Urban Traffic Control Method for Sri Lanka

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Abstract *-Traffic congestion is a major problem in many cities of Sri Lanka. Failures of uncoordinated signal points, poor law enforcement and bad physical management of traffic are the leading causes for congestion. One of the major problems with Sri Lankan municipal is that the existing infrastructure cannot be expanded to cater the dynamic flooding behavior people and automobiles; the only available option is effective management men and automobiles. Traffic congestion has a negative impact on economy, the environment and the overall quality of life. The paper proposes effective urban traffic control/management to overcome aforesaid difficulties. The propose method uses automated moving camera systems along the road network for dynamic identification of flow of traffic as well as fixed/movable objects. Data will be collected by central server and will be passes to the management authorities. The proposing system would be able to identify dynamic behavior of the pedestrians and automobile drivers with changing aspects of infrastructure and environment. Proposing system would be able to deploy with less time and high security. Especially the system can cater effective management of Security of People and Property.*

Keywords - Traffic, Poles, Congestion, automobiles, economy, Dynamic Behavior, Wireless, Camera, Security.

I. INTRODUCTION

Statistics shows that government/Private sector workers are wasting their time on the roads due to traffic congestion. Due to heavy traffic directly loose effective working hours and indirectly loosing large sum of money for wasting fuels as well as accidents due to poor management of traffic. According to the latest statistics, the national average speed is 26 km per hour, which also gradually reducing day by day. Within Colombo district limit, the average speed is 22 km per hour. The speeds forecast that national average speed has projected to drop about 19 km per hour and the Colombo district figure would drop to 15 km per hour by 2031. When average speed decreases, leading to longer travel times, causing a rise in pollution levels. Hence the economic loss due to congestion rises sharply. Currently Sri Lanka congestion cost in urban areas Approximately Rs. 32 billion, which is 0.5% of the Gross Domestic Product (GDP), which is likely to be increased by 2% of GDP. Currently, fuel bill is about 6% of GDP, and that is likely to be increased to 8% .

All these poor management methodologies directly impacting economy of Sri Lanka. Sri Lankan roads network not properly planned and implemented. Due the fact that just beside roads building installations are there all over the country. Because of that fact road network can't be widen of expanded. Currently very few highway roads are there but their impact on overall traffic is minimum.

The main problem light based traffic control is that, they are not networked, just managing the point traffic. And the manual management by using police also can be considered as point management option. These point techniques are worsening the traffic situation in Sri Lanka. In this proposed method should be able to dynamically manage the traffic and other required parameters by different authorities. In general traffic management system in Sri Lanka few locations are fitted with fixed cameras and other locations are managed just by fixed timing lights. The propose Urban traffic monitoring system is a new approach that monitors the dynamic traffic flow using movable camera network, fitted at the height of 50m to 200m. The camera moving tracks (cables) can be mounted on existing high rise building or secured location pole system can be implemented with power. The acquired image/data through cameras and sensors would be able process via distributed or central server system.

The following type of information would be able to process through the system

- Pedestrian movement
- Pedestrian security aspects
- Environmental Data

- Pollution
- Burglars (Urban security Aspects)
- Traffic offenders
- Accidents
- Crime

Introducing a locating /detecting algorithm to find people and automobiles which greatly enhance the characteristics of law enforcement authorities in Sri Lanka.

II. EXISTING SYSTEMS

A. Point based fixed Video Analysis system

Video analysis consists with a cameras placed in a heavy traffic point, which consists with a communication unit. The traffic is continuously monitored using the cameras. Some systems video may compress before transmissions. Processing based on the node location or centrally with few connected nodes. Analysis result based on the algorithm, which implemented on raw video data. The processed information includes frequency, average speed as well as the lane occupancy of automobiles. The problems associated with the system are

- Only point based information analysis.
- Would not able to identify traffic dynamics of roads.
- Only the capability of daytime video processing.

