SMART TRAFFIC MONITORING SYSTEM

Project Report Submitted in partial fulfilment of the requirements for the degree of Bachelor of Technology from Maulana Abul Kalam Azad University of Technology, West Bengal (formerly known as West Bengal University of Technology)

By

Snehasish Pradhan (Roll No. 34900319049)

Rohan Karmakar (Roll No. 34900319031)

Rajbir Banerjee (Roll No. 34900319046)

Rahla Kisku (Roll No. 34900319047)

Preety Kumari Jha (Roll No. 34901319035)

Under the Guidance of

Dr. Aritra Acharyya
Assistant Professor

Department of Electronics and Communication Engineering

Cooch Behar Government Engineering College

Cooch Behar, West Bengal

May, 2023

Certificate of Recommendation

It is hereby recommended to consider the project report entitled "**Smart traffic monitoring system**" submitted by

Snehasish Pradhan (Roll No. 34900319049)

Rohan Karmakar (Roll No. 34900319031)

Rajbir Banerjee (Roll No. 34900319046)

Rahla Kisku (Roll No. 34900319047)

Preety Kumari Jha (Roll No. 34901319035)

for partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering from Cooch Behar Govt. Engineering College affiliated to Maulana Abul Kalam Azad University of Technology (formerly known as West Bengal University of Technology).

---------- ----------

Dr. Aritra Acharyya — Project Guide

Dr. Palash Das — HOD, ECE

Certificate of Approval

It is hereby approved that the project report entitled "**Smart traffic monitoring system**" submitted by

Snehasish Pradhan (Roll No. 34900319049)

Rohan Karmakar (Roll No. 34900319031)

Rajbir Banerjee (Roll No. 34900319046)

Rahla Kisku (Roll No. 34900319047)

Preety Kumari Jha (Roll No. 34901319035)

for partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering from Cooch Behar Govt. Engineering College affiliated to Maulana Abul Kalam Azad University of Technology (formerly known as West Bengal University of Technology).

Board of Examiners

Name	**Signature**
---	---
---	---
---	---
---	---
---	---

Acknowledgement

It is our pleasure to acknowledge our supervisor **Dr. Aritra Acharyya, Assistant Professor, Department of Electronics and Communication Engineering, Cooch Behar Government Engineering College, Cooch Behar, West Bengal**, for being not only the source of encouragement, but also great resource of knowledge and information. We shall remain indebted to him for the immense help we have received from him.

We would also like to thank all the faculty members, technical assistants and staffs of the Department of Electronics and Communication Engineering, Cooch Behar Government Engineering College, for their kind and friendly cooperation extended to us.

We have no appropriate words to express sincere thanks to our family members for their continuous support and encouragement.

Project Members

Roll No.	Name	Signature
----------	----------	----------
----------	----------	----------
----------	----------	----------
----------	----------	----------
----------	----------	----------
----------	----------	----------
----------	----------	----------
----------	----------	----------

Contents

List of Figures

Abstract

Traffic congestion in cities is a major problem mainly in developing countries; to encounter this, many models of traffic system have been proposed by different scholars. Different ways have been proposed to make the traffic system smarter, reliable, and robust. This paper presents the various approaches made to enhance the traffic system across the globe. A comparative study has been made of different potential researches in which intelligent traffic system (ITS) emerges as an important application area. Important key points of each research are highlighted and judged on the basis of implementing them in developing countries like India.

Our model uses USB Camera modules and a centrally placed microcontroller and uses vehicular length along a length to implement intelligent traffic monitoring system.

Chapter 1 INTRODUCTION

1.1 Introduction

The traffic jam is a daily-life problem in any metropolitan city. With the rise of standard of living, the number of vehicles is increasing at an exponential rate. In response to this, many researches are done in developing an intelligent traffic system (ITS), i.e., a traffic system which is involved in a much closer interaction with all the components of a traffic including vehicles, drivers, and even pedestrian. It not only provides safety at intersections and prevents traffic jam, but manages the traffic as a whole. Developed countries like America, Japan, and U.K. have already implemented ITS on their roads and still many researches are going on to make traffic systems more advanced and suitable for developing countries also. Apart from surveying various research works on ITS, this paper proposes a model which follows a simple algorithm based on the length of traffic on each lane. The length of traffic on the other lanes affects the time allotted to the current lane. AI algorithm is to be used to determine the length of the traffic from the footage of the usb cameras. The proposed idea can reduce the traffic in all lanes proportionately reducing the chances of congestion. Besides, it also manages the occurrence of any emergency vehicles such as ambulance, fire brigade, etc. in any lane and also provides the mechanism to detect the route of a vehicle. Once implemented, it does not require any human assistance for its working.

