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A Review for Traffic Management System Using Different IOT Devices

Mrs. Snehal Naik[1], Prof. Mrs. Shruti Patil[2]
[1]EXTC Dept., Shree L. R. Tiwari college of Engineering, Mira Road (E)-401107
[2]EXTC Dept., Shree L. R. Tiwari College of Engineering, Mira Road (E).-401107

***Abstract*—** *In recent years, traffic congestion is a major problem in Indian cities as well along with other countries. Traffic congestion is because of increased use of vehicles by the tremendous growing population of country. Another reason is the infrastructure that exists cannot be expanded so as the need for better management of the traffic. Traffic congestion affects day today life in terms of pollution of environment, fuel wastage, increased travelling time etc.*

Traffic monitoring system is used for monitoring of traffic. Intelligent traffic systems are developed to monitor the traffic keeping the goal as improving transportation safety, mobility and efficiency of transporting. It can be used to detect traffic congestion, Vehicle violating traffic rules, provision for smart parking of vehicles, automatic toll collection charges speed limit violation detection etc.

Internet of things (IOT) can play a vital role in Traffic Management, by using various availed methods for traffic management such as video analysis, Infrared sensors, Inductive loop detection, wireless sensor network, RFID etc. are effective methods for traffic Management. Different types of sensors are used for data collection.

***Keywords*—** *IOT, IR sensor, RFID.*

I. INTRODUCTION

IOT was first introduced by Kevin Ashton. IOT model refers to as virtually "everything" will be connected or can communicate with each other over internet. IOT is creating ubiquitous standard in wired and wireless communication. IOT permits people and objects to be connected Anytime, Anywhere, with Anything and Anyone.

IOT related to traffic can be divided into three layers – Application, Network and Acquisition. Acquisition layer comprises of sensors like RFID, IR etc. Network layer includes Wi-Fi, cellular mobile network; Zigbee, Bluetooth etc. Application layer makes use of information and analysis [1]

In the course of time there is a rapid and growing global trend towards the Internet of Things (IOT) at all levels of government and commerce. The common definition was that the IOT involves heterogeneous objects and connectivity. However, toreach the goal of the IOT there is a need for a model describing the communication between these heterogeneous objects, such as the TCP/IP model. Much discussion was done by a group of researchers from large industrial companies and research institutions to lay a common "architecture" for the Internet of Things: the IOT Architecture project (IOT-A). The heterogeneity of smart devices along with the currently existing infrastructure raises the impossibility of having a single design protocol that fits all application domains. Therefore, a more secure IOT model is needed.

II. LITERATURE REVIEW

In [1] different methods for implementation of traffic monitoring systems closely knit with IOT devices are reviewed.

In [2] the solution has been provided for problems that are arise in parking lot management systems via RFID. RFID readers, RFID Labels, computer and software are used for RFID Technology. The software has been handled for management, controlling, transaction reporting and operation tasks for parking lots located at various part of city. Database management system is used to store and manage vehicle tracking dataof software requirement visual programming language is used for operation.

In [3] UHF –RFID tag chip has been used in traffic management to strengthen system security and improve performance of tag. UHF RFID tag is designed using low power technology, SMIC 0.18 μm CMOS EEPROM technology for implementation.

It is secure as it performed authentication and authorization between reader and tag. Cryptographic algorithm is used for hiding identity information sensitivity of tag can be increased by using low power technology.

In [4] traffic density calculation, vehicle classification is achieved by video monitoring systems. Cameras are used at junction, according to the density of vehicles; traffic light switching is done by use of algorithm. Hence reducing congestion, waiting time and fuel consumption. MATLAB video and image processing toolbox software is used for the implementation and C++ compiler is used to generate the results.

In [5] monitoring of Traffic flow in traffic light junction was investigated by using wireless sensor network.one sensor and two sensor based traffic light controller are implemented and compared with (GLD) Green Light District Simulator's best first Traffic Light control . Implemented Traffic light controller gives better results, closed to ideal results. One sensor based traffic light controller is to detect the vehicle approaching towards traffic light. Two sensors based controller is used to calculate queue length .The gain value is obtained from observing roads and controller compares the gain values and selects the phase which allows maximum vehicles to pass by switching traffic light controls reduced

waiting time. For comparison of traffic light control Green Light district Simulator is used. It is open source java based simulator; enables users to create different road maps for different traffic patterns.

III. Types of Methods for Implementation

Various types of methods for implementation are:

- Radio frequency identification
- Video data analysis
- Wireless sensor network
- IR sensor

A. Radio Frequency Identification (RFID)

a. RFID: A Radio Frequency Identification (RFID) system consists of RFID controller and RFID Tag.

