Automatic Traffic Control and Localization using Ad-hoc wireless network.

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ABSTRACT
The automotive industry in India is one of the fastest growing globally. India manufactures over 11 million vehicles (including 2 wheeled and 4 wheeled) which is creating a heavy problem of traffic control and security. In most of the part, the traffic is controlled based on timer, regardless of density of congestion over a particular area at particular time. In this paper we have came out with an approach, solving the heavy traffic and the automobile security problem with the help of image processing/laser detection and establishing simple adhoc network(using router and PCI cards). The shortest path with minimum cost is decided based on a congestion value which depends on number of vehicles intake, outcome and distance between the source and destination. It also provides a method of local positioning of the automobiles without using satellite communication.

Keywords -: image processing, laser detection, adhoc

1. PROBLEM DEFINATION
In simple ad hoc network, whenever a node comes in the range of a network (security-none) it becomes a part of the network and start communicating [5]. In this paper with the help of simple ad hoc network and image processing/laser detection technique(for detection of number of vehicles in/out from a particular lane), we have created a wireless network, in which each vehicles have a wireless PCI card and each crossing has a router ,which will pass information to the subsequent vehicles(wireless mobile nodes) in its range about the shortest optimal path to their desired destination and will also gives the information about its current location.

Destination point will be asked every time the vehicle starts as shown in the figure below. This destination point will be automatically detected by the router as vehicle comes in its range(to improved network capability, and provided QoS support for network services at certain extent, partial bandwidth reservation scheme) [10].

The camera/laser at both the end of every lane will detect the number of vehicles entering and exiting a particular lane and will decide the congestion/cost of that path.

Now with the help of our algorithm, best path to reach the next crossroad will be evaluated and the process will be repeated until vehicle reaches the destination point.

2. SOLUTION STRATAGY
Here when the vehicle will come in the range of the router (considering the speed to be not very fast)[11], it will send a packet containing destination point information, i.e. the IP address of the destination pt. and his IP address and his MAC address, to the router (as shown in Figure 3.2 and Figure 3.3). The router will then pass the packet to the requested IP address (vehicle) about the information of the next node, calculated by the server, to the vehicle and the path will be indicated in the vehicles display[12].

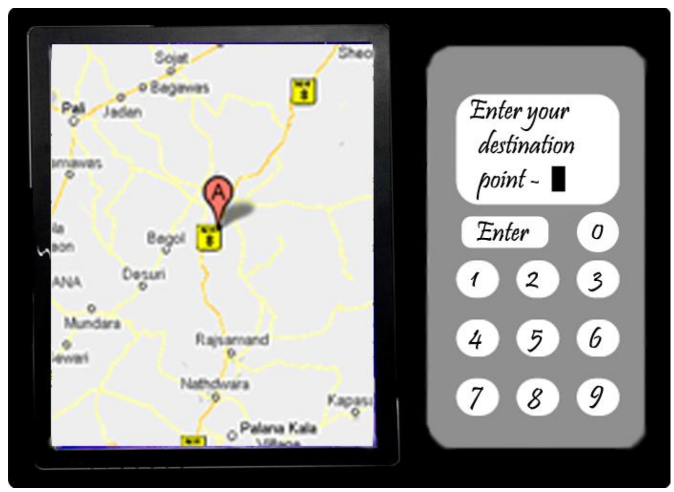

Figure 1: Device connected in the vehicle, interacting with the user and the server

The shortest/best path, will calculated as shown by the flowchart as in Figure 2.