1.2 Review of Previous Works (Literature Review)

In the previous semester, we have focussed on building the vehicle detection algorithm. We had the data (vehicle images and traffic footage) . We did the essential data pre-processing to make it ready to feed in the algorithm. A model was being built to detect vehicle in traffic. We were working on it to make it more efficient.

1.3 Objective and Motivation

- *Department of Transportation/Management:* The system would highly benefit them to effectively manage the traffic that causes congestion. This would help them resolve the issues that cause traffic.

- *Vehicle Owners/Drivers:* The system would be a great help to them. They could utilize it to avoid problems that would likely to arise due to traffic especially accidents. The system would help them be secured and save time spent being stuck in a traffic.

- *Commuters:* This is also very important to the commuters, especially the public commuters. with the implementation of the traffic management system, they will be able to receive and view the real-time updates of the traffic.

Chapter 2 LIST OF COMPONENTS USED

1. Raspberry Pi 4 Model B:

Raspberry Pi 4 Model B is the latest product in the popular Raspberry Pi range of computers. It offers ground-breaking increases in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. For the end user, Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PC systems. This product's key features include a high-performance 64-bit quad-core processor, dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability (via a separate PoE HAT add-on).

2. USB Camera Modules :

USB Camera module have been using in various difference device in our life. As the developing of technology, camera module is not untouchable in civil usage, even customized OEM Camera module is available in many manufacturer. Today we will go thought the basic knowledge of USB camera module.

3. USB Multiplexer for Cameras :

The U360-004-SLIM 4-Port Ultra-Slim Portable USB 3.0 SuperSpeed Hub's built-in USB cable connects to your laptop, Ultrabook™ or computer to expand the number of available USB 3.0 ports. Just plug and play with no drivers, software or external power supply needed. The bus-powered hub distributes necessary power to its four USB 3.0 ports through USB connection. When using a separate cable between the hub's USB Micro-B port and your device's USB port or a USB charger to draw additional power, the hub can provide up to 1.5A for fast charging of mobile devices. The ultra-slim case measures 4.2 x 1.3 x 0.4 inches to fit easily into your pocket, backpack, briefcase or laptop bag to connect USB-enabled devices wherever you are. It supports USB 3.0 data transfer rates up to 5 Gbps—ten times faster than USB 2.0—and is backward compatible with USB 2.0 and USB 1.1 devices. All four ports support USB Battery Charging (BC) specification v1.2. The U360-004-SLIM is compatible with all Windows® and Mac® operating systems.

4. Connecting Wires :

A connecting wire allows travels the electric current from one point to another point without resistivity. Resistance of connecting wire should always be near zero. Copper wires have low resistance and are therefore suitable for low resistance.

5. Coral USB Accelerator :

The Coral USB Accelerator adds a Coral Edge TPU to your Linux, Mac, or Windows computer so you can accelerate your machine learning models.

6. Dual Pole MCB :

Double-pole breakers have two hot wires that are connected by a single neutral wire. That means if there's a short circuit on either of the poles' hot wires, both trip. These breakers can be used to serve two separate 120-volt circuits or they can serve a single 240-volt circuit, such as your central AC's circuit.

7. IP-65 Outdoor MCB Box :

- Great Quality- Made of high quality ABS and PC plastic, this distribution box is durable and sturdy.
- IP65 Grade- Waterproof & weather designed, effectively block splashing water, rain, dust, snow, oil, UV, etc. This distribution box is designed for 8 ways circuit breaker, can be widely used for both indoor and outdoor applications.
- Openable Clear Cover- You can observe the status of applications through the clear cover without opening it, super convenience for you to use.
- Easy To Use- Includes Din Rail, terminals could be custom made, easy to install MCB; Knock-out holes for cable enter and out; Can be installed directly on the wall without slotting.

