and others also capable of designing low cost system for traffic monitoring .but we are using Raspberry Pi board for developing traffic monitoring system because of its key features like easy and handling of powerful HD camera, good performance to power consumption ratio at reasonable cost.

The HD camera which is connected to the Raspber ry Pi captures the real time videos of traffic and it is used for traffic monitoring and congestion avoidance. The main importance in designing real time traffic monitoring and congestion avoidance system are [2]

- low cost of components
- low power consumption
- reliability
- low maintenance .

The main features of Raspberry Pi single board computer are

- ARM1176JZF-S core CPU
- Broadcom Video Core IV GPU
- 512MB
- 5Mpix Camera module capable of full HD video @ 30 fps
- Slots like USB,GPIO,UART,12C and SPI bus
- Power rating is 700Ma

The processing of high –definition video streams in real time application is an important challenging task with computationally demanding algorithms so it is necessary to perform as much as possible image processing on the GPU. The modern GPUs are very efficient in computer graphics and its highly parallel structure makes them more effective than general purpose CPUs for algorithms in which processing of large blocks of data is carried in parallel.

III. EXPERIMENTS AND METHODOLOGY

2.1. Design for proposed work

- Raspberry Pi single board computer is connected to the Road-side unit
- This unit is mounded with a HD camera for capturing real time video.
- For wireless communication ZIGBEE module is connected to it.

2.2. Software module used

- Python is used
- OpenCV library files are used
- For the wireless communication the ZIGBEE protocol is used

2.3. Methodology

- Real time video is captured using HD camera attached to Raspberry Pi single board computer system
- Traffic is monitored using this real time video captured
- Using the real time video captured the image acquisition on snapshot is done
- For better result and clarity of image the image enhancement is done

- Checking for image matching using edge detection
- By using the help of communication network a preknowledge about the traffic jams can be provided [3].

2.4. Procedure

In this there are mainly two phases for design and development of the proposed system. The Phase I gives idea and analysis about road . Whereas Phase II deals with the communication and transmission of the message regarding the present condition of the road to the adjacent road-side unit.

Phase I unit block diagram:

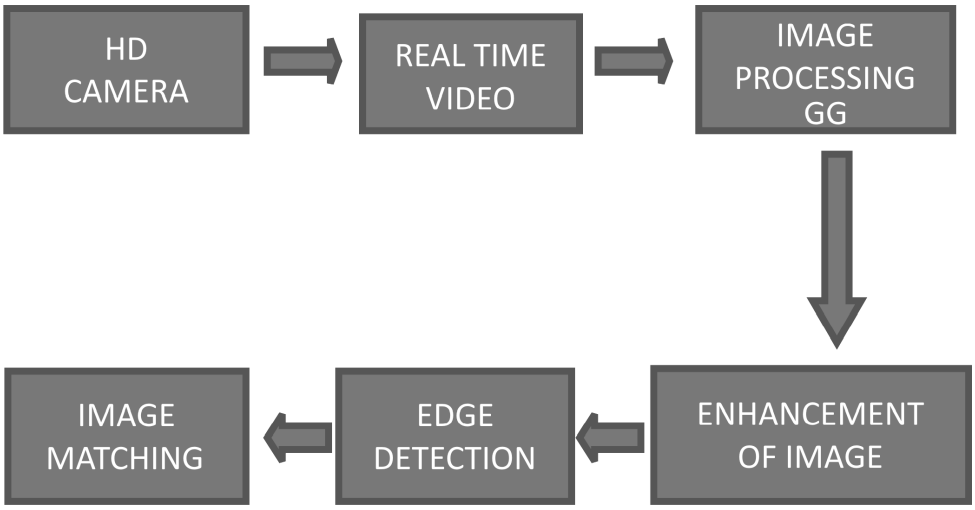

Figure 1: Video Processing Block Diagram

Phase I: Firstly the image of the road is being captured, when there is no traffic or less traffic on the road. This captured image is kept as reference image at a particular location where the system is installed. Then the real time video is captured using HD camera, from that image is obtained using snapshot. Then enhancement of image is done.