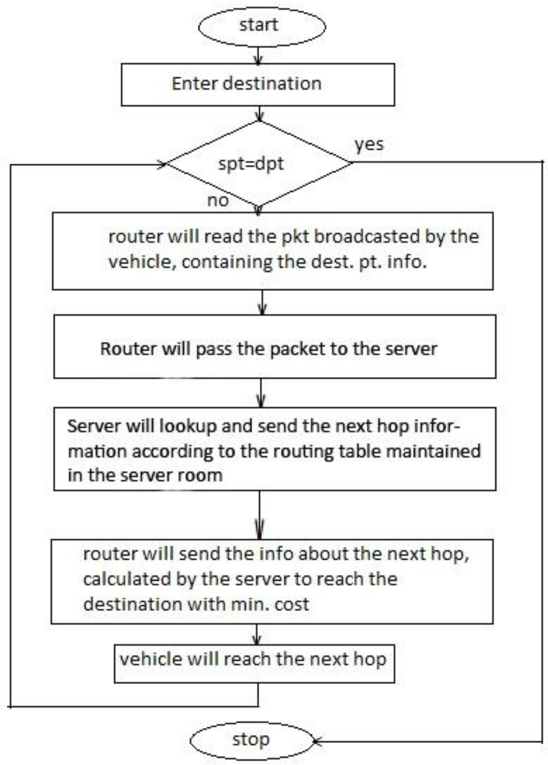

Figure 2: General flowchart for proposed system.

2.1. Application of Dijkstra's algorithm in traffic control.

Dijkstra's algorithm solves the problem of finding the shortest path from a point in a graph to a destination. It turns out that one can find the shortest paths from a given source to all other points in a graph at the same time [3].
The algorithm constructs paths starting at the source and going towards the destination. The choice of which path to be extended first and which path can be pruned depend upon a projected path cost function, which is obtained by adding the cost already calculated by the laser [14].

The pseudo code for Dijkstra's algorithm is fairly simple.

//ALGORITHM

Given a graph G, with edges E of the form (v1,v2) and vertices V, and a source vertex , S.

dist : array of distances from the source to each vertex
prev : array of pointers to preceding vertices

i : loop index
F : list of finished vertices
U : list of unfinished vertices

/ Initialization : set every distance to INFINITY until we discover a path */*

For ever vertex V

dist=INFINITY

prev=NULL

/ the distance from the source to the source is defined to be zero */*

dist[s]=0

*/*this loop corresponds to sending out the explorers walking the paths, where the step of picking "the vertex v, with the shortest path to s" corresponds to an explorer arriving at an unexplored vertex*/*

Receive the input and output detected by the laser and calaulate the cost of each path using the formula –

*Cost = (congestion * distance (in meters))/500*

Where, congestion= input/output

```
while(F is missing a vertex)
    pick the vertex v, in U with the shortest path to s
    add v to F
    for each edge of v, (v1,v2)
    {
        if dist of v1+length(v1,v2) is less
        than dist[v2]
        {
        dist[v2]=dist[v1]+length(v1,v2)
        prev[v2]=v1
        }
    }
    Update U
}
```

In this algorithm every distance is initialized to infinity, except the distance from the source [9].

2.2. LASER DETECTION

A laser light barrier system HLS comprises a transmitter unit and a receiver unit. The transmitter unit contains an eye-safe semiconductor laser device, which emits light pulses continuously. The receiver unit contains a highly sensitive photo detector. When a system is aligned and switched on, the emitted light pulses are picked up by the photo detector in the receiver unit.

During operation in adverse environments, the optics of the transmitter and receiver units will in time inevitably be covered by a layer of dust or a dirt/oil film reducing the initially high power margin. To avoid this, the receiver features an independent 'Pre-Alarm' function. If the strength of the continually received optical signals fall below an individually adjustable threshold, an independent 'early warning' signal is activated, alerting the maintenance staff [7].

3. IMPLEMENTATION DETAIL

For the setup, a router is required for each crossroad and a pair of laser and a receiver at each end of a lane. The routers at the crossroad will directly interact with the server room (wired) passing information to the nodes (vehicles) which will be connected wirelessly with the routers. The proposed architecture can be depicted as given in Figure 3.1.