8. IP-67 Enclosure :

IP67 enclosures protect electronics from dust and moisture, including temporary immersion. Use an IP67-rated enclosure when you want to be extra sure that your design will be protected from washdown and weather. They are perfect for use in a variety of applications, including industrial and commercial settings.

9. *Spike Buster :*

Spike busters, popularly known as surge protectors, are devices that restrict the voltage supplied to an appliance or an electronic device by stopping or shorting any unwanted voltages, which may harm your device.

10. 4G LTE Dongle :

4g dongles give you access to the mobile 4g network enabling you to connect to the Internet from your device from wherever you are. This is of course providing you have access to the network and, as with your mobile phone, have paid for access to the network.

11. CCTV Camera Mount :

Security camera mounts and brackets provide each camera with the support required to record video footage from a vantage point on a wall, ceiling, or poll.

12. Externally Powered 4-port USB Hub :

The hub is USB powered so there is no need to always plug into an AC adapter, giving you the ability to connect up to four electronic devices to your laptop all at once. Charge your phone or MP3 player and access your external hard drive from one hub.

Block Diagram of Smart Node :

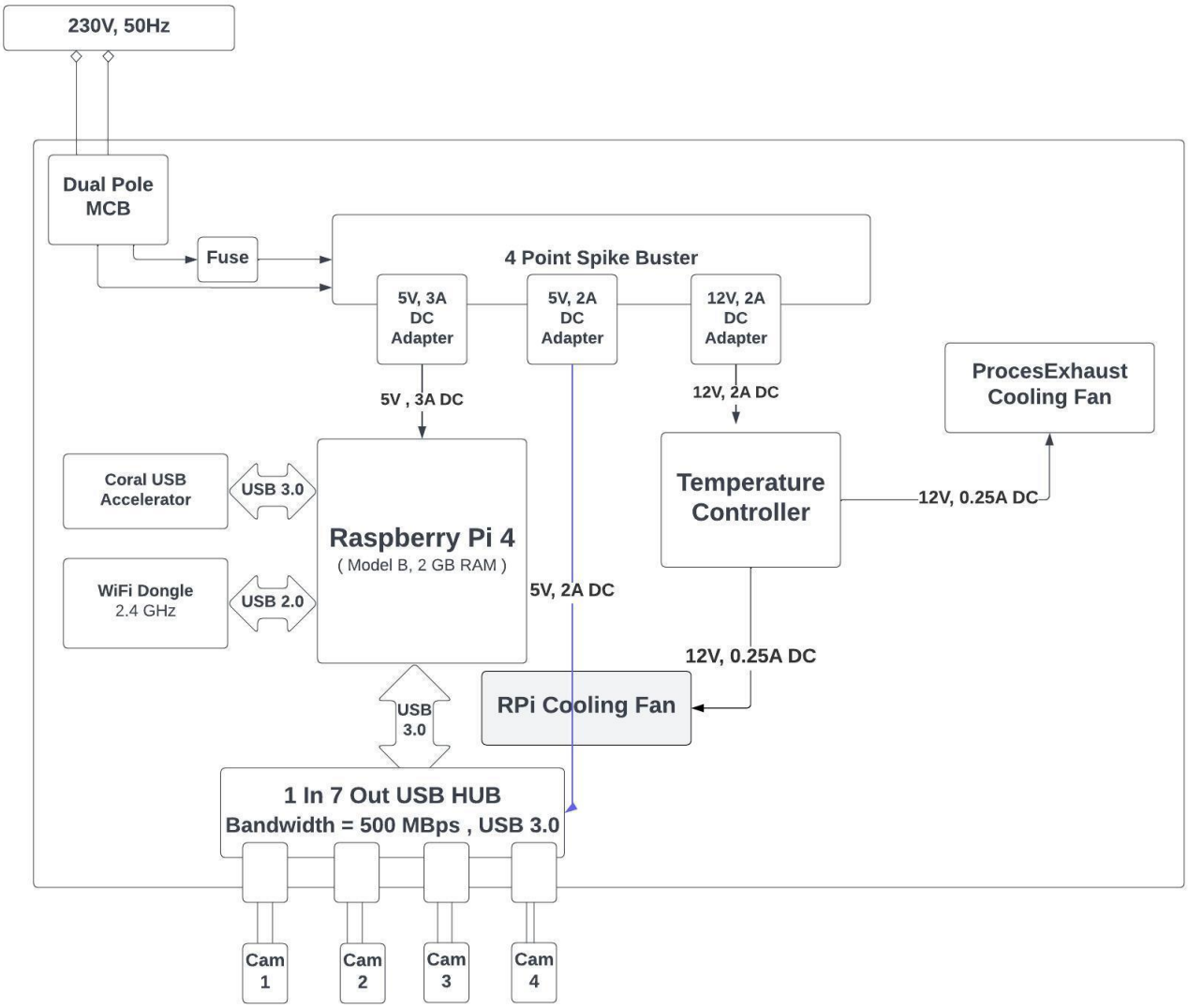

Fig 1 : Block Diagram of Smart Node Circuit connections

Chapter 3 WORKING PRINCIPLE AND PROPOSALS

1. Real-Time Systems:

Real-time systems in case of traffic managing system take the input of the current situation through video surveillance or WSNs and deal with the situation. The traffic signals are controlled according to the presence of vehicles and are operated automatically in real time. A real-time optimization model was used by Dotolie et al. that investigated the issue of traffic control in urban areas. The model took into considerations the traffic scenarios which also include pedestrians. This technique was applied for analyzing real case studies. Wenjie et al. concentrate on calculating the time that a vehicle requires to reach the intersection from a particular point, dynamically, by the use of sensors. By this, data performs various calcula-

tions to find the green light length. Albers et al. used real-time data to monitor current traffiflows in a junction so that the traffic could be controlled in a convenient way. Reliable short-term forecasting video captured in a recorder plays an important role in monitoring the traffic management system. The data required can

be easily provided by the CCTV cameras that can be beside the roads as per requirement. Van Daniker visualized the use of transportation incident management explorer (TIME) for calculating real-time data. Challal et al. proposed a distributed wireless network of vehicular sensors to get a view of the actual scenario

