SMART TRAFFIC CONTROL SYSTEM

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Note: Architecture, design and technologies used in this document shall change in future versions of the Document.

Summary.

Smart Traffic Control System (STCS) controls the traffic signal at the junction of three or more intersecting road in the city. Surveillance camera shall be used to find missing person, criminal person, and stolen vehicles within city. STCS finds missing person or stolen vehicle, immediately calls to police and as well as person who registered the complaint. If any vehicle violates the traffic rules like one way, signal at junction, STCS, sends SMS & calls to the vehicle owner's registered cell number & sends email and hard copy of notice to the registered email id & correspondence address to pay the penalty. Also informs the nearest police station to catch the vehicle. And then it registers the case in its database. System keeps track of registered case until case is resolved. STCS also takes proper decision at junction when there are emergency vehicles like ambulance, fire vehicle and many others. STCS also monitors the vehicle speeds and sends message to the vehicle owner if driver crosses the speed limits.

1 Contents

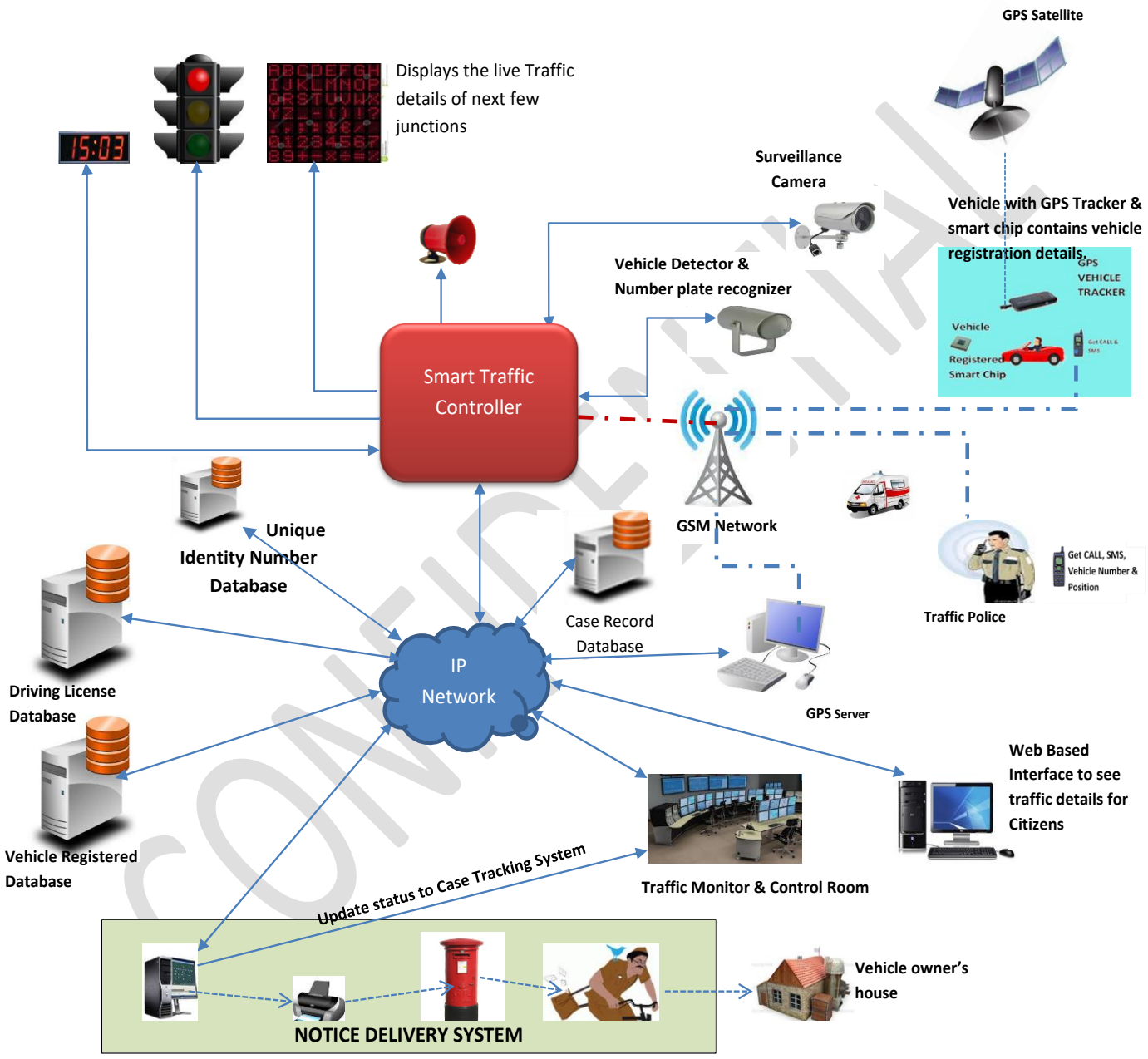
2 STATEMENT OF PROBLEM: WHY?