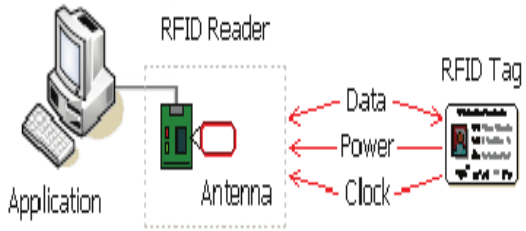

Fig. 1. RFID

b. RFID Controller: The RFID controller consists of RFID interrogator. This interrogator is used for the communication with the RFID tag. The RFID controller then gets the signals/data received by the interrogator. Messaging interference is used to send commands and data messages from the controller components. Controller core is present inside the RFID controller. The controller core listens to the interrogators and depending upon the configuration; the controller core can perform read/write operations upon the RFID tag or can do both listening and performing operations. The RFID controller can have serial interface through which external GSM/GPRS devices can be interfaced with it to make a dual radio device.

c RFID Tag: RFID tags are wireless devices which make use of radio frequency electromagnetic fields to transfer data, which is used for identifying and tracking of the objects. RFID tags are of two types: Active and Passive.

Active RFID has a battery installed, which the passive RFID doesn't have. Passive RFID has to depend on external source for working. Tags information can be stored in a non-volatile memory.

d. Applications of RFID sensor

1) Smart Parking guidance
2) Automatic collection of toll charge
3) Automatic vehicle speed detection
4) Traffic congestion detection
5) Traffic rule violation detection
6) Detecting emergency vehicle

B. Video Data Analysis

Video analysis consists of smart camera placed which consists of sensors, processing unit and communication unit. Traffic is continuously monitored by making use of smart camera. The video captured is compressed to reduce the transmission bandwidth. This captured video is then used to calculate different traffic statistics such as speed, frequency of vehicle, lane occupancy.

The problem in video analysis is:

1) Increased cost of system
2) Affected with weather condition

Proper lighting is required during night time for surveillance.

Fig. 2. Camera used for monitoring [4]

C. Wireless Sensor Network

Sensors are used to record changes in environment like temperature, wind speed, pressure, fog etc. The recorded data is the transmitted to gateways like Ethernet, cellular mobile network.

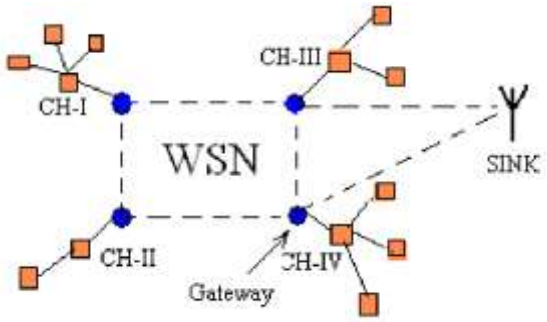

Fig. 3. Sensor Mesh Network

Wireless sensor network is classified in three architecture with respect to Traffic management system- adhoc, infrastructure, and hybrid.

Adhoc architecture include three types of sensors namely on road, on vehicle, on road and on vehicle sensor. Infrastructure architecture depends on improvement of road infrastructure whereas hybrid architecture is combination of both [1].

D. IR Sensor

IR sensor or infrared sensor contains two packages – Transmitter and receiver. Transmitter emits the infrared waves that travel through space [1]. If the object is detected; waves reflected to the receiver and further commands are send by the receiver to the electronic circuitry. Vehicle on board with IR sensor can intimate the driver about vehicles in near vicinity [1]. Thus collision can be avoided.

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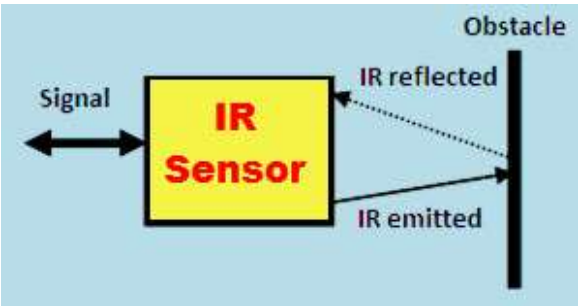

Fig. 4. IR Sensor

Infrared Sensors Infrared sensors are used to detect energy emitted from vehicles, road surfaces and other objects. The energy captured by these infrared sensors is focused onto an infrared sensitive material using an optical system which then converts the energy into the electric signals. These signals are mounted overhead to view the traffic. Infrared sensors are used for signal control, detection of pedestrians in crosswalks and transmission of traffic information. The basic disadvantages of infrared sensors are that the operation of the system may be affected due to fog; also installation and maintenance of the system is tedious .

IV. Types of Sensor

Different types of sensor are used for monitoring of traffic as follows;

Inductive loop detector, Load cell, IR sensor, RFID, Pnematic tube, GPS based,CO_2 sensor, FOG sensor, Ultrasonic sensor, Magnetometer sensor

V. Comparison of Methods

Different types of methods are compared in Table I.

TABLE I. Comparison of Methods

Methods	Advantages	Disadvantages
RFID	Easy to install, security is more.	Expensive, no standardization for manufacturing.
Video data analysis	More accurate, crime rates are reduced, faster and secure.	Affected due to weather condition, proper lightening required during night, maintenance and installation cost is more.
Wireless sensor network	Greater flexibility and lower installation, maintenance cost. Consumes low energy, battery powered, small in size sensor, deployed at various locations.	Encrypted radio signals, factory default username and password, slow speed.
IR sensor	Sensors detect motion in daytime and night time reliably. secured , faster accuracy is more, good stability , Cost is less	Affected by weather condition, maintenance is more, requires line of sight between transmitter and receiver.

