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RFID-GPS based mechanism using aodvrp for stolen vehicle detection in vanet

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Article Info	ABSTRACT
	The traffic on the road was in the rise for the past few years, with more and more vehicles enter the road there was less scope of having better traffic. However, it could be maintained with the implementation of the proper system. The other major concern was on the theft of the vehicles and the accidents the drivers succumb to while in the road. This paper recommends the novel RFID-GPS mechanism based on AODV Routing Protocol algorithm in the hybrid VANET configuration that was working as a decentralized Ad hoc. The algorithm was framed in such a manner that it could be effective in maintaining traffic through communication among Vehicles and vehicles (OBUs) to the Roadside Unit (RSU). The RSUs would generate the possible route by Ad hoc On-demand Distance vector routing protocol and control the signals within the accessible limit if there were an emergency. The information about the stolen vehicles and the driver would be sent to the police station and hospital respectively that aid to track the vehicle by the Radio Frequency Identification-Global Positioning System (GPS) information and save the driver in case of an accident. The performance of the RFID-GPS mechanism based on AODV algorithm based on VANET was analyzed in NS2 and is related to the existing Zigbee. The outcomes exhibited that the proposed method was better in all performance metrics especially in throughput.

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1. INTRODUCTION

The roads of the world were getting accumulated by the vehicles that were increasing with the days. There arises the need for better communication among the vehicles through which the traffic delays, congestions and ensuring the safety of the user and the vehicle from theft. Hence the concept of Vehicular Ad-hoc NETworks (VANET) was developed to ensure the safety of the vehicles that hit the road. The VANET was the extensional variation of the MANET which provides the freedom for the nodes to leave or enter the network, required the different protocol for routing than in MANET [1]. The VANET was constructed in an ad-hoc manner by which the communication of information was performed among the different vehicles in motion and the devices that were connected by wireless means. The information that one node contained would be transferred to all other nodes and vice versa [2]. With the emergences of internet of things various problems like traffic congestions, emergency vehicle management etc can be solved effectively [3].

However, implementing the VANET was a challenging process due to the quality of service that they were intended to perform, the design of efficient routing algorithm, robustness to variation in traffic, communication among the vehicles and security in the secure network [4]. Tracking the location of a stolen vehicle using GPS alone may not be effective, since it does not have any coverage in tunnels. Also managing

the emergency vehicles, especially in peak traffic hours is a challenging task. There does not exist an efficient system that coordinate tracking of stolen vehicle and finding non-stop path for emergency vehicles. Henceforth many variations of VANET were being proposed to overcome the above challenges [5-7]. In the present work, the VANET was developed employing the novel approach of RFID-GPS mechanism using AODV Routing Protocol. The main objectives of the paper were to improve the comfort and safety of driving through the traffic and to minimize the traffic intensity, minimize the accidents, managing emergency vehicles and locating the stolen vehicles.

In the suggested model the VANET would communicate the information among the nodes of the Vehicle and also to the roadside unit (RSU). The system was constructed in such a way to provide priority for the emergency vehicles to pass through the signal at the particular quickly by turning the signal into green instantly by the communication from the nodes to the node in the traffic signal.

2.   LITERATURE REVIEW

The VANET architecture along with the transmission models that included the signal modeling, security and routing protocols of various algorithms. The outcome recommended that some VANET approaches performed well in the urban environment whereas the some in the highway. This indicated that the VANET's was influenced mainly by the crowding of vehicles [8]. A novel VADD was introduced with the idea of creating the helper node in which the vehicle in motion carried the packet until the new one enters into the area. This helper node technique had enhanced the performance of the VANET regarding the privacy, throughput, packet delay and loss of data [9].

The two routing protocols Dynamic Source Routing and Ad hoc On-Demand Vector were implemented among the highway police cars. The outcome showed that the AODV protocols were better in providing communication among the police cars in the highway in real time. The DSR protocols performance deteriorates with increase in the density of the node and the duration of call among the police cars [10]. The Radio Frequency Identification (RFID) was implemented to predict the position of the vehicle. The vehicle would acquire the information from the GPS receiver and the RFID that aid them to estimate the exact position of other vehicles. The Kalman filter was employed to reduce the accuracy error that occurs as the result of signal-noise ratio [11]. The integration of the RFID (cloud-based) with the VANET had many advantages in data processing and storing. CBRFID tags of high and ultra-high frequency were found to be very useful in the authentication of the vehicle [12]. The co-operating positioning of the particles in the GPS-assisted VANETs was implemented to reduce the quantity of the co-operative awareness message (CAM) payloads with no degradation in accuracy. It continually provided location service with very high-precision during the congestion of the channel and reducing the computation load and communication when it was free [13].

