An Efficient Approach for Traffic Monitoring System Using Image Processing

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Abstract. Traffic congestion has become a major problem in the world wide. So we need efficient system which monitors the traffic and updates the time setting in traffic signal. The cameras installed in the road junction will be used to capture the real time traffic and these images will be processed to count the number of vehicles in each lane. MATLAB Platform is used where it develops the various object detection algorithms for the combination of many image processing algorithms. The real time object detection and tracking will be generated by control signals where Arduino programming will provide an interfacing hardware prototype. The centroid value will be calculated in each lane. Based on the centroid values obtained from the system, the signals will be sent for the traffic pole as the output.

Keywords: Zigbee communication · Arduino · MATLAB

1 Introduction

The increase in population in the world has created increase in number of vehicles in day today life, which leads to the traffic congestion problem that occurs in different countries. Due to traffic congestion people are not able to reach their destination on time and it also makes people to wait for longer time. Because of traffic, people are violating the traffic rules and also we can come across some accidents that happen due to the traffic. Traffic congestion also harms the environment by creating pollution which would also influence the health of the people. To overcome traffic congestion problem, one of the method that is proposed is RFID-based on smart traffic control context for emergency vehicles [1]. Based on RFID technology it controls and manages the traffic signal at the junction and make an easy way for an emergency vehicle to travel from the traffic jam. RFID technology helps in computing the density of vehicle to control the traffic.

In common traffic jam is associated with many more problems like mismanagement of traffic signals which leads to the loss of time, loss of fuel as well as loss of money. People nowadays are very busy, so that they don't want to waste the time. It is very necessary to develop fast, economical and efficient traffic monitoring system. To avoid such problems there are a many techniques available. But no technique is perfect as the

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real time situations keeps on changing. But we have made an attempt to reduce the traffic congestion problem by monitoring the traffic signal with the help of image processing technique, where the camera is present at the centre of the four lanes and capture the images of the vehicles.

The images which are captured are sent to the MATLAB, where the images are processed and centroid values are calculated. If the centroid value is more, then for that particular lane green signal is provided with the help of Arduino. The information from the MATLAB is transferred to Arduino through Zigbee communication link. Thus the traffic signal is change accordingly. The cycles are repeated after every thirty seconds which is the pause time that has been provided. In general, when the count of vehicles in one particular lane is more, traffic monitoring technique will help in resolving the traffic problem.

2 Literature Survey

In 2018, Mousa et al. [2], Lah et al. [6] proposed a system where the possible solution includes an IoT Cloud system for traffic monitoring and quick warning. Geo-location and speed data are collected by a GSM/GPRS/GPS TK103 tracker based on the system installed in vehicles and the data is sent through OpenGTS servers which are stored in a SQL database, presenting instantly OpenStreetMap visualization of traffic outline. The disadvantage is that it fails to plan to inspect the impression of the reliability in system which not used in future.

In 2018 Celesti et al. [3], Nagmode and Rajbhoj [5] proposed a system where the implementation is done which senses the existence of such gases and uploads the data to the website and sends the information to the concerned people. The next part of this work is vehicle monitoring unit, which can be static in vehicles. The system will track the location of the vehicle, detect the accidents that cause to the vehicle, monitors its engine temperature and presence of poisonous gases. This system also contains the feature where it locates the vehicle and avoid it from moving till the message is sent by the owner. The further part of the system is that vehicle which do signal jumping are detected and punished. This system is used in the countries where the traffic is more violated. The drawback of this system is that it is not used for future.

Recently in 2017, Soleh et al. [4], Nagmode and Rajbhoj [7] proposed a system where vehicle traffic flow is monitored by vehicle detection, tracking, counting. Here the vehicle detection is done by background detection algorithm and morphology operation. The detected vehicle is tracked by adaptive measurements. The vehicles are counted by the counting lines when the vehicles pass after it. This system efficiently counts the vehicle by adaptive tracking; yet it is recommended to use the method which combines the calculation with distribution state estimation method like kalman filter.