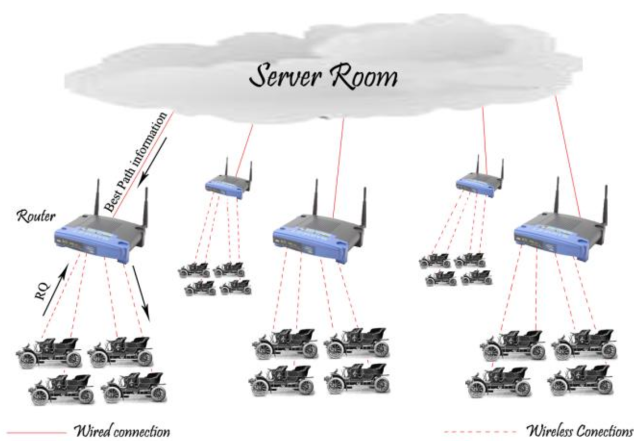

Figure 3.1: Three level implementation of the test-bed

The laser will be at the level of the vehicle's tire, and will detect the number of wheels entering (n1) and exiting (n2) the lane for specific number of time and hence will evaluate the number of vehicles.Number of vehicles (entering/exiting) = (n1 or n2)/2.

Thus the congestion of that lane is decided based on number of vehicles input and output.

Congestion = input/output

This congestion value is further used to evaluate the cost of the path.

Cost = (congestion * distance (in meters))/500

IP address of the vehical	MAC address of the vehical	IP address of the destination pt.	IP address of the router

Figure 3.2: Packet send by the node (vehicle)

Vehical's IP address	Vehical's MAC address	Router's IP address	Path informa-tion to the next node

Figure 3.3: Packet received by the node (vehicle)

Using the below algorithm we can evaluate the best optimal path from one source to destination.

```
Best_path()
{
        Enter the destination point
        Source point will be automatically detected by the
        vehicle
        nextspt=djk(spt,destpt)
}
djk(spt,destpt)
{
        graph G will be the graphical representation of the
city     where vertices(V) represents the cross road and the
        edges(E) represents the roads.
        Source point will be V1(where the vehicle is) and
        destination point will be V2.
        //Cost of each path will be determined by the formula
-        cost = (congestion * distance(in meters))/500
        //And the shortest path will be evaluated by the
        Dijkstra's algorithms
        nextspt = the next hop(vertices) as calculated by the
                        Dijkstra's algorithm
}
```

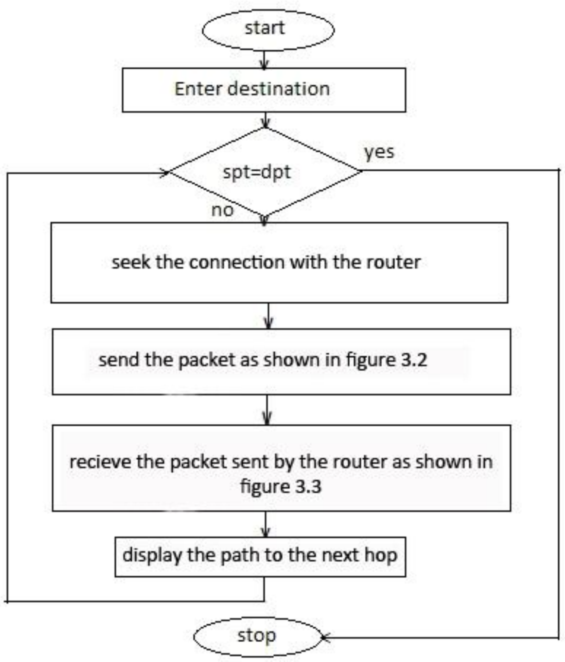

Figure 3.4: flowchart for client level.