The novel concept of combining the GPS and non-GPS algorithm in the VANET architecture was implemented to locate the vehicle accurately. This method deliberated the fusion model by which the vehicle could be located in open GPS areas and also the area where the GPS would be absent (tunnels, mountain regions). The SimONE tool was used for the simulation and analysis [14]. The implementation of the RFID within the RSU would count the number of vehicle on the road. If the number increased beyond the threshold, the RFID would deliver the information regarding the traffic congestion. This method also provides the option for the ambulance to inform about emergency by which the roads would be cleared for free movement [15].

The performance of the VANET system was analyzed regarding the packet delivery ratio (PDR) and message overheads from the various protocols that include AODV, GPSR, CBR and DSR. The outcome of the work deliberated that the cluster based routings (CBR) were the superior related to all other protocols as they undergo the deprovement of the curve with an increase in simulation time [16]. The performance of the VANET was evaluated over the usage of the DSDV, AODV and DSR routing protocols. The PDR, packet loss percentage and end-end delay parameters were embraced to evaluate those routing protocols in a planned area [17]. The VANET with the speed and distance based beaconing scheme was established using the second version of network simulator (NS2) over the 100 and 200 nodes to evaluate the performance of the suggested VANET. The performance metrics evaluated was average delay, minimum and maximum delay, and the packets dropped in that scheme [18].

3.   RFID-GPS USING AODVRP ALGORITHM

The first step of the algorithm was to provide the input on the set of the vehicle that can pass through the installed signal over the period and the maximum number of nodes or vehicles (n) that the system as has been designed. The second step in the algorithm was framed to detect whether the number of nodes (i)

was less than the maximum (n) within the limit of the setup. If i was less than n, then the distance between the nodes was calculated, and the position of the nodes was estimated in x and y directions. Then the value of i was incremented.

```
Begin:
Step:1
Input→ 'n' number of vehicles, v[n];
Initialize the vehicle v[i]=1; //considering the 1ˢᵗvehicle
Step: 2
while (i< n)
{
Distance= getDistance (v[i]);
D= (vx[i], vy[i]) // finding GPS location of vehicles
Increment i;
}
Step: 3
if (v[i]<= Maximum Range)
{
Broadcast messages from RSU to vehicle through OBU;
if (Direction == Omnidirectional with ID)
{
Detect location(v[i]); //find location of vehicle using tag
Vehicle location details with ID monitor by server;
}
else
Checking location north & south
}
Else
Message transmit from vehicle to vehicle via OBU
with route discover & maintain;
Step: 4 Stolen Vehicle Identification
for (i=0; i<=n; i++) // checking availability of sensor
{
if (RFIDsensor== Null)
Unable to detect stolen vehicle;

else if (RFIDsensor==available) &&(RFID→intermittent)
RFID Ray united continuously & stolen vehicle detects;
}
Step: 5 Checking Emergency Vehicle
for (i=0; i<=n; i++)
{
while (detect (vehicle attributes))
{
if (vehicle != emergency vehicle properties)
No emergency vehicle detected;
else
Emergency vehicle detected and signal will change
for those vehicles by sensor;
}
vehicle act as normal;
}
Step: 6
for (i=0; i<=n; i++)
{
if (NV count==high)
{
Network traffic is occurred;
if (vehicle without ID)
Unauthenticated vehicle detected;
else
Authenticated vehicle;
}
else
Route is traffic free;
End
```

The third step of the was to detect whether the V[i] was less than the maximum range, if it were satisfied then the RSU would generate the information that was communicated to the vehicles through the OBU in them. If the system could track for 360º, then the location of the vehicle would be tracked, and the information from the advance tags would be transmitted to the servers. In some cases, it might be bi-directional. At a similar time if the V[i] were higher than the maximum range, then the RSU would generate the new routes and send it to the vehicles and maintain traffic. Optimal route finding was possible through distance, hop count, waiting time and energy consumptions with AODVRP (Ad hoc On-demand Distance vector routing protocol).