B. Traffic Light Based System

Traffic light based system is programed to operate on fixed time intervals. The system provides point based traffic management capability. The main disadvantages are (a) there are no connectivity between points (b) fixed time intervals without knowing vehicle dynamics (c) Poor management of rush hours.

III. PROPOSED SYSTEM

The proposed system consists with high definition (HD) cameras which are able to move, pan, tilt and zoom, mounted on a fixed cable network, the height of the cables from the ground can be grouped in to four layers (1) 50m pole height cable networked camera system (2) 100m pole height cable networked camera system (3) 150m pole height cable networked camera system (4) 200m fixed pole mounted camera system.

The cameras are fitted to the cables network which is able to move between the poles, with dynamic moving algorithm, based on the parameters of the roads. The minimum distance between the poles 500m and single cable between poles would be able to support 3-6 cameras based on importunacy of data. For example, when stressing the security aspect in particular locality which is highly populated the cable system support much variety of camera systems integrated with sensors. The powering mechanism for the cameras based on the same transporting cable system. The cable network laid along the road as well as build up areas. layer 1 systems can be align along the road, layer 2 systems can be align with roads/ buildups, layer 3 systems can be align with buildups, layer 4 system will be fixed and mounted with remote sensing cameras and devices. Layer 1,2 & 3 network camera wireless link to distributed server systems and layer 4 camera system link to the system via fixed cable. All the distributed servers are optically connected to a central server which has the access to the relevant authorities.