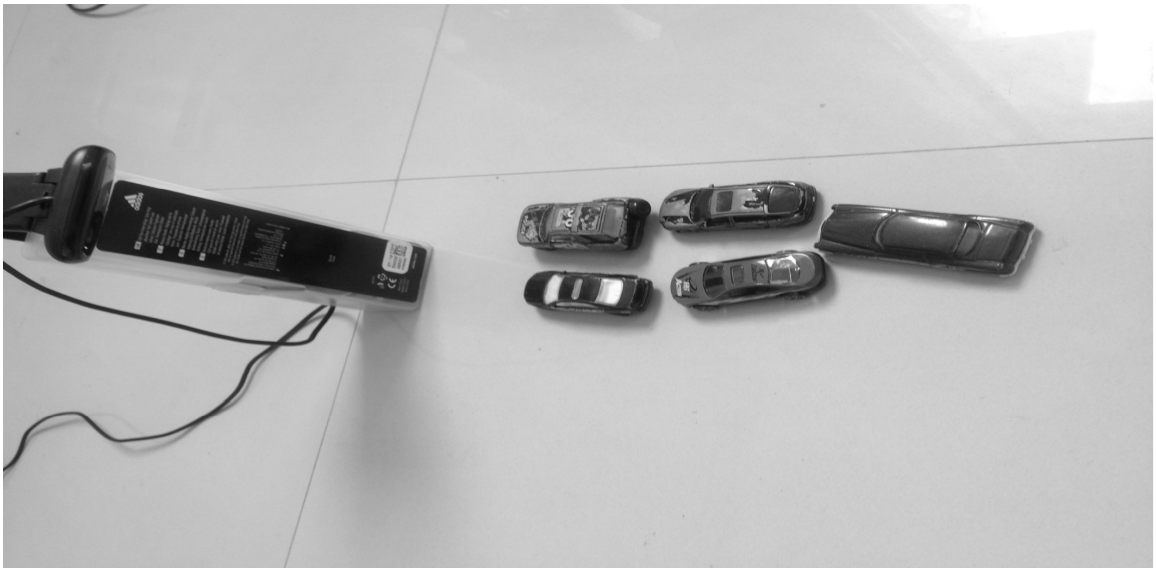

Figure 2: Camera Unit

The objective of enhancement of image is to process the image to make it more suitable for the specific application than the original image

The algorithm used for the enhancement of the image is 'Gamma Correction' the power law transformation is used in this method to enhance the image. The power law transformation have the general form as below

$$S = cr^{d}$$

Where 'S' denote the output gray level image, 'r' denotes the input gray level , 'c' and 'd' are the constants (positive).

After the image enhancement the next process is edge detection .The edge detection methods locate the pixels in the image that corresponds to the changes in the gray scale edges of the object seen in image. Common algorithms used are Prewitt, Sobel, Canny and Laplacian Operators.

Here we are using the canny edge detection algorithm for edge detection. In this method it finds edges by looking for local maxima of the gradient of image[4].

The complete set up is shown below:

Figure 3: Full System Overview

Image matching is done after the edge detection . It is the process in which two representative edges of the same objects are paired together then any edge on one image is compared and is evaluated against all the edges of other image. This is done by using Canny operator. So by using this the congestion can be avoided by giving a pre knowledge for drivers about traffic density and routing the vehicles accordingly.

PHASE II: To communicate with the adjacent road-side unit the Zigbee module is used . The Zigbee module is used since it provide the wireless communication . We are using Zigbee because it provides a complete network where all the devices are able to communicate and also it can be controlled by a single unit.

The block diagram of phase 2 is shown below:

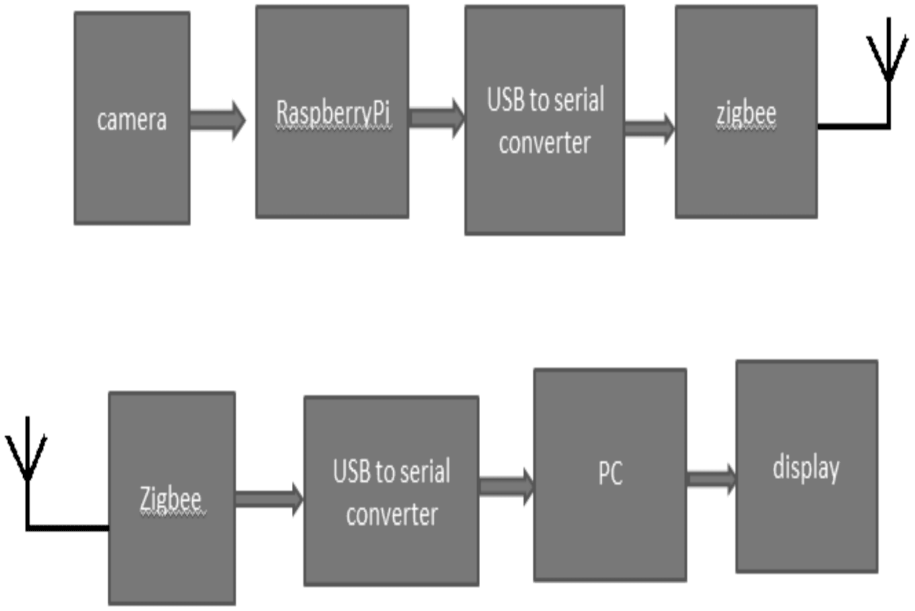

Figure 4: Communication Block Overview

CHARACTERISTICS OF ZIGBEE

- Low power usage4
- It provides maximum data rates allowed for each of these frequency bands are fixed as 250kbps @ 2.4GHz
- Master slave topology
- It is having automatic network configuration
- It have dynamic slave device addressing
- Provides virtual peer-to-peer links
- Have full handshaking for packet transfers
- Can have up to 254(+master) network nodes