The fourth step in the algorithm was to identify the stolen vehicle. First, the system would detect whether the RFID receiver, transmitter, and sensor were present or not. In the absence of the one thing, it would be improbable to identify the stolen vehicle. If all that mentioned was present the outcomes from the RFID setup were accumulated to identify the stolen vehicles. The fifth step was to determine whether there was an emergency vehicle in the limit by checking the attributes of the vehicle. If the attributes matched the emergency vehicle the signal of the roads would be turned green for the time to aid the movement of it through the traffic. All other vehicles would be informed about it from the RSU. The condition would remain unaltered if there were no emergency vehicle.

The sixth and the final step of the algorithm were to maintain the network traffic if the number of the vehicle in the traffic was very high then the system would oblige to detect the unknown or unauthenticated vehicle within their limit range. By doing so, the traffic would be controlled, and the information on the unauthenticated vehicle would be sent to the servers. Similarly, the AODVRP would generate the shortest route for the vehicles that were moving in the same direction to access the different possible routes. Thereby the numbers of nodes in the consecutive RSU would decrease and the traffic would be reduced in the least possible time.

4. METHODOLOGY FOR RFID-GPS USING AODV PROTOCOL

VANET was developed to generate and transfer the communication among the vehicles in the road, but it could not be constrained within that as they were competent in communicating with the RSU. This

helps transmit the information about the traffic through the clouding units so that the information was widespread on the networks. Hence the VANET has the two primary forms of communication as V2V and V2R communication [19]. The hybrid VANET was implemented in this model which transfers the information among the vehicles, RSUs and cellular WLAN. The suggested hybrid model would reduce the average traveling cost of the vehicles. The proposed network model was generated on NS2, which consists of a set of vehicles. Every vehicle (node) should have some kinds of id (which is v1, v2, v3, v4,…Vn), through a collection of nodes or systems a network topology is formed. Framework for RFID-GPS using AODV in VANET as shown in Figure 1.

The network was incorporated with a RFID-GPS mechanism that uses AODV Routing Protocol. This protocol was employed to provide a destination for routes on demand by multicast routing techniques. RFID-GPS mechanism for communication network as shown in Figure 1.
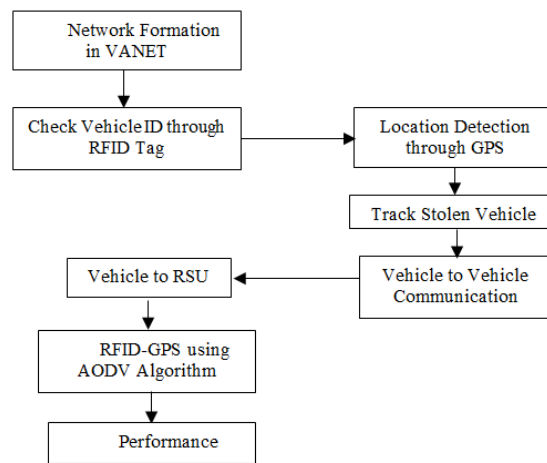

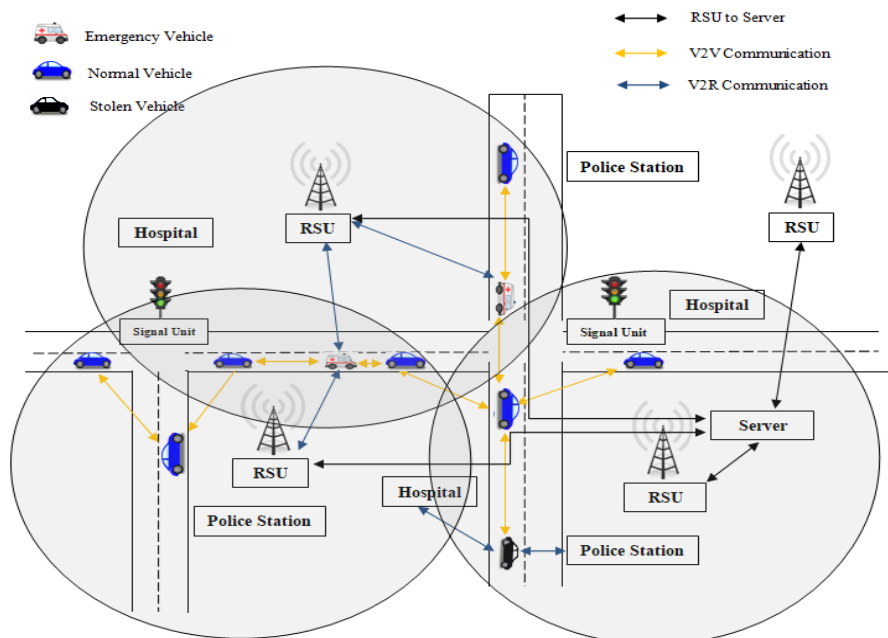Figure 1. Framework for RFID-GPS using AODV in VANET