and used its various sectors to lower the congestion but not taking decisions in real time. The use of two types of sensor network was proposed, vehicular sensor network and wireless sensor network, and the combination of these two permits the monitoring as well as managing of the traffic. Chandak et al. used video surveillance for realizing the real-time scenario. It deals with decreasing response time of the emergency cars by establishing communication between emergency cars and traffic lights. The data collected in real time can be used to determine the traffic density and also based on the traffic present. Several path optimization techniques can be used, which are discussed in the next two sections.

1.1 Traffic Density

Realization of the traffic density at a particular intersection for a given time can also help in reducing traffic congestion at that point. This data can be analyzed to determine several factors like green light length, traffic at the particular time, etc. Zhou et al. used the concept of adaptive traffic light control algorithm which manipulates both the sequence and length of traffic lights in accordance with the detected traffic. The algorithm uses real-time data like the waiting time of vehicles, volume of traffic in each lane, etc. to determine traffic light sequence and optimal length of green light. The algorithm produces lower vehicle's average waiting time, thus providing much higher throughput. The system proposed by Sinhmar used IR sensors to determine the density of traffic based on which the traffic signals were updated to provide a smooth flow of vehicles. Hussain et al. proposed a system that uses a central microcontroller at every junction which receives data wireless sensor placed along the road that determines the traffic density. The microcontroller uses this data to control the traffic using the

programed algorithm to manage the traffic in an efficient manner. Srivastava et al. suggested ways to determine the number of vehicles using weight sensors, then with the use of a programmable logic controller to analyze the data, and then park in automated parking or has diverge them accordingly.

1.2 Path Optimization Technique

Finding the best and shortest path to destination can be used as a tool to minimize the traffic along a path. The traffic along the road can be sent to the incoming vehicle proving them the idea about the traffic and thus they can take an alternative path to the destination. Gambardella and Bertelle et al. proposed to find optimized path for transportation using the concept of ant colony optimization. Once an optimized path is found, we can add several other features to make it more convenient and avoid traffic jams. Ozkurt et al. have proposed the use of video surveillance and neural network to reduce the traffic stress across the network. Xia researched to find an optimal road network and analyze the traffic dynamics by the movement of each car and the statistical property of the whole network. Kale et al. designed a system that uses the traffic information and sends it to the incoming ambulance by allowing it take way according to the situation. The various performance valuation criteria are used such as average waiting time, the average distance traveled by vehicles, and switching frequency of green light at a junction.