In India & other countries, Traffic is controlled by either police or traffic signal lights automated or manually in single junction of roadways. If vehicle violates the traffic rules, police has to catch him manually. There is also possibility that, police may ask for bribe. There is no evidence that vehicle has violated the traffic rules. Also accident occurs due to not considering the traffic rules. There is no synchronization of traffic signals of same straight road. Due to this, increases the delay in traffic control system, burns more fuel and increases pollution in environment. This causes impact in economy of country. So in India & other countries, existing traffic control system is ad hoc and difficult to bring the awareness of traffic rules to the drivers. It is also very difficult to find missing person, stolen vehicle and criminal person.

3 OBJECTIVE

- To reduce traffic delays, accidents, travel time, congestion, and environmental pollution and to see web based live traffic details.
- To Deploy in at-least three road junctions in city.
- To synchronize the multiple traffic signals of single straight road.
- To switch the traffic signals based on the density of traffic movements.
- To Detects the signal violated vehicle and sends SMS & voice call to registered cell number to pay penalty.
- To send SMS & Voice call to police control room to catch the signal breaker vehicle by reporting the position of vehicle using GPS system.
- After 24 hours of signal violation, sends notice to the registered vehicle owner's home address.
- Also records video 24x7 hours and captures traffic violated vehicles details.
- To track & catch the criminals & their vehicles.
- To detect and track explosive materials in vehicles by scanning vehicles (optional).
- Can be used for women security.
- To locate stolen vehicle.
- To detect whether vehicle number is valid or not.
- To reduce the bribe & corruption in department of traffic.
- To protect law & order of the country.
- To monitor lane discipline.
- To divert the traffic to other road.
- To Broadcast the traffic details of given junction.
- Vehicle owner gets traffic details to their registered cell number via IP network.
- To report traffic details of nearest Junction.
- To view Live traffic details of given junction point in TV and Web Interface to citizen

4 ARCHITECTURE



Get the vehicle owner address from database in post office, print notice letter & post it automatically. And deliver the notice letter to registered vehicle owner's house. Update the Case Tracking System in Traffic Control Room.

Certain equipment and components has to be deployed in the entire existing traffic control system. The following section gives the components to be deployed in different places of city.

Note: Vehicle can be any type which is registered while purchasing.

Vehicle Type can be

- Two Wheeler: Bike, Scooter
- Three Wheeler: Auto Riksha
- Four Wheeler: Car, Ambulance, Van,
- Bus
- Truck
- Fire Vehicle
- Many more
- Automated Self-driven vehicle.

4.1 Junction.

Every junction, following devices shall be shall be deployed

1. **Vehicle Detector**. It detects the vehicle whether it has crossed the traffic signal or not. If signal is crossed, it scans the vehicle chip which is adopted in the vehicle and gets all the details of vehicle and sends immediately vehicle details to STC. Also detects the emergency vehicle like ambulance, fire brigade vehicle, etc…
2. **Surveillance Camera.** To capture the video/ still image of vehicle & driver and sends it to the traffic control room & STC.
3. **Clock Timer.** It is count down timer, when it reaches to zero, traffic signal shall switch from one light to other light
4. **Display.** Used to display the live traffic details of next few junctions in the same direction.
5. **Speaker.** Shall be used to announce the message from the traffic police.
6. **Smart Traffic Controller.** STC connected to the traffic lights, clock timer, vehicle detector, camera, display screen and also connected to the GSM/GPRS network and IP network. STC is core decision making device based on the input data received from other devices. When it receives the data from vehicle detector, it immediately gets the owner details from RTO office and compares with vehicle chip data and immediately it calls to the vehicle owner, traffic police, sends email, sends SMS, also connected to the traffic control system via IP network. It also identifies the whether vehicle is emergency vehicle like ambulance , fire brigade or not based on vehicle chip data and allows to go emergency vehicle. STC will transmit the status of signal light periodically. So that automated driven vehicle can recognize and act according to signal light.
7. **Note:** At least ‘N’ sets of above mentioned devices have to be deployed in each junction whereas ‘N’ roads are intersected at junction.