Figure 2. RFID-GPS Mechanism for Communication Network

In general, the RFID system was established using the tags, backend servers and readers. The advanced tags were to be used in this setup that contains capabilities of symmetric key cryptography. This

RFID system was to determine transmission range, and check whether all nodes were in transmission range or not. It also aids to acquire information about all kinds of the vehicle placed in the surrounding location and their ids were detected through the sensor. Figure 3(a) exhibit the transmission range and ID detection in the proposed network on network simulator (NS2). The following stages constructed the transmission system model:

a.　Source encoding the message into signals

　　　　The OBU/RSU unit would encode the information from there end into the possible signals. The information could be of distance between the vehicle and RSU or in-between two vehicles along with the primary identifications of the vehicles. The information from the RSU would be of some vehicles in contact with RSU, the number of nodes in the traffic, if there were any emergency vehicles on the road etc.

b.　Signals are adapted for transmission

　　　　After encoding the information in the form of appropriate signals, the signals would be modulated for the transmission to be received by the receivers at OBU/RSU. These adaptations were necessary for transmitting the signal without any error so that the vehicles and traffic on the roads can be effectively handled.

c.　Reconstruct the encoded message from a sequence of received signals and decodes it

　　　　The signals received from the receiver unit of the OBU/RSU would be decoded and the information would be retrieved by decoding the signals that were sorted and arranged in proper sequences.

d.　Mathematical expression [20]:

　　1.　Vehicle to RSU

$$f(B_{RSU}, SJR) = a + b.\ln(B_{RSU}) + \frac{c}{SJR} + d.\ln(B_{RSU})^2 + \frac{f}{SJR^2} + \frac{g.\ln(B_{RSU})}{SJR} \tag{1}$$

　　2.　Vehicle to vehicle

$$f(Neighb, SJR) = a + b.Neighb + c.SJR + d.Neighb^2 + f.SJR^2 +$$
$$g.Neighb^3 + h.SJR^3 + i.Neigh.SJR + j.Neighb^2.SJR + k.Neighb.SJR^2 \tag{2}$$

Where B_{RSU} value represents the mean number of beacons received per RSU, SJR is the vehicle density, and a, b, c, d, f, g, h, i, j, k are the zunzun coefficient as shown in Table 2, Neigh represent number of neighbor vehicle. The ZUNZUN tool evaluates different prototypes of functions such as polynomial, exponential and logarithmic, to achieve the best fit by providing data obtained through simulations. The relative error is used to discriminate among the different functions. Error Values for Density Estimation as shown in Table 1.

Table 1. Error Values for Density Estimation

Error	V2I density estimation error		V2V density estimation error	
	relative	absolute	relative	absolute
Minimum	1.23E+00	5.40E+01	-1.45E-01	-2.49E+01
Maximum	1.70E+00	4.84E+01	1.97E-01	2.55E+01
Mean	3.04E-02	2.85E-13	4.15E-03	6.63E-13
Std. Error of Mean	3.54E-02	2.42E+00	9.01E-03	1.14E+00
Median	1.58E-03	2.37E-01	2.18E-03	1.41E-01

Table 2. ZunZun Coefficient Values

V2V		V2R	
Coefficient	values	Coefficient	Value
A	−7.917E+02	a	2.30E+02
B	−6.599E−01	b	1.91E+01
C	2.27E+03	c	−4.295E+02
D	1.20E+00	d	3.19E+01
F	−2.102E+03	f	1.88E+02
G	−1.751E−02	g	−6.813E+01
H	6.31E+02		
I	−4.811E+00		
J	−7.644E−01		
k	1.46E+01		

There would be communication among the vehicles and RSU when the vehicle was running in the road or caught in the traffic congestion. The RSU would provide the details about the traffic for a limited distance so that the driver of the vehicle could decide on the shortest or possible way to reach their destination. The location of the vehicles was determined with the help of the GPS that the vehicle should be built with and this aid the police to track down the location of the stolen vehicle. If the vehicle were stolen, the following communication would take place as follows.

1) Vehicle to hospital

The details of the stolen vehicle would be sent to the hospital first so that if the driver of the vehicle might have experienced the accident or attacked by the person who stole the vehicle. So they might need medical attention to save a life, hence in our system, the first information on the stolen vehicle was sent to the hospital.