2. **Data Analysis Systems:**

Data analytical systems are those systems that take the present or statistical data, process them in the processor, and then act according to predefined algorithm. Like real-time systems, it may collect data in real time, but is unable to take any decision in real time, i.e., it must follow the instructions that are provided to it. Yousef et al. suggested a scheme of solving traffic congestion in terms of the average waiting time and length of the queue at the isolated intersection and provide efficient flow in global traffic control on multiple intersections with the accordance of real-time data. Thus, the data collected can be used in various ways depending on the perspective of the user. The next two sections define such ways of using the data.

2.1 Information Chaining System

The data collected at one junction can be sent to the other junction informing it about the situation and allowing it to take measures. The same can be used in case of cars, ambulance, and other vehicles. This is quite similar to the path optimization technique, but here the path that would be taken by the user is not suggested by the rsection. The controller controls the traffic light timings and phase sequence to ensure smooth flow of traffic with minimal waiting time, queue length, and delay time. Jantan et al. proposed monitoring system in addition to the traffic light system to determine different street cases (e.g., empty, normal, crowded) with different weather conditions using small associative memory depending on the stream of images, which are extracted from the streetsvideo recorders. It also gives a high flexibility to learn different street cases using different training images. Placzek described a method which is designed to be implemented in an online simulation environment that enables

optimization of adaptive traffic control strategies. Performance measures are computed using a fuzzy cellular traffic model, formulated as a hybrid system combining both cellular automata and fuzzy calculus. Dakhole et al. used ARM7-based traffic control system that proposes a multiple traffic light control and monitoring system that reduce the possibilities of traffic jams, caused by traffic lights. This system uses ATmega16 and ARM7 for its processing. Jaiswal et al. described the optimization of traffic signals by focusing on three areas—Ambulance, priority vehicles (like VIP cars, police jeeps), and Traffic density control—thus providing a stoppage free path for ambulances, preventing traffic congestion, and also managing traffic density by increasing duration of green light of the lane where density is high.

3. Proposed Method:

The proposed model mainly concentrates on the following factors:

(i) Unnecessary consumption of the time slice in a certain lane, when there are fewer vehicles.

(ii) If any lane has any emergency vehicle such as ambulance, it also has to wait for its turn.

(iii) A lane with less or more traffic has to wait for the same time span. Normally, the green signal in the traffic light remains on for a fixed interval for each road. In the existing system, congestion of vehicles may happen if lots of vehicles are waiting in a particular lane and the other lane which has fewer numbers of vehicles is made free.