4.2 Control Room

Control Room shall contain many monitoring tools and machine and shall be used web based graphical interface to view and monitor the traffic remote junctions which are connected to the cloud & IP network.

4.3 Police Station

1 Police person shall contain hand held device to receive the call from STC and also shall be used to update the case record. Also used to capture video & audio conversation while catching the faulty person.

2 Every police station shall contain the machine connected to the cloud & IP network and Web Based Graphical Interface shall be used to monitor and view video at traffic junctions.

4.4 Post Office

1. Machine connected to the Cloud, IP network. Automatically prints the notice & address of vehicle owner and puts it into the letter box.

4.5 Citizen

1. Web Based interface to see the live status of traffic of city.
2. Android application on mobile phone to view live traffic status.

4.6 RTO Office

Regional Transport Office shall contain the Big Data & data ware house containing the details and database of Vehicle Registration and driving License database.

4.7 Vehicle

Registration Chip (smart card) shall be deployed in vehicle while registration, containing the details of vehicle registration, owner's address, contacts numbers.

4.8 Description

As we aware that Red signal is used to stop the vehicles, Yellow Signal is to slow down and Green signal is used to go . In many cities, vehicles are moving without following traffic rules and jump the traffic signal. Due to this accident occurs at junction and other places. It also causes delay in traffic movement. Due to this it will impact on growth of economy of country and loss of human lives. To monitor the traffic in systematic way, we need to change the existing traffic system and adopt advanced traffic control system using latest technologies. We may have following scenario to describe the new traffic control system. Let's have look on new traffic system to be adopted in the country.

Vehicle has the electronic chip and is deployed while registering the vehicle. This electronic chip contains the details about the vehicle, registration number, owner of the vehicle, owner's details, like address, contact number, email id and photo. When vehicle jumps the red signal, vehicle **detector** at junction, collects the vehicle details from electronic chip deployed in vehicle and surveillance camera captures the vehicle image & registration number. Vehicle Detector & Camera communicates and provides the violated vehicle details to the Smart Traffic Controller. Then STC immediately recognizes the vehicle number and gets the owners detail from registration office. STC creates the case and stores all the vehicle details in server database. Once STC has owners contact number, it immediately calls to the registered cell number and warns to the vehicle owner and with automated voice informs to the owner that he has violated the traffic rules and has to pay the penalty for the same. STC keeps track of vehicle movement & direction, and immediately gives a call to the nearest police station in that direction and provides all collected details of violated vehicle. Police has to catch the vehicle and collect the penalty from the driver and update the record of the case using tablet like device in server's database and case is closed. Police has to deposit the collected amount to the government account. If police is unable to catch the violated vehicle, STC sends email to registered email id & SMS to the registered number and also