2) Vehicle to Police Station

After sending the information to the hospital, the information was communicated to the police station with the details of the advanced tags. This would help the police to track the vehicle based on the detection of the same details from the retrieved RFID from the surrounding locations. In this tracking, the GPS would help the police to narrow down on the stolen vehicle by accurate location. Figure 2 shows the communication of a stolen vehicle with nearby hospital and police station.

The RSU would gather the RFID information from all the signals and send them to the different police station through the secure Hybrid network so that the stolen vehicle would quickly come under the monitoring of the police in which direction the vehicle was heading for and the GPS would support to track the location of the vehicle. Similarly, the unregistered vehicle was detected in the road by analyzing the signals received from the vehicles in RSU unit. This is shown on Figure 3(b).
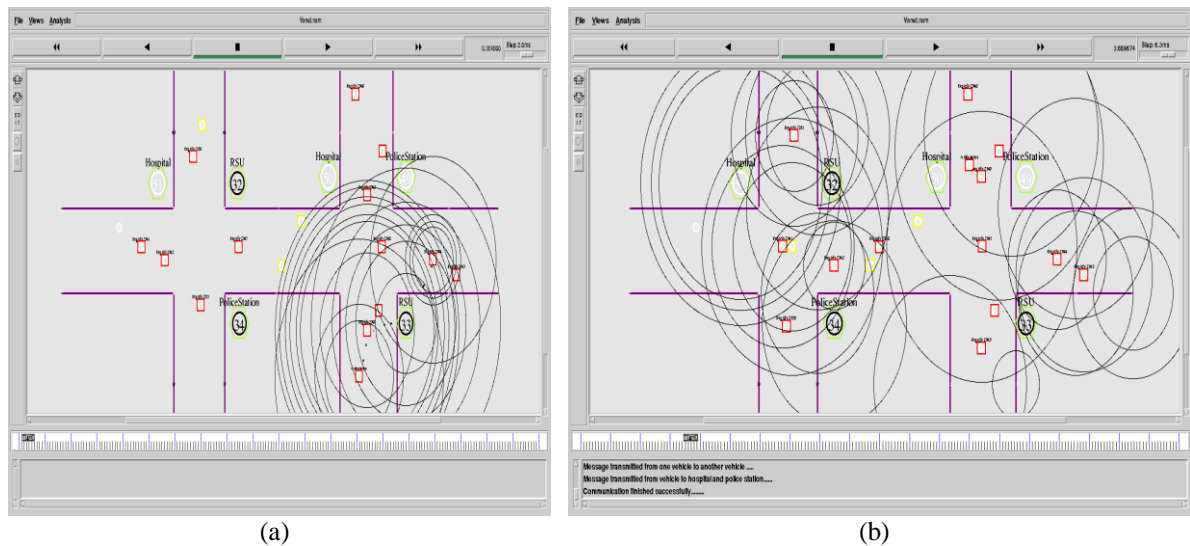

(a)   (b)

Figure 3. (a) Transmission Range and ID Detection (b) Tracking of stolen and unregistered vehicle

5.   RESULT AND DISCUSSION

The performance evaluation was performed on the recommended RFID-GPS mechanism using AODV algorithm based on VANET (RGAODVRP_PIC16F877A) was compared with the Zigbee_Atmega328 [21] and their results were discussed below.

a.   Traffic analysis

The traffic analysis between the two algorithms was shown in Figure 4(a). The RGAODVRP_PIC16F877A reduced traffic compared than Zigbee Atmega328. The RSU in the recommended system initiated the information on the traffic congestion when the number of vehicles breached the critical number. This information was transmitted to all the vehicles within the limit area and to the traffic controller. This system also provides the best alternative route to reach the destination for the drivers. Hence it reduces traffic congestion or reducing the time for traffic to be usual. In this way, RGAODVRP_PIC16F877A outperformed the results obtained by the Zigbee Atmega328 in traffic analysis.