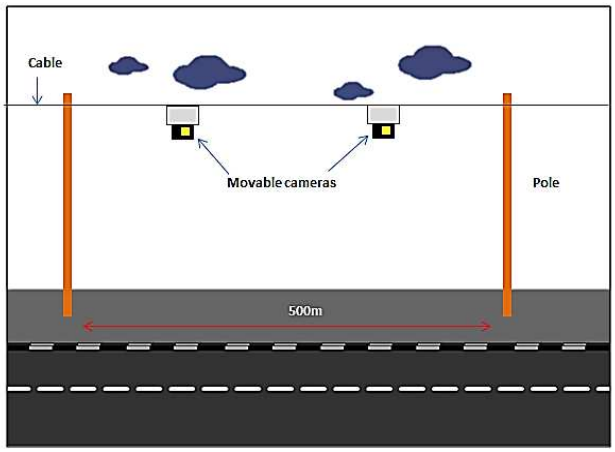

Fig. 1 Proposed System front view

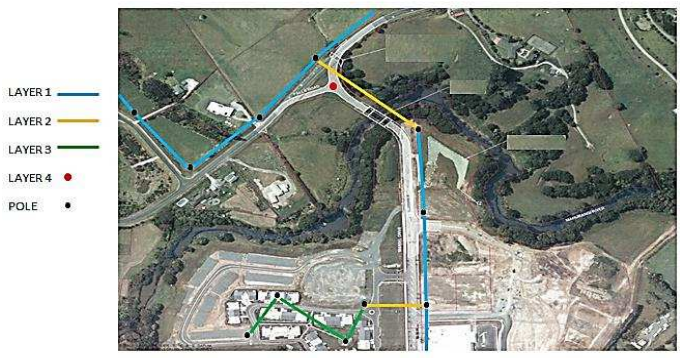

Fig. 2 Proposed System top view

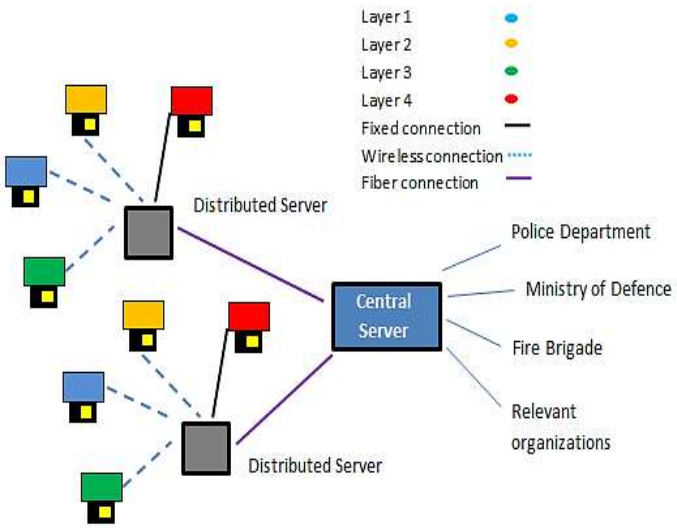

Fig. 3 Proposed System Network

A. Properties use in selecting HD cameras.

Cameras used in these application ranges from simple, low-resolution units to HDTV-class cameras. As per the requirement of information low resolution to high resolution camera can be selected, specially layer 3 and 4 cameras should have the highest resolution capability .As technical demands increase, one of the challenges for camera image sensors is the high dynamic range (HDR), in which such cameras must operate. From daylight to darkness with bright vehicle lights and reflections, the camera and its control

System must be able to detect and classify all activity at an intersection. Such cameras require a very HDR in order to see across the wide range of light levels that might occur in a single scene; for example, perceiving a pedestrian at night when bright vehicle lights are in the scene.

B. Thermal Imaging Sensor

This sensor uses thermal imaging to detect the presence of pedestrians and bicyclists that are approaching or waiting at the curbside or walking on the crossing. Thermal imaging cameras can see in total darkness, through shadows and sun glare, and thus provide reliable traffic detection2 The sensor is connected to the traffic signal controller via TCP/IP network.

C. Air quality monitoring sensor

The air pollution sensor used in this air quality monitoring study is an Internet Video Surveillance (IVS) camera. This camera is use to monitor the concentrations of particles less than 10 micrometers in diameter. This set-up can provide a continuous, on-line, real-time monitoring for air pollution at multiple locations. It is used to capture outdoor images continuously.

D. Temperature and humidity sensor

The camera series are specially designed for reliable, vandal-resistant and weatherproof installation. Humidity sensor in camera works on the principle of relative humidity and gives the output in the form of voltage. This analog voltage provides the information about the percentage relative humidity present in the environment and temperature sensor in camera indicates the level of temperature in environment.

E. Night vision capability

Night Vision Goggles in cameras are electro-optical devices that intensify (or amplify) existing light instead of relying on a light source of their own. Ambient light is captured, amplified thousands of times, and displayed for the user via a phosphor display. The ambient light comes from the moon, stars, sky glow from twilight conditions, or distant manmade sources such as cities.

IV. COMPARATIVE ANALYSIS OF EXISTING AND PROPOSE SYSTEM

A. Road Traffic

We use the concept to extract information such as traffic light positions and delays, intersection stop probabilities, speed limits and road capacities. Existing systems are highly concentrated on the point road traffic reduction, but the propose system is handling entire traffic congestion in the zone.

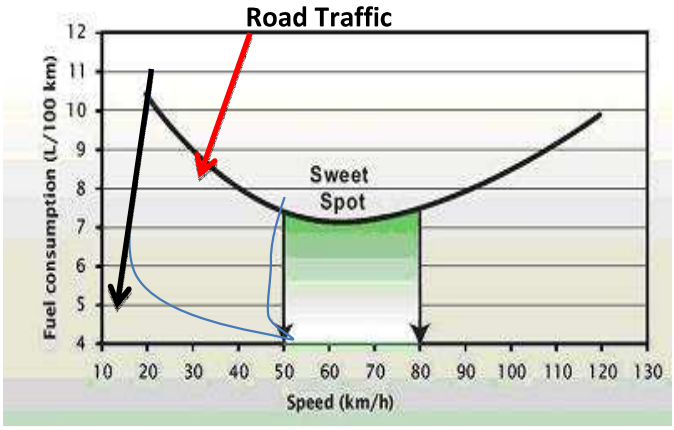

Fig. 4 Fuel Consumption per Speed

With the images of vehicle densities, speed limits, intersection data are sending to the controlling system and with an algorithm connect central node link to traffic light system. Autonomously light handle it and give priority to the each wanted directions. Improvement of system tends to save the energy which is directly affected to the economy.