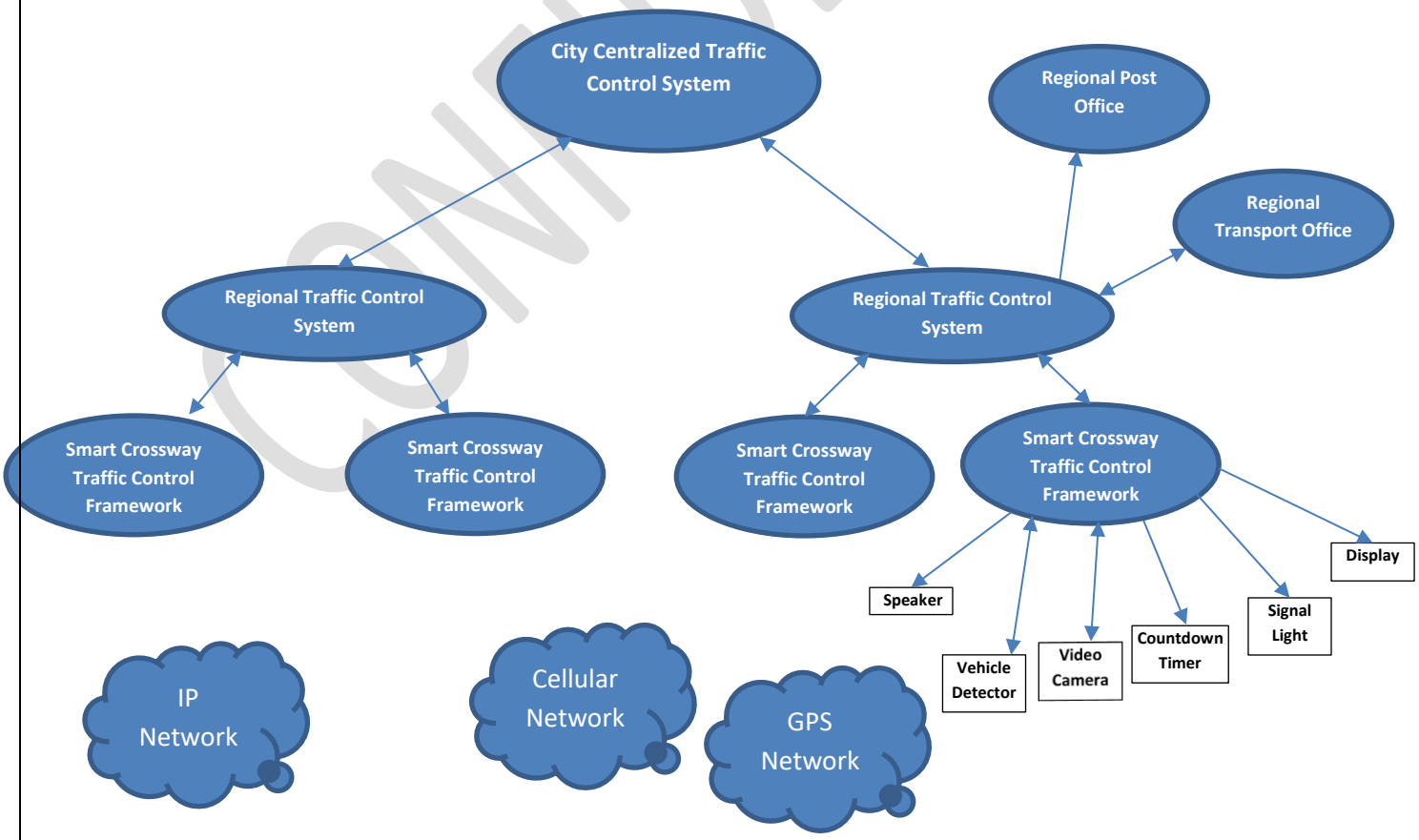
gives reminder call/sms/email once in 24 hours to the owner as well as nearest police station. After 24 hours of event occurred, STC sends message to the notice deliver device which is installed in post office. And post office device automatically prints the notice and address to be delivered. A post man collects the notice and delivers to the address. If address does not exist, then post man updates the record in the server database using the web based interface. Traffic Control System which is installed throughout the city, keeps on monitoring the vehicle until the case is closed and keeps on informing the movement of vehicle to the all police stations of city. Police has to catch the vehicle and owner, update the true address with proper address proof and collect the penalty from the person.

This system recognizes the emergency vehicles like ambulance, fire brigade,

This system can be used to monitor any illegal activities near by the junction and detects the weapon for safety and security purpose. System can also be used to find the missing/criminal person by showing his pic on the LED DISPLAY BOARD. If owner has not updated his contact details and didn't received any response within certain time, then vehicle shall be caught and force owner to update the contact details with valid proof document in the system. If vehicle is sold to other person and not re-registered the new owners detailed in the system, then previous vehicle owner will be responsible for any consequences happens. Previous owner must force to re-register the vehicle with new owner name other previous owner will keep on receiving the calls & notices if any traffic rule violation happened by previous owner.

4.9 MODEL

The issue can be resolved by adopting the latest technologies and with well-defined model. The following model may help to provide the solution to the existing traffic control system in single city.



5 PROTOTYPE

Initially Prototype of complete solution shall be deliverable which shall include either real or simulated solution of all the components as mentioned in Architecture Section,

1. Software solution of Smart Traffic Controller.
2. Simulated Traffic Light Module
3. Android application and Web Graphical Interface to get live traffic update
4. Web Graphical Interface to update the aadhar, vehicle registration and license record.
5. Software for automated the notice printing machine.
6. Emergency Vehicle Detection.