                    (a)   (b)
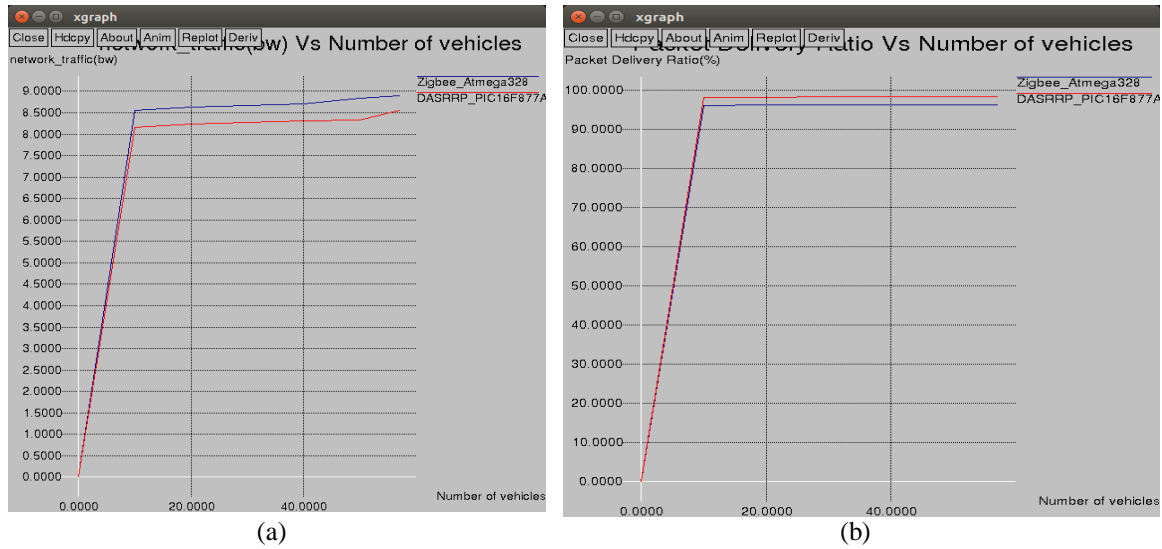
Figure 4. (a) Traffic Analysis (b) Packet Delivery Ratio Analysis

b.   Packet Delivery Ratio (PDR) Analysis
         The analysis on the PDR between the two systems showed that the RFID-GPS mechanism using AODV had performed slightly better than the Zigbee has shown in Figure 4(b). The robust nature of the hybrid VANET had provided the edge to transmit the packets from the source to nearly 98% of the receiver packets compared to the existing setup with 96% effectiveness in PDR.
c.   Throughput Analysis
         The main impact of the recommended system over the existing one was deliberated in the throughput analysis. The existing setup had the medium throughput value of 0.42, but the recommended RFID-GPS using AODV algorithm had performed with a throughput of 0.96. The Figure 5(a) exhibit the variation among the throughput values of each system.
d.   Security analysis
         Figure 5(b) displays the variation in the security performance of the recommended system that showed a small improvement related to the existing setup. The integration of RFID and GPS had provided better security to the vehicle and also tracked them if they were stolen. The suggested system helps to reach and save the life of the person if it was in danger.

                    (a)   (b)
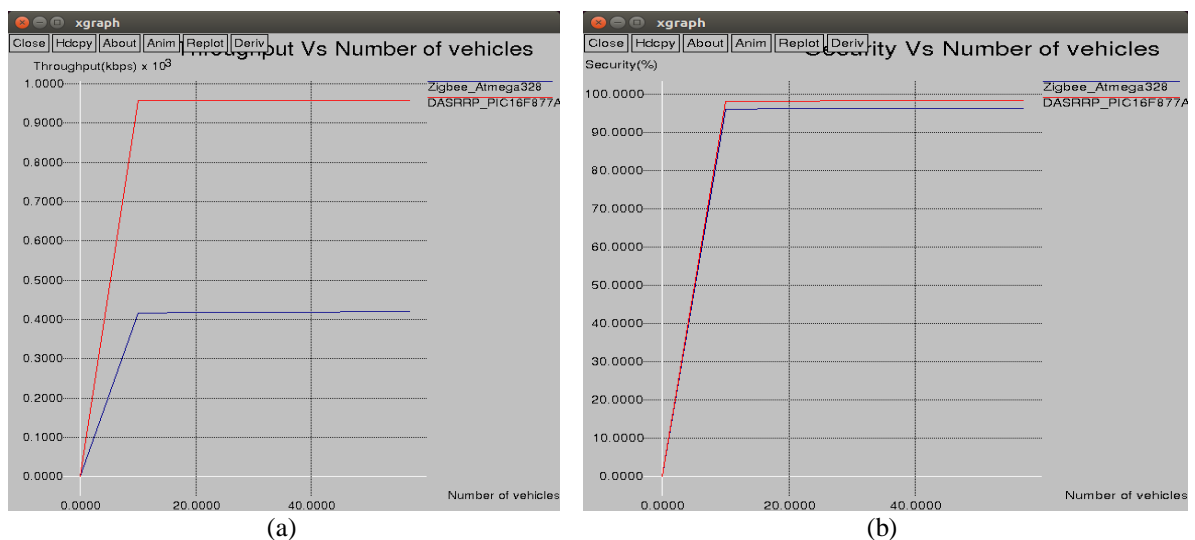
Figure 5. (a) Throughput Analysis (b) Security analysis