Recently in 2017, Ye et al. [8], Dubey and Rane [9], Talukder et al. [10] proposed a system in which real time vehicle traffic is monitored by using IOT including Sensing Technology. In real time application ultrasonic sensor are used to distinguish the traffic at different tracks. Then the managed and identified data is moved to server through WIFI. However the disadvantage of the system is, it makes use of sensors which need to be placed on each lane of road.

In 2016, Gao et al. [11], Tian et al. [12] planned a system where innovative method is used to detect the traffic thickness and user attention jointly which uses the wireless private communication system which is real and consistent. The proposed method will detect the records and estimate the traffic data using the real time and ancient traffic data. But the system is designed for the prediction of traffic not for proficiently monitoring a traffic.

In the literature to summarize the traffic congestion is controlled by various methods using sensors like ultrasonic sensor which is used to detect the vehicle traffic level. The existing systems also make use of RFID, camera, Vehicle Ad-hoc Network, Image processing algorithm, such as Haar-cascade and Background subtraction and also make use of traffic dataset. But the existing system is not so efficient in solving the traffic congestion problem. In order to overcome, the proposed framework an image processing technique is used to monitor the traffic which would not led in traffic congestion.

3 Methodology

Figure 1 portrays the detailed diagram of the proposed framework.

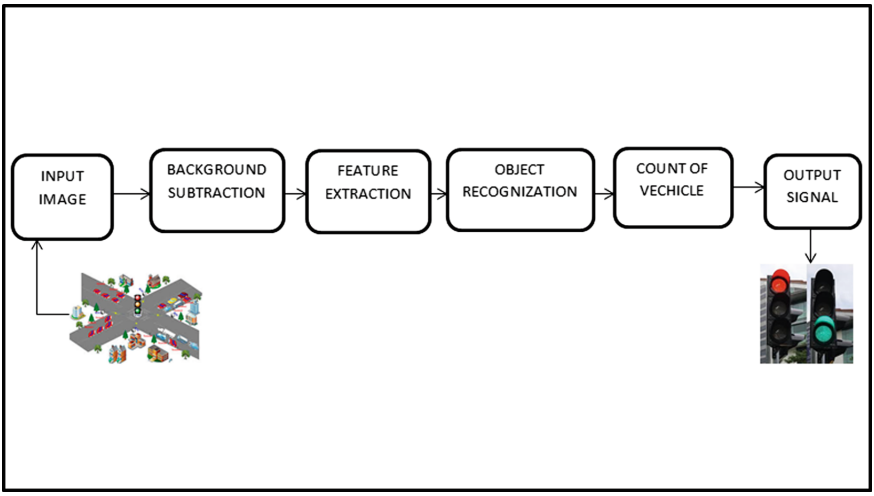

Fig. 1. Block Diagram

The proposed system consists of following stages:

Stage 1: The images are captured from the camera which is located at the centre of the traffic lane and the captured images are processed.
Stage 2: The background subtraction method take place where the objects are tracked and the foreground elements are extracted from background models.

Stage 3: The feature extraction. Where the images are extracted as given input so that the extracted images can be used as the relevant data.
Stage 4: The object recognition is done. The vehicles present in the traffic lane are recognized and density is calculated.
Stage 5: Counting the number of vehicles present in the particular lane. Each traffic lane vehicles are counted and estimated.
Stage 6: When once counting of vehicles is done then the centroid value of each lane is estimated. If the centroid value is more than the particular lane consist of high centroid value that traffic signal is made green. Thus the signals are outputted to traffic lane.

4 Experimental Setup

Figure 2 appearances the several segments of the proposed system which embraces Arduino Uno microcontroller, Zigbee segment, LED lights and power supply. These segments are unified for proficient traffic control. The results of the processed images are transmitted to Zigbee module. Arduino Uno accepts the data since the Zigbee segment. According to the data received by the Arduino Uno the traffic signal are given.