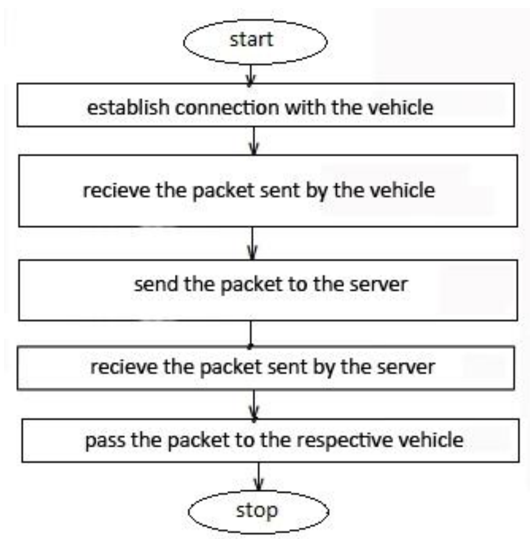

Figure 3.5: flowchart for router level.

4. LOCALIZATION AND SECURITY

Every vehicle will have a PCI card. The router will also broadcast the information about its location.

Whenever a vehicle will come in the range of a wireless router, its location along with the location information will get displayed on the screen in the vehicle. Thus the vehicles will get their local position.

As every vehicle will have its unique IP address and MAC address, thus the location of a particular vehicle can be easily identified by the server. At any instance of time the router in communication with the vehicle can help us to localize the vehicle with predefined location of the router as shown in Figure 4, there by increasing the security of the vehicle [12].

5. RESULTS

To prove that the proposed formula is efficient for finding the best shortest path. We have checked it with some random input values to see its optimality.

Input	Output	Distance(m)	Cost
10	7	200	0.57
10	5	200	0.8
10	7	400	1.14
10	10	1000	2

Table 1. Result

Further to see the feasibility of the above algorithm proposed, we assume the following graph –

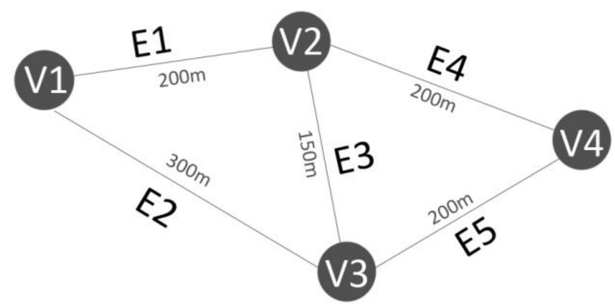

Figure 5.1: Graphical representation of the scenario

While vehicle is at source point (V1) it has two paths as E1 and E2 to reach the destination V4 as shown in Figure 5.1. Current cost of the edges comes out to be as shown in Table 2.

Edge	Input	Output	Distance(m)	Cost
E1	12	8	200	0.6
E2	7	3	300	1.4
E3	5	6	150	0.25
E4	10	8	200	0.5
E5	8	5	200	0.64

Table 2. Result

After implementing the above algorithm proposed, path to reach the V4 with minimum cost comes out to be V1-E1-V2-E4-V4. Here edge E1 will be suggested to the vehicle. As vehicle reaches V2 again shortest path from new source point to destination point will be calculated and as the input and output are continuously changing, new table is determined as shown in Table 3.

Edge	Input	Output	Distance(m)	Cost
E4	12	6	200	0.8
E3	4	4	150	0.3
E5	11	9	200	0.48

Table 3. Result

Again after implementing above algorithm shortest path comes out to be V2-E3-V3-E5-V4. Now the vehicle will be suggested to choose E3 although it was not in the shortest path calculated from the V1.