Wastage of Money due to Road traffic = **Fuel Consumption per vehicle on traffic** x **Number of vehicles**

Wastage of money due to traffic within 2km for vehicles 60,000 for average consumption of 8.5 l/100km is Rs 1,193,400 within 40min. With proposed system can lower this value up to half of this amount. It proceeds to an economical save in traffic peak hours.

Excising system cannot identify emergency vehicle, it treats normal car and ambulance same way. So there are chances of delay in emergency services. But with the proposed system, emergency vehicle and traffic signal are equipped each. As emergency vehicle come near to an intersection, it broadcast a signal, to notify traffic signal its presence. As soon as traffic signal receive signal from emergency vehicle it gives green light to that particular lane, in which emergency vehicle is coming. Police officer based traffic system is most efficient than any other technique. But as it includes human as a part of system this scheme is inadequate. Efficiency of system depends on experience and capability of the person. And with development of technology point management technique does not give an answer for these problems. With the proposed system it direct to a management which includes whole parties who can lower the traffic.

B. Other Benefits of concept

1) Parking

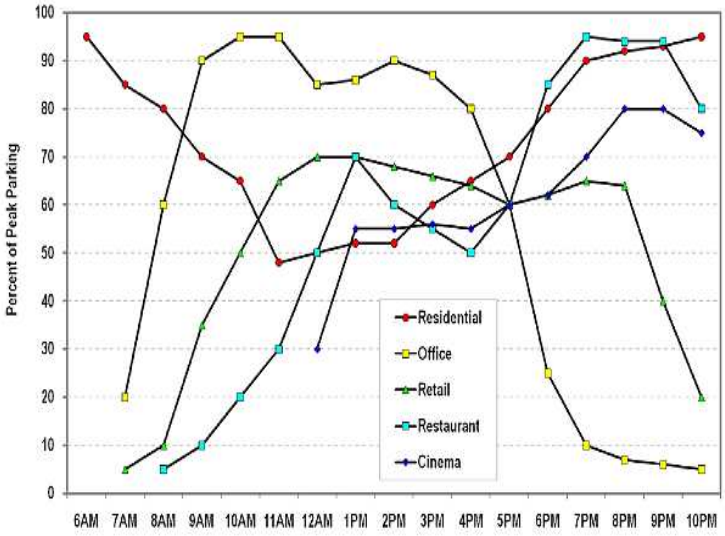

Fig. 5 Parking Accumulation by Land Use by Time of the Day

The activity pattern of each land use is linked with the temporal usage of parking facilities. And with system can connect to the parking systems and give an idea on availability via Wi-Fi.

The proposed system aims at effective management of traffic congestion. It is also cost effective than the existing system. It can be observed from the results that the dynamic road traffic management system provides better performance in terms of total waiting time as well as total moving time. Less waiting time will not only reduce the fuel consumption but also reduce air and noise pollution.

2) Monitoring Temperature in area

The station equipment, positioning and type depend on several factors: type and intensity of emissions, types of pollutants, which are present in the atmospheric environment, local and international legislation

requirements, criteria and guidelines, additional information provided by preliminary assessment; population exposure; siting of stations; expected trend of atmospheric pollution

The types of station are related to macro-siting criteria, which are adopted to define the site where a fixed station should be located. Consequently, the siting criteria, together with local legislation, are also affecting the type of equipment installed in each camera, which can measure of different pollutants.