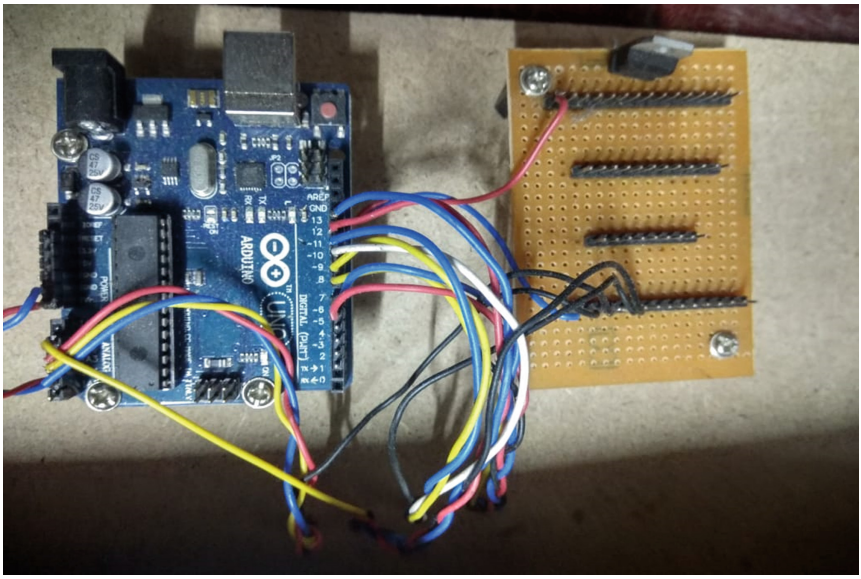

Fig. 2. The Hardware experimental arrangement

Figure 3 demonstrate the experimental arrangement of the proposed framework. Small toy cars are used to pretend a traffic consequence on the traffic junction.

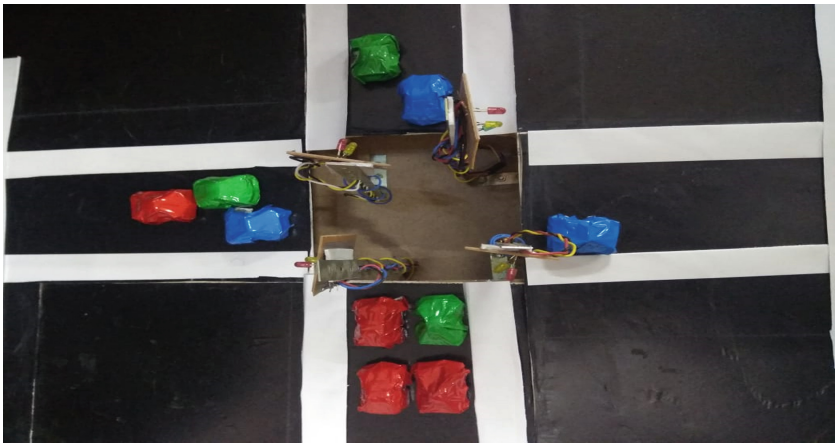

Fig. 3. The implementation of vehicle traffic monitoring system

Video recording of each lane is done by the camera which is installed in the traffic junction. Images are captured from the video for every 5 s. The captured images are processed and the objects are identified. The total vehicle count in each of the four lanes is calculated. The calculated count of the vehicle is transmitted to Arduino Uno through Zigbee module. The Control signal is sent for the traffic light by Arduino. So the green signal is activated to the lane with maximum vehicles.

5 Results and Discussion

The Table 1 shows the number of vehicles present in the lane_1, lane_2, lane_3 and lane_4. The first row in the table shows that lane_1 has more number of vehicles present than other lanes, so the lane_1 will be provided with green signal and rest other lanes are provided with red light. In second row, lane_1 has more number of vehicles so the green signal will be updated and other lanes are provided with red signal. The third rows represents that lane_2 has got more number of vehicles so green signal is updated to lane_2 and rest lanes are updated with red signal. The fourth row represents that lane_5 and lane_4 will be having same number of vehicles and lane_2 and lane_4 are having 0 numbers of vehicles. Now the preference given to the lane that is calculated first, so lane_1 will be provided with green signal rest lanes are provided with red signal.In the fifth row the lane_4 has more number of vehicles compare other lanes so the lane_3 will be provided with green signal and rest lanes are provided with red signal. To avoid the accidents in real time we introduced a minimum of 5 s delay between switching the lights from green to yellow then red. In this way the vehicles are calculated in the lanes and based on the more number of vehicles present in the lanes the green signal will be updated to the lane.