6 REQUIREMENT

6.1 Hardware Requirements

- Smart Controller Hardware (ARM CPU).
- Surveillance Camera with Number Plate Reader
- Vehicle Detector Hardware (Loop Detector).
- H/W Module to store vehicle details & RF Transmitter deployed in Vehicle
- Traffic Lights.
- 7 Segment LED Digit Display
- GPS Module.
- GSM Modem
- Data Storage Server Machine
- Printer
- LED Display Board
- Traffic Lights, Timer, Camera
- Oscillator
- Control Room Setup
- RF Transmitter Module
- RF Receiver Module.

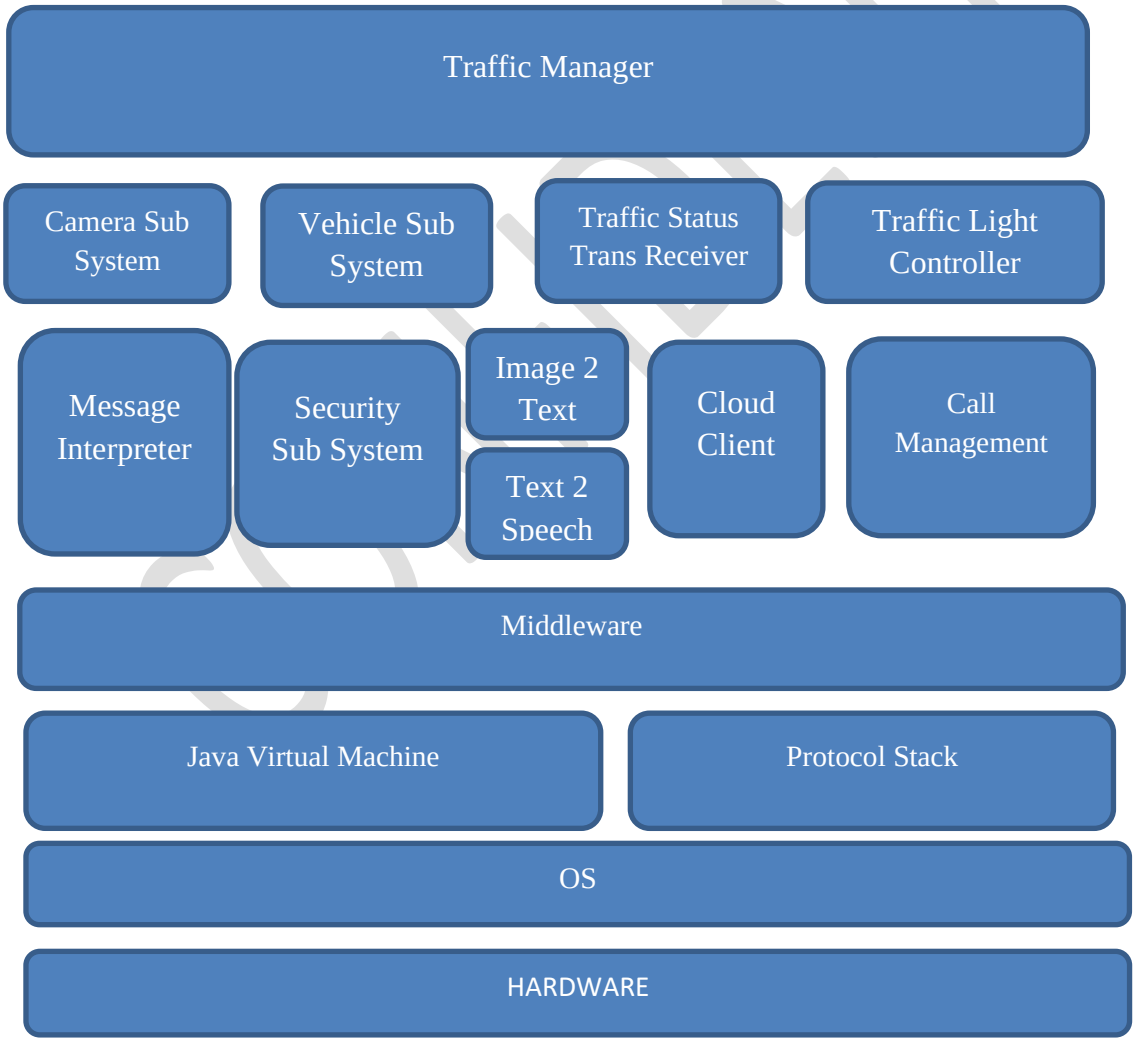
7 SOFTWARE MODULES.