3) Thefts of and from Cars on Residential Streets and Driveways

Theft of and from cars in residential neighborhoods is only one of a number of vehicle-related problems that occur in residential neighborhoods that the police must address.

a) Carjacking
b) Insurance fraud
c) Burglaries to garages and outbuildings
d) Injuries or deaths resulting from stolen vehicle pursuits
e) Thefts of and from commercial vehicles
f) Thefts of motorcycles, all-terrain vehicles or bicycles
g) Speeding in residential areas.

With police street monitoring system cannot capture each and every above mentioned possibility. During night times it is more severe. So with the proposed system it will not be a big issue for police officers. And because of coordination in each management schemes again it is more efficient than earlier.

4) Face recognition

During the past 5 to 8 years, much research has been concentrated on video based face recognition. The still image problem has several inherent advantages and disadvantages. For applications such as drivers' licenses, due to the controlled nature of the image acquisition process, the segmentation problem is rather easy. However, if only a static picture of an airport scene is available, automatic location and years, much research has been concentrated on video based face recognition. However, if only a static picture of an airport scene is available, automatic location and Segmentation of a face could pose serious challenges to any segmentation algorithm. On the other hand, if a video sequence is available, segmentation of a moving person can be more easily accomplished using motion as a cue.

The face is detected using skin color information using with cameras and with a model of a mixture of Gaussians. The facial features are then located using symmetry transforms and image intensity gradients. Correlation-based methods can used to track the feature points. The locations of these feature points are used to estimate the pose of the face. This pose estimate and a 3D head model are used to warp the detected face image into a frontal view. All these data is connected with control point and can be identified.

5) Urban area cleaning

Tracking progress on Collection and disposal of solid waste is monitor by twice a day. And give still images to the control base and connect with the road cleaning authority.

6) Urban area monitoring

Monitor the area for accidents, natural hazards, environmental changes, weather climates by taking 1 minute of a clip by in each hour by each camera.

7) Urban Transit

Access to urban transit systems can also be a challenge, especially when connectivity between the transit city and its suburbs is complex. The goal is to offer enough incentives, such as park-and-ride facilities, so that the interface between the transit and non-transit transport system can be improved with connecting to the control system of introducing concept.

8) Automatic detection of speed limit Violation

We can use this technique to calculate the speed of a motorist and to detect if he violates the prescribed/set speed limit. If the motorist violates the rule, a warning message will be sent to the motorist via audio and/or video interface and penalty will be calculated in the server and billed monthly to the vehicle owner.

9) Automatic Billing of Core Area / Toll Charges

Automatic toll collection and automatic core area charge collections are also done using the same framework. Controller unit will be placed at toll-booth and along the motor able roads around the core area which will detect each individual vehicle uniquely within its zone by capturing their device ids and will keep records of the time during which the vehicle was seen by those Controllers within its reading zone. This information will be sent to a main server. Accordingly the main server will calculate the charges and raise bills against the vehicle ids.

V. REDUNDANCY TECHNIQUES OF PROPOSED SYSTEM

a. The system should be performing duties in all weather conditions. So it should be water resistible, withstand for high solar radiation, working at high temperatures maximum 40^{o}C – 50^{o}C and the system should be well sealed.

b. For the anti-theft, the height of poles should be out of reach of people. Every camera should be intercepting their viewing angle with each other, this helps to see multiple view operations of cameras.

c. If the main power supply is failed system has an inbuilt battery of 24hrs backup time as well as the power given to the controlling system is given through UPSs.

VI. CONCLUSION

The proposed work focuses on urban Traffic Control System using high definition cameras which will eliminate the drawbacks of the existing system such as high implementation cost, dependency on the environmental conditions, etc. The proposed system aims at effective management of traffic congestion. It is also cost effective than the existing system. And it is capable of fulfill mentioned areas.

Furthermore, the study presents the problems in urban areas all over the world caused by urban development and the related sources. Urban development leads to a problem, which affects economies worldwide. Urban Cities have a negative impact on the financial situation of a country, on the environment and hence the overall quality of life. The proposed system can be enhanced by synchronize with other existing systems.

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