Table 1. Represents testcases with number of vehicles in the traffic junction.

Test case	Lane_1	Lane_2	Lane_3	Lane_4	Green signal
1	5	4	3	2	Lane_1
2	4	3	3	1	Lane_1
3	1	5	4	3	Lane_2
4	5	0	0	5	Lane_1
5	2	3	4	1	Lane_3

The results are processed in the MATLAB by calculating the centroid values of the object in the images. These calculated values are sent to Arduino using Zigbee wireless connection. The traffic signals are altered according to the results received by the Arduino. The lane with highest vehicle density gets the green signal.

6 Conclusion

To address the difficulties in Traffic management, an efficient traffic monitoring system is introduced, which monitors the traffic in real time. The snapshots will be processed to extract the details of the vehicle density at intersection of each side and the time slots for the traffic signal will be computed. As the development is object-driven, the system has a scope for modification. In future, if anyone wants to build a complex system for handling complicated roads, they can easily develop complex systems over our proposed system or use our system as a module in it. Experimental results show that this system has good performance and robustness, which can satisfy the need of time monitoring. Certain intelligent traffic monitoring system successfully implemented on some particular region will not be successful on some other regions.

References

1. Naik, T., Roopalakshmi, R., Ravi, N.D., Jain, P., Sowmya, B.H.: RFID-based smart traffic control framework for emergency vehicles. In: 2nd International Conference on Inventive Communication and Computational Technologies (ICICCT 2018) (2018)
2. Mousa, M., Abdulaal, M., Boyles, S., Claudel, C.: Wireless sensor network-based urban traffic monitoring using inertial reference data. IEEE. 978-1-4799-8856-3/15 $31.00 © 2015
3. Celesti, A., Galletta, A., Carnevale, L., Fazio, M., Lay-Ekuakille, A., Villari, M.: An IoT cloud system for traffic monitoring and vehicular accidents prevention based on mobile sensor data processing. IEEE Sens. J. **18**(12), 4795–4802 (2018)
4. Soleh, M., Jati, G., Sasongko, A.T., Jatmiko, W., Hilman, M.H.: A real time vehicle counts based on adaptive tracking approach for highway video. IEEE. 978-1-5386-2038-0/17/ $31.00 c 2017
5. Nagmode, V.S., Rajbhoj, S.M.: An IoT platform for vehicle traffic monitoring system and controlling system based on priority. In: 3rd International Conference on Computing, Communication, Control and Automation (ICCUBEA) (2017)

6. Lah, A.A.A., Latiff, L.A., Dziyauddin, R.A., Kaidi, H.M., Ahmad, N.: Smart traffic monitoring and control architecture and design. In: IEEE 15th Student Conference on Research and Development (SCOReD) (2017)
7. Nagmode, V.S., Rajbhoj, S.M.: An intelligent framework for vehicle traffic monitoring system using IoT. In: International Conference on Intelligent Computing and Control (I2C2) (2017)
8. Ye, D., Liu, X., Liu, G., He, B., Lin, H.: Self-organization traffic flow methods based on traffic intelligent control systems. In: 29th Chinese Control And Decision Conference (CCDC) (2017)
9. Dubey, A., Rane, S.: Implementation of an intelligent traffic control system and real time traffic statistics broadcasting. In: International Conference on Electronics, Communication and Aerospace Technology, ICECA 2017 (2017)
10. Talukder, M.Z., Towqir, S.S., Remon, A.R., Zaman, H.U.: An IoT based automated traffic control system with real-time update capability. In: IEEE-2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT) (2017)
11. Gao, Y., Hong, A., Zhou, Q., Li, X., Liu, S., Shao, B.: Prediction of traffic density and interest using real time mobile traffic data. In: International Conference on Identification, Information and Knowledge in the Internet of Things (2016)
12. Tian, S., Shi, S., Gu, X.: Framework design of monitoring system for traffic based on embedded and RFID technology. IEEE. 978-1-4799-5344-8/15/$31.00 ©2015