Automated Traffic Surveillance: Evolution and Implementation

[1] Kriti Bhandari, [2] Niranjana Raghavan, [3] Aditya Iyer, [4] Niteen Autade

[1, 2, 3, 4] Department of Electronics, K. J Somaiya Institute of Engineering and Information Technology
Mumbai, Maharashtra, India

Abstract

The rampant growth in use of four-wheelers has led to an increase in road congestion at all signal points. In the light of time constraints, drivers find an easier way out by breaking signals. Presently, our defense against such practices lies at the mercy of traffic policemen stationed at various signal points in the city and monitoring of surveillance cameras. However, constant manual monitoring is not always feasible because of limited manpower. Also, while the use of CCTV cameras only aids in monitoring, fine deduction is still looked after by individual traffic authorities. This system of automated surveillance is based on wireless RF transmission and circumvents the need of expensive wired fiber optic cables. The three key elements of this system include (a) infrared transmitter and sensor (b) a dual state transmitting system (c) a control room managing the data base. The motion of a vehicle passing the pre-established line near the signal is judged by the infrared arrangement, including the strip of sensors on the lower surface of the vehicle under consideration and the IR transmitter on the surface of the road, precisely on the above mentioned limiting line at the signal. The presence of the vehicle thus detected will be accounted for by a transmitter installed in it, thus changing its regular state of transmission and providing the unique number of the offender's vehicle to the control room. The transmission stage works on the RF frequency. FSK modulation being a reliable and apt scheme has been used for the purpose of modulation of data. This brings us to the next stage of the project dealing with the data base matching and there after sending a plan of action to the undersigned bank of the user wherein the fine deduction process will be initiated. Thus in this paper, we focus on simplifying surveillance by introducing automated monitoring system.

Keywords: *RF transmission; automated traffic surveillance.*

1. Introduction

In recent years, there is an overwhelming growth in vehicular traffic seen on the city streets. According to Mumbai RTO records [1] as on 31st March 2011, "73.31 percent of the state's meter fitted taxis operate in Mumbai alone. Also, the city accounts for 27.75 percent of state car population. And out of the total vehicular population of 1,74,34,099 including two and four wheelers of all kinds, Mumbai shares 10.73 percent."

Currently the system being employed in Mumbai is the CCTV system. CCTV cameras have been stationed at 100 junctions in the city for visual surveillance. The main function of this system will be to collect real time videos from distant cameras and transmit the footage via an optical fiber network to a control room fitted with workstation PCs having various application software. This system employs the use of digital image processing to identify an unusual situation, and alerts the nearest police van. [2] The fine deduction is again done manually.

The motivation for this project was derived from the various discrepancies seen in the existing traffic surveillance system in our country. The dominant problems currently faced are the contentions of bribery, human error etc when it comes to identification of vehicles which do not abide by the pre-laid traffic rules. This drove us to the cessation that an automated system would serve as an imperforate method to abate the current issues facing us today. Automated traffic surveillance system provides the solution to this problem in three basic steps. The three major steps can be defined by the three C's – Capture: captures the vehicle which does not follow the postulated traffic rules and regulations, Communication: communicates the information of the vehicle wirelessly to a distant control room which hold the records of the various vehicles (private and public) Cataloging: by matching the obtained information of the above mentioned vehicle from the regularly updated database, the stipulated amount in deducted from the respective account on the owner. Thus by this method we aim at eradicating any problems associated with the traffic surveillance system and aim at making it even more efficient with the inculcation of new technology.

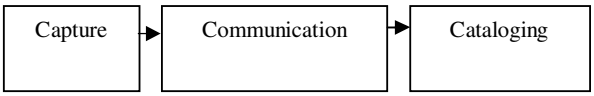

Fig 1.1 The three Cs

In this paper we have come up with a system that bypasses manual fine deduction and hence implements a more efficient system for the same. This system eliminates entirely, the need for manual surveillance. The project has been divided into three stages which shall be discussed one by one.