Zigbee is an IEEE 802.15.4-based speciûcation for a suite of high level communication protocols used to create personal area networks with small, low-power digital radios. The technology deûned by the Zigbee speciûcation is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or Wi-Fi. Applications include wireless light switches, electrical meters with in-home-displays, trafûc management systems, and other consumer and industrial equipment that require short-range low-rate wireless data transfer. Its low power consumption limits transmission distances to10–100meters line-of-sight, depending on power output and environmental characteristics. Zigbee devices can transmit data over long distances by passing data through a mesh network of intermediate devices to reach more distant ones. Zigbee is typically used in low data rate applications that require long battery life and secure networking (Zigbee networks are secured by128 bit symmetric encryption keys.) Zigbee has a deûned rate of 250kbit/s, Best suited for intermittent data transmissions from a sensor or input device[5].

In the phase II, the result of phase 1 is used to process. After the edge detection the contour number is calculated. The contour is the closed area which is being identified by the edge detection of the image. So this contour number gives the information about the number of vehicles present currently. Thus we get the density of the vehicle present on real time bases. And finally the number of vehicle present is used to calculate the congestion. The threshold is set to calculate the congestion .When the number of the vehicles in real time image snapshot is greater than the defined threshold then the information is passed to the next road-side unit, that the traffic jam is there ahead and it displays in the next junction the real time traffic

condition of respective ahead junction .Hence it advices the drivers to take the alternative route to avoid congestion.

Final output figure is shown below

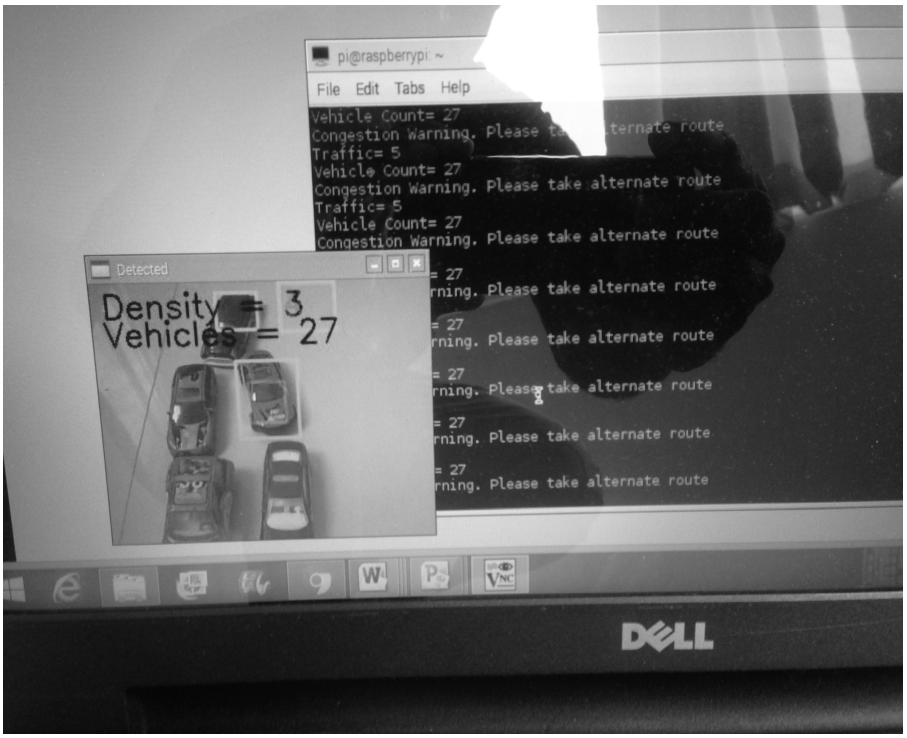

Figure 5: Visualization of Final Result

CONCLUSION

An approach for the real time traffic monitoring using wireless and congestion avoidance based on Raspberry Pi single board computer using python and Open CV was proposed in this paper. The image processing analysis and wireless communication were proposed with the focus on low power consumption and reliability of the system. This is still far from the final version of the traffic monitoring and congestion avoidance system and there is much more to improve. In future we plan to perform further experiments including speed evaluation, driver identification for security and system for night and all weather conditions.

ACKNOWLEDGEMENT

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