e. Delay

The delay parameter estimates the time duration to transmit the bit of data to all nodes in the network. In this parameter also the RFID-GPS mechanism using AODV had edged out the existing Zigbee by 10ms. Figure 6 exhibited the variation among the two systems.
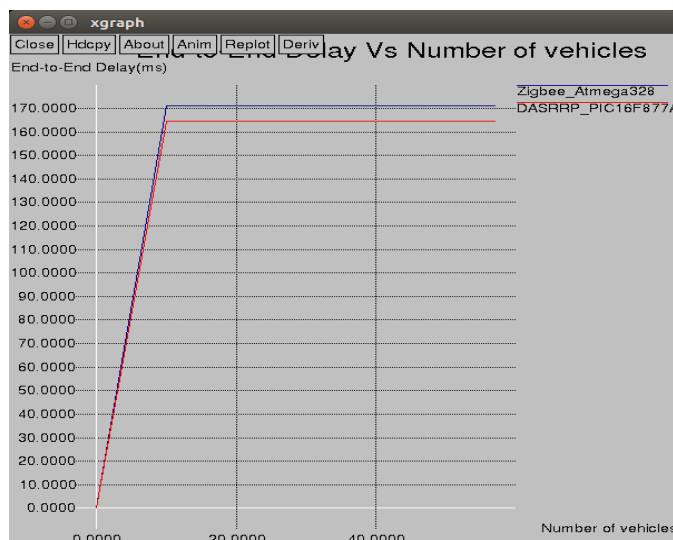

Figure 6. Delay

6. CONCLUSION

The hybrid VANET network which connecting the vehicles, RSU and cellular towers were developed with the novel RFID-GPS mechanism using AODV algorithm as the routing protocol. The advanced RFID tag was incorporated into the architecture of the RSU by which the details of the vehicles were encrypted. From the simulation using the NS2, it was established that when the vehicle was stolen there would be the communication from the vehicle to the hospital and police station correspondingly to help the driver save his life and vehicle. With the help of the incorporated GPS and the advance tag, the police would be able to find the stolen vehicle easily. The performance of the recommended RFID-GPS AODV algorithm was analyzed based on the traffic, PDR, delay, throughput and security metrics. The outcome exhibited a better performance of the recommended algorithm over the existing one in every parameter.

The present study was more viable in the urban regions where the police stations and hospitals were nearby, and the number of traffic signals was high in numbers than in the remote or in highways. The constrained nature of GPS in remote areas is also a matter of concern. In the future, this algorithm has to be enhanced for the highway roads with non GPS setup that might provide the best form of VANET for detecting the stolen vehicle.

REFERENCES

[1] Ravi Tomar, Manish Prateek, G. H. Sastry, "Vehicular Adhoc Network (VANET)-An Introduction", *International Journal of Control Theory and Applications, International Science Press,* 2016,Vol. 9 (18), pp. 8883-8888.
[2] Prabhakar Ranjan, Kamal Kant Ahirwar, "*Comparative study of VANET and MANET routing protocols",* In Proceedings of the International Conference on Advanced computing and communication Technologies (ACCT 2011), pp. 517-523.
[3] H. Varun Chand, J. Karthikeyan, "Survey on the Role of IoT in Intelligent Transportation System", *Indonesian Journal of Electrical Engineering and Computer Science (IJEECS)*, Vol. 11, No. 3, (2018): pp. 936-941.
[4] Sabih ur Rehman, M. Arif Khan, Tanveer A. Zia, Lihong Zheng. "Vehicular Ad-Hoc Networks (VANETs)-An Overview and Challenges", *Journal of Wireless Networking and Communications,* 2013, Vol. 3(3): 29-38.
[5] H. Varun Chand, J. Karthikeyan, K. Simy Mary "A Review on Localization and Detection of Nodes in VANET", *International Journal of Recent Technology and Engineering*, Vol. 8, No. 1, (2019): pp. 1374-1377.
[6] Anita Mohanty, Sudipta Mahapatra, Urmila Bhanja *"*Traffic congestion Detection in a city using Clustering Techniques in VANETs", *Indonesian Journal of Electrical Engineering and Computer Science (IJEECS),* Vol. 13, No. 3, March 2019: pp. 884-891.