VI. Communication and Addressing of IOT Devices

Smart devices like sensors, network adapters will be installed at the primary level. These smart devices must communicate with each other through certain protocol. Protocol is a set of rules that define how a communication task is performed. A collection of protocols leads to protocol stack. TCP/IP or Transmission control

Protocol/Internet protocol is one of the easiest and most widely used protocol architecture today. TCP/IP is a result of a project called ARPANET funded by USA Defense Agency in1970s. [1]

Each of the devices is provided with a unique IP address for communication with others. There are two type of IP address versions- IPv4 and IPv6. IPv4 is 32 bits long. Due to personal computing we are already running out of IPv4 addresses. IPv6 address is 128 bits long and was launched in 2012. [1] IPv6 provides internet protocol security called IPsec and can meet large number of IP address requirement.

TABLE II. The Security Model

OSI Layers (ISO 7498-1)	**Security Model** (ISO 7498-2)
Application	Authentication
Presentation	Access Control
Session	Data Integrity
Transport	Non-Repudiation
Network	Confidentiality
Data Link	Assurance/ Availability
Physical	Notarization/ Signature

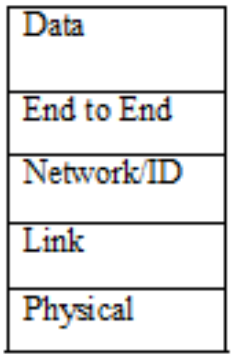

Fig. 5. IOT-A Communication Reference Model

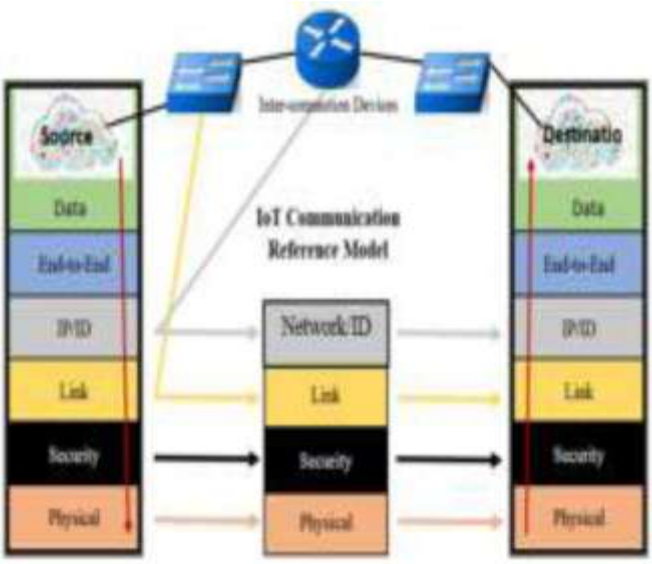

Fig. 6. Scenario of End-to-End Communications through the IOT

The security layer will be placed between the Link layer and Physical layer as a filtration layer before the processes of sending and receiving data.

VII. Security of IOT Devices (Physical and Virtual)

Often in developing countries, installation of high-end infrastructure comes with a risk of physical security. There a device installed for public benefit is found missing the very next day. With unavailability of sensors installed at the primary level the system becomes non-functional. To restore the system, new sensor need to be procured which adds to the cost and delay to the system. It affect the future development projects. Wireless communication often compromises on cyber security. Dedicated communication link between a transmitter and a receiver increases the cost and time of installation of system. But it does come with an added advantage of cyber security. Wireless sensor network has weaknesses like encrypted radio signals, factory default user name and password used by network devices etc. This enables any intruder to control intelligent traffic signal system for their personal gain or can cause traffic congestion. Implementation of cloud server for data storage can provide three levels of security – device security, connection security and cloud security**.**In the security hierarchy of information transmission process, it has to guarantee the confidentiality, integrity, authenticity and instantaneity of data and information, which mainly refers to the security of telecommunication network and corresponds to the security of transmission hierarchy in the Internet of Things.

Based on the IOT Communication Reference Model, an extra layer called "Security Layer". This layer can be considered as a step forward to a centralized management of all security mechanisms into a single and powerful layer. The Security Layer aims to confirm the identity of the sender/receiver, and to help to block connections to potentially vulnerable services.

VIII. Conclusion

Current traffic signal controlling method has turned obsolete in addressing different traffic situations arising in the course of a day. Also, some sort of control must be provided to onsite traffic police officer for emergency situations. Traffic congestion has an adverse impact on financial health of a country. It leads to fuel wastage, permanent damage to the environment and inferior quality of life. Moreover, hefty man hours are also lost behind the wheels which could have been utilized for productive work. It can be seen that using IOT for traffic management system can address traffic congestion effectively. IOT can enhance the efficiency of information transmission, traffic monitoring and management. This will augment vehicle efficiency, reduce trip time, reduce fuel wastage and ensure cost effectiveness. It can detect the traffic rule violation; also provide higher priority to emergency vehicles. Accident detection and emergency vehicle detection can decrease the mortality rate because of road accidents.

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