1. Front end GUI, for vehicle registration. HTML, JAVASCRIPT
2. SQL Server to store Vehicle details i.e database.
    - Owner's database table.
    - Vehicle Details table.
3. Vehicle Detection Module.
4. Camera Module.
5. Traffic Light Module.
6. GSM/GPRS Module.

7. GPS Module
8. Smart Traffic Controller framework
9. Automated Printer Module.
10. Control Room GUI HTML, JAVASCRIPT.
11. SQL DATABASE for case record and video.
12. GUI for live status of traffic
13. Emergency vehicle (ambulance, fire vehicle) detection module.
14. Text Recognition
15. Text to Speech
16. Cloud library.

8 SMART TRAFFIC CONTROLLER FRAMEWORK

The following block diagram shows the modules to be implemented in Smart Traffic Controller framework. In this framework, all messages are in xml format and each module shall use same xml parser to interpret the message.



8.1 Traffic Manager

This is responsible to interacts with other sub systems in the framework and takes appropriate decision to base on traffic rules. All traffic rules are defined in this module. It is responsible to make a call, get the vehicle owner details, and get the vehicle status, status of traffic light and type of vehicle like ambulance, fire vehicle and other normal vehicles. It captures the snapshot of vehicle and then creates the case and sends it to the remote control room. It periodically checks the status of traffic light and vehicle position and takes appropriate action. It also recognizes or extracts the vehicle registration number from camera sub system.

8.2 Camera Sub System

This module responsible to connect to the IP based Surveillance Camera and capture snapshot of vehicle when it is violated the traffic rules. This shall include the complete protocols list like HTTP, RTSP, RTP/RTC, SDP and video decoders like MPEG2, MPEG4, WMV, etc… required to connect to the IP camera and take snapshot of vehicle.

8.3 Vehicle Sub System

This module connects to the vehicle detector and gets information about the status or position of vehicle from vehicle detector. Based vehicle position and status of traffic light, this identifies whether vehicle has violated the traffic rules or not. If vehicle violates the traffic rules, then it signals to the Traffic Manager.

8.4 Traffic Light Controller

This module controls the traffic light based on the timer and input from the vehicle sub system. It is responsible to switch the traffic light from red to green, green to yellow and yellow to red. It also maintains the status of traffic light.

8.5 Traffic Status Trans Receiver

This module is responsible to send and receive the live traffic status from other junctions.

8.6 Security Sub System

This is responsible for applying the security rules while transmitting and receiving the data over the network. This may include all cryptography algorithms, authentication, and token for security purpose.

8.7 Text 2 Speech

This module converts the text into speech i.e. audio which will use during voice call.

8.8 Call Management

This module is responsible for managing the calls and sends the voice over the network. This may use the protocol stack's interface to make a GSM, CDMA, call or voice over IP or PSTN.

8.9 Protocol Stack

This includes all the interfaces to the protocols like HTTP, RTSP, RTP, RTCP, SDP, and SIP, SSL, GSM/GPRS, CDMA, used in the system.

8.10 Java Virtual Machine

This is responsible for executing the Java Byte code.

9 VEHICLE DEVICE

Smart Card with RF Rx/Tx containing the vehicle & owners related information and transmitting the data. This shall be deployed in Vehicle. It also has emergency vehicle details within it.

10 CHALLENGES

It involves vehicle automobile industry and legislature of country authorities

As of now, if we consider traffic signal system & few automated driven vehicles are exists, in that case, automated driven Vehicle should recognize the traffic junction and act accordingly as per signal light. This means, traffic controller should transmit status of signal light digitally to all type of vehicles.

11 DISADVANTAGES

- The project involves car industry, country authorities which could add complexity. Probably legislation would be required to oblige car makers to include such chips in the vehicles.
- There could be points to be taken into account derived of privacy rights, at least in some countries. There are people working on automatic-driving cars: if they succeed relatively soon, the system you propose would become outdated.