Chapter 4 PROJECT REALIZATION

Fig 2 : Image of Smart Edge Node Unit

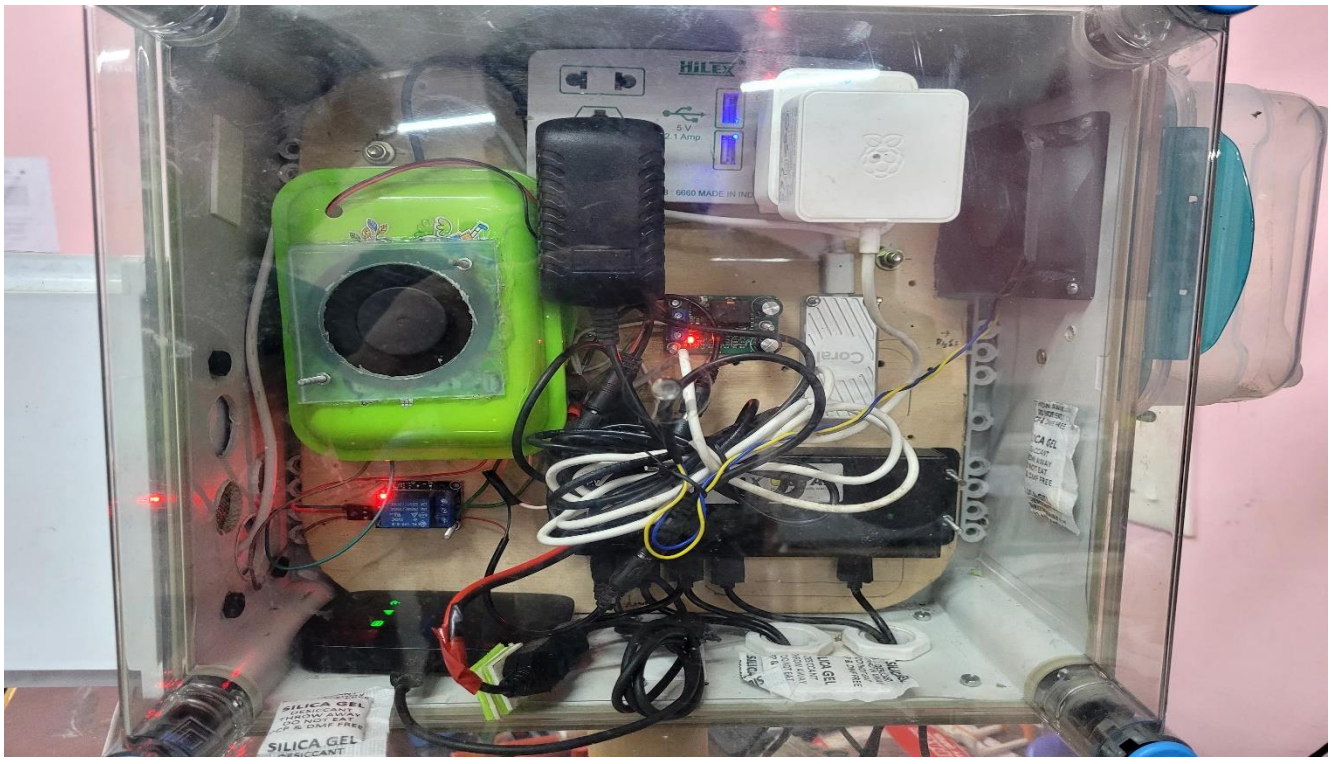

Fig 3: Close Up Image of Smart Edge Node Unit

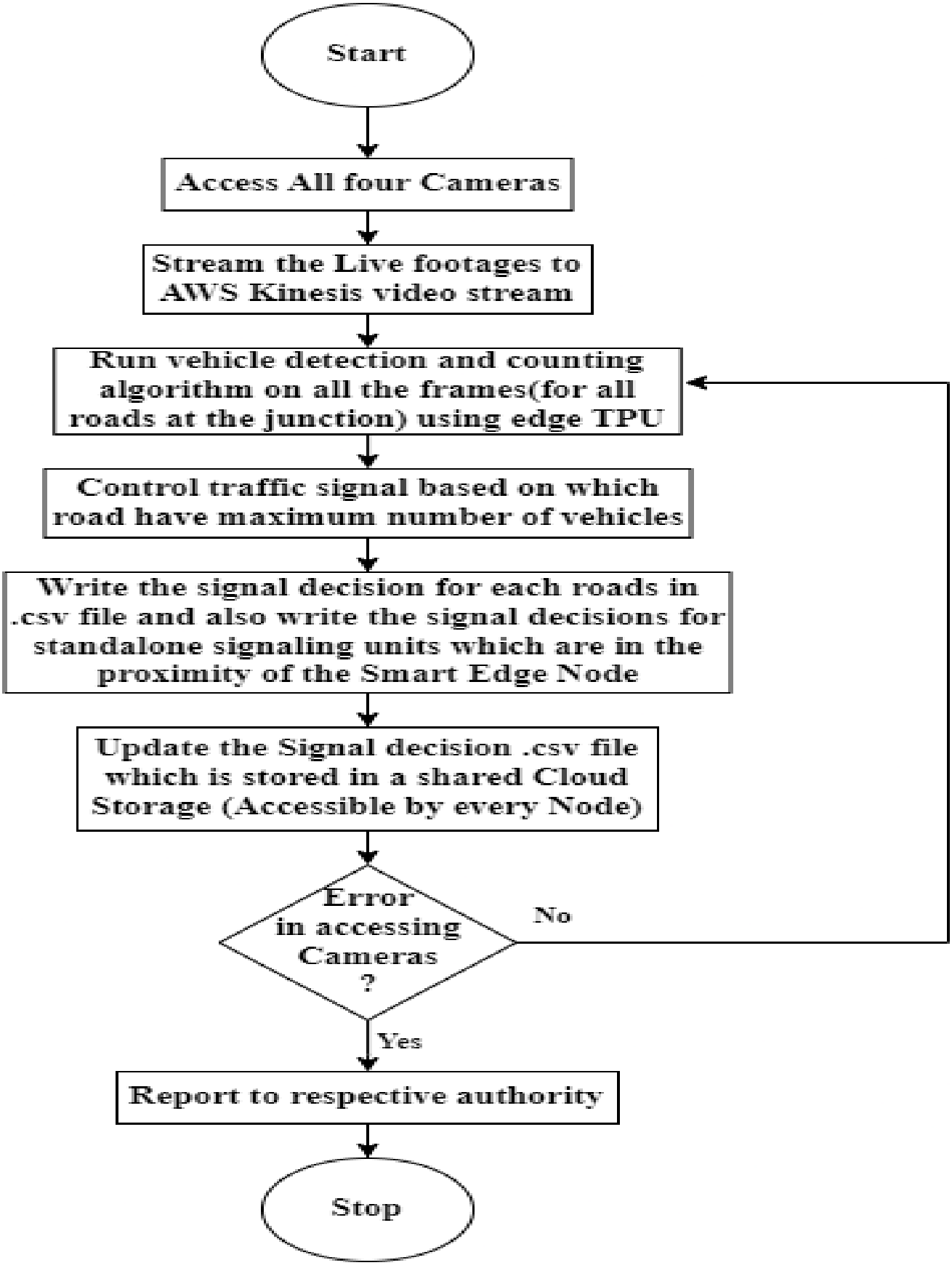

Fig 4: Flowchart of operations of Smart Edge Node Unit

Chapter 5 FUTURE WORKS AND CONCLUSION

5.1 Future Works

- Field testing of smart signal units as well as stand alone signal units.
- Traffic violation detection and reporting
- Server end design and implementation
- Development of mobile apps for remote access, remote surveillance, real-time traffic update
- Hybrid System depending on high traffic zone priorities

5.2 Conclusions

The work presents review of the existing research done in field and tries to develop a system suitable for developing countries. The project has two objectives, which are, first, calculating the length of the vehicles on the road for the flow of the traffic smoothly without congestion and, second, developing priority-based signalling which will help to give the priority to the emergency vehicles such as ambulance. The microcontroller can be programmed easily which gives scope for deployment better algorithms in future. The cameras are to be fitted above the roads and connected to the raspberry pi through multiplexer at the intersection. These are some hectic jobs which are to be dealt before implementing the system, but once implemented, it will make our traffic system more convenient and cities smarter.