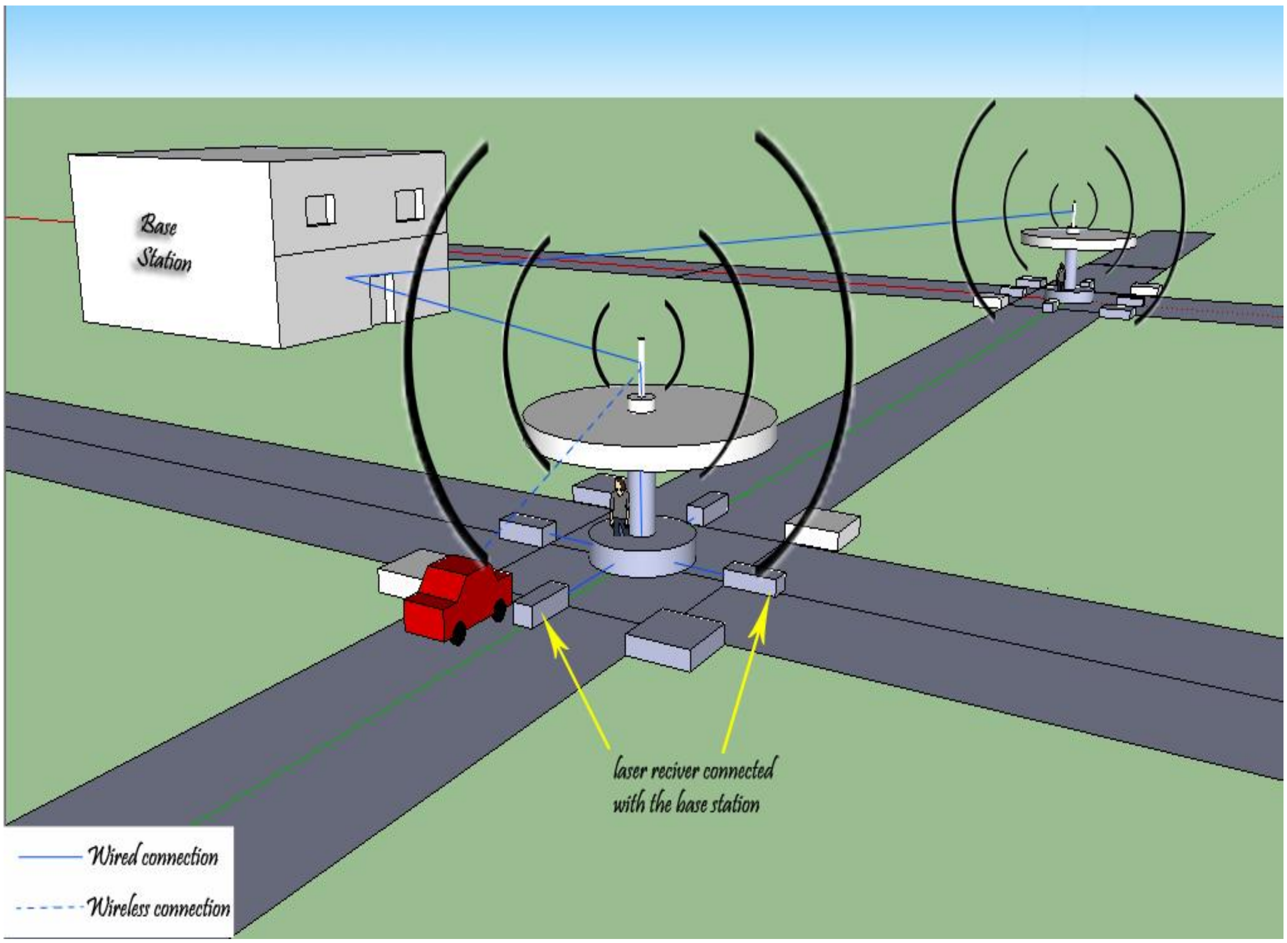

Figure 5.2: Model for proposed System

6. ACKNOWLEDGMENT

The idea of traffic control and localization was thought by our self and was wondering for approach and the way for implementation it using Ad-hoc network. We thank to all our friends and teachers for helping us to give an idea to approach with a simple and effective solution. We are very thankful to our institute for providing necessary working environment and needed resources for this project.

7. FUTURE SCOPE

a) Further image processing can be used instead of laser detection which will more refine the result by differentiating the objects.

b) As the all the vehicles are connected, they(users) can communicate among themselves[13].

c) VoIP can be implemented in the vehicles, for conveying special messages[10].

d) Furthermore Internet service can also be provided in the vehicles with the help of the routers.

e) Remote surveillance system can also be incorporated.

8. REFERENCES

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