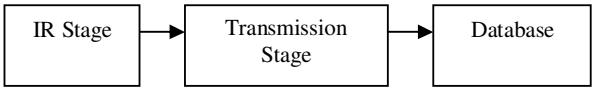

Fig 1.2 Stages in the project

The basic approach to the elucidation of the problem of traffic surveillance can be solved by our project which follows the three step approach. IR Stage: It is for the detection of the vehicles which break the traffic rules. Transmission: It is for sending the data which includes the unique code to the control room. Database: After the reception of data the sorting of the received number from the data base has to be done.

2. Description

2.1. Capture

1) *Working:* The first stage is the IR stage. Infrared radiation is a component of the electromagnetic spectrum with wavelengths of 5-50um for planets with temperatures between about 50K and 1000K. [3] This system uses a continuous strip of IR transmitters each operating on 38 KHz frequency. This strip will be positioned at each zebra crossing, parallel to the road and in alignment with it. This transmitter will be activated at the same instant that the traffic signal turns red.
2) *Future Scope:* Further development of this stage can be done, Single element receivers can be replaced by imagine receivers and diffuse transmitters can be replaced by multi-beam transmitters also called as quasi-diffuse transmitters. Line of sight and Non-line of sight links can be developed further depending upon the requirement [4]. The reason for selecting IR over other energy bands is many. To name a few, Infrared emitters and detectors capable of high-speed operation are available at low cost. The infrared spectral region offers a virtually unlimited bandwidth that is unregulated worldwide [5]. Multi-path fading is also prevented by using IR source-sensor pair. Since the IR source has to be placed on each and every zebra crossing, there is bulk requirement for the same. Hence the power consumption needs to be optimized, for this Impulse Radio Ultra Wide Band systems can be used [6], it would reduce the power consumption.

2.2. Communication

The second stage is the dual transmitter-receiver stage, which is positioned at the base of the vehicle. This consists of an IR sensor that captures the rays from the transmitter incase the vehicle happens to break the signal. This is the receiver part in this stage which triggers a subsequent transmitter part. This transmitter part employs FSK modulation technique to wirelessly send a code at 434 MHz/9600 Baud Rate. This code is unique to every vehicle and is transmitted to the control station.

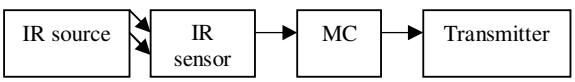

Fig2.1 Overview of Transmitter Stage

The block diagram gives a detailed view of the first stage. As stated before, the IR sensor in the vehicle gets triggered when the vehicle passes over the source. This received signal then triggers the subsequent transmitter in the vehicle. The microcontroller decides what data is to be sent, one of the two options signifies that no traffic rule is broken and the transmitter is functioning perfectly. This is done in order to ensure that all the users have the transmitter installed in their respective vehicles and no tampering is done to the same. The other data is the code which is sent and its further use is seen after it has been received successfully and given to the computer. The modulation technique used for the wireless communication of data is Frequency shift keying modulation [7],[8],[9].In FSK modulation the frequency changes depending upon the data, say for 0 binary data, fl frequency is transmitted, then for 1 binary data fh frequency might be transmitted. The values of fh and fl should be such that fh-fl>>2fb, where fb is the baud rate.