References

1. Mariagrazia, D., Pia, F.M., Carlo, M.: Real time traffic signal control: application to coordinated intersections. In: IEEE International Conference, vol. 4, pp. 3288, 3295. 5–8 Oct 2003.

2. Wenjie, C., Lifeng, C., Zhanglong, C., Shiliang, T.: A realtime dynamic traffic control system based on wireless sensor network, parallel processing, 2005. In: International Conference on ICPP orkshops, pp. 258–264. 14–17 June 2005, ISSN: 1530-2016, Print ISBN:0-7695-2381-1.

3. Queen, C.M., Albers, C.J., Forecasting traffic flows in road networks: a graphical dynamic model approach, 29 July 2008.

4. VanDaniker M.: Visualizing real time and archived traffic incident data. In: Proceedings of the 10th IEEE International Conference on Information Reuse and Integration, pp. 206–211. IEEE Press Piscataway, ©2009, ISBN: 978-1-4244-4114-3.

5. Sharma, A., Chaki, R., Bhattacharya, U.: Wireless sensor networks. In: 3rd International Conference on ICECT, Jan 2011. doi:10.1109/ICECTECH.2011.5941955.

6. Amine Kafi, M., Challal, Y., Djenouri, D., Bouabdallah, A., Khelladi, L., Badache, N.: A study of wireless sensor network architectures and projects for traffic light monitoring. In: International Conference on Ambient Systems, Networks and Technologies, pp. 543–552, 28Aug 2012.

END