[7]   Wan Mohd Hafiz bin Wan Hussin, Marshima Mohd Rosli, Rosmawati Nordin, "Review of traffic control techniques for emergency vehicles", *Indonesian Journal of Electrical Engineering and Computer Science (IJEECS),* Vol. 13, No. 3, March 2019: pp. 1243-1251.

[8]   Irshad Ahmed Abbasi and Adnan Shahid Khan, "A Review of Vehicle to Vehicle Communication Protocols for VANETs in the Urban Environment", *Future Internet,* 2018, 10, 14, pp. 1-15.

[9]   Er. Gaganpreet Kaur, Dr. Sandeep Singh Kang, "Technique to control Data Dissemination and to support data accessibility in Meagerly Connected Vehicles in Vehicular Ad-Hoc Networks (VANETS)", *International Journal of Advanced Research in Computer Science,* Vol. 7 (6), (Special Issue) November 2016, pp. 58-64.

[10] Irshad Rahim Memon, Wajiha Shah, Wanod Kumar, Khalid Hussain Mohammadani, Sufyan Ali Memon, "Performance Evaluation of Routing Protocols in VANET on Highway: Police Cars Communication Scenario", *Engineering Science and Technology International Research Journal*, Vol. 1, 3, Sep, 2017.

[11] Kun Zheng, Quan Yang, "*Vehicle Positioning Method Based on RFID in VANETs*", Proceedings of the 2nd International Conference on Computer Science and Application Engineering-CSAE, 18, 2018.

[12] Melaouene Noussaiba, Elmakfalji Chaimae, Romadi Rahal, "*A cloud-based RFID for VANET access filtering*", 3rd International Conference of Cloud Computing Technologies and Applications (CloudTech), 2017.

[13] Gia Minh Hoang, Benoit Denis, Jerome Harri, Drik T.M Slock, "On Communication Aspects of Particle-Based Cooperative Positioning in GPS-aided VANETs", 2016 *IEEE Intelligent Vehicles Symposium* (IV), pp. 20-25.

[14] Muhammad Tufail Hashmi, Awais Adnan, Fazle Hadi, Muhammad Zubair, "*Localized data fusion model for VANETs using GPS and non-GPS system*", International Conference on Communication Technologies (ComTech), 2017, pp. 180-185.

[15] Sriram Giridharan, "Road Traffic Congestion Management Using RFID (Ambulance Clearance And School Zone Speed Management)", *International Journal of Innovative Technology and Research,* Vol.6, 3, April-May 2018, pp. 8162-8172.

[16] Mazen Alowish, Yasuhiro Takano, Yoshiaki Shiraishi, and Masakatu Morii. "Performance Evaluation of a Cluster Based Routing Protocol for VANETs", *Journal of Communications,* Vol. 12, 2, February 2017.

[17] Nausheen Saeed, R. U. Amin, A. S. Malik, M. K. Kasi, B Kasi, "Performance Evaluation of AODV, DSDV and DSR Routing Protocols in Unplanned", *NECTechnical Journal,* Vol. 22, 2017, pp. 143-150.

[18] Kritika Kanwar, Shabnam Parveen, "Performance Evaluation of Distance-based and Speed based Beaconing in VANET", *International Journal of Computer Applications,* Vol. 170, 6, 2017, pp. 6-13.

[19] S.Mallik, P. Ramkumar, "*Real-Time Path Planning Based On Hybrid VANET Using In Transportation System*", International Conference on Emerging Trends in Applications of Computing (ICETAC 2K17).

[20] Julio ASanguesa, Javier Barrachina, Manuel Fogue, Piedad Garrido, Francisco J. Martinez, Juan Carlos Cano, Carlos T. Calafate, Pietro Manzoni, "Sensing Traffic Density Combining V2V and V2I Wireless Communications", *Sensors*, Vol. 15(12), 31794-31810.

[21] Sivakumar. R, Vignesh. G, Vishal Narayanan, Prakash. S, Sivakumar.V, "*Automated Traffic Light Control System and Stolen Vehicle Detection*", IEEE International Conference On Recent Trends In Electronics Information Communication Technology, May 20-21, 2016, pp. 1594-1597.