Advantages of Using Fsk

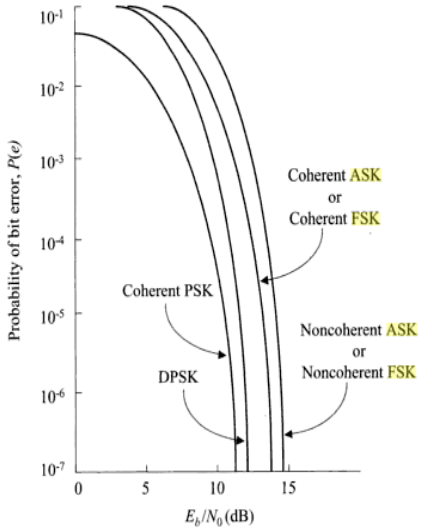

Fig 3.1 Error performance for Binary Modulation Systems

The probability of error for ASK, FSK and PSK have been plotted in the figure above. ASK and PSK require the same amount of bandwidth while FSK usually requires more bandwidth. Although ASK implementation is simple, it has poor error performance and is more susceptible to fading and non-linearity as compared to FSK. [10]. Various improvements can be introduced by using M-ary FSK modulation technique since the power consumption for the same is low[11] [12].

2.3. Cataloging

The data is received successfully by the FSK receiver module. This data is sent to the micro controller. The data is received in the computer and is matched with

all the entries of a pre made database. Required emails are sent both to the offender as well as to the bank from where the transaction is to be performed.

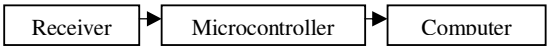

Fig 2.3 Overview of the receiver end

The security for the data of the users is an exigent factor that is taken care of by;

1. Keeping the fields read only fields.
2. The bank account details are shown using asterisks(*).

Numerous other techniques for the same can be put into practice.

3. Advantages of Proposed System Over Existing System

A. The current system displays real-time feed of the junction scene. This may cause server load. The hardware for this is costly and extensive. The total cost of the proposed system does not exceed a few hundreds of rupees.
B. The current system uses fiber optic cables and hence laying out the cables is going to be another huge undertaking. The proposed system is completely wireless and eliminates use of optic cables.
C. The existing system is an effort to monitor the traffic congestion. It does not take care of traffic infringements. Manual surveillance is required which is eliminated by the proposed project.
D. The camera equipment currently in use is PTZ cameras whose prices run in thousands of dollars. [16]
E. The existing system stores the video feed for up to seven days. Again, storage costs are bound to shift the cost high.
F. Most glaring point is that in a city like Mumbai, the camera equipment is liable to get stolen. Especially in areas that are notorious.

4. Conclusion

Apart from the already stated application in traffic Management, this system can be explored and its utilities can be observed in various other spectrums too.

For instance:

A. Traffic management as a vehicle counting system.
B. Tracking system for the police and armed forces.
C. Improvement in inter- city and inter-state security.
D. Toll collection on private roads. .

Thus by this method we can annihilate the quandary of traffic vigilance existing in India (where no technical aid is available) and also in a few other countries where alternate vistas are available.

We have seen how FSK has been chosen as a better option over ASK. The most important factor in the proposed system is the elimination of manual surveillance and fine deduction. This is a simple system which is cost-effective and requires much lesser labor work and installation costs than the existing system.

5. Future Scope

Various demodulation techniques are being developed today, which showcase better performance which can be measured in terms of the BER value measured relatively [13], demodulators offering high sensitivity [14], and also the most important factor that is low power consumption [15] are to be concerned, and the inception of an optimized demodulator can be done. Similarly when it comes to the data base and its management, various vistas are available and are also currently being developed to increase the efficiency of accessing the data and also increasing the security as far as crucial information is considered.

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Kriti Bhandari has completed her engineering with distinction in Electronics from K J Somaiya Institute of Engineering and I.T, Mumbai University in 2013. She has won the first prize in Technical Paper Presentation in Fusion 2013 organized by Vasandada Patil Pratishthan's college of engineering. She has also been the topper in the third year of engineering in Electronics Department. Her research interests include Wireless communication Computer Networking and Embedded systems..

Niranjana Raghavan has completed her engineering with distinction in Electronics from K J Somaiya Institute of Engineering and I.T, Mumbai University in 2013. She has won the first prize in Technical Paper Presentation in Fusion 2013 organized by Vasandada Patil Pratishthan's college of engineering. Her research interests include Wireless communication, Computer Networking.