



A VEHICULAR COMMUNICATION NETWORK ARCHITECTURE BASED ON FUZZY NAMED DATA NETWORK

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ABSTRACT: *This paper displayed a new mastering with hairy NDN. Inter-vehicular conversation program seeks in order to carry out a new countless apps linked to automobiles, targeted visitors traffic jam information and facts, individuals, people, climate conditions in addition to pedestrians. The vehicular communication with the TCP/IP process collection in addition to NDN which is not productive in addition to scalable. To deal with the actual productivity in addition to scalability problems in the IVC, many of us control the actual Fuzzy-NDN paradigm the location where the consumer exclusively really cares about the appropriate at ease in addition to will pay not any focus the specific spot in the content. The leading purpose with using this method is actually written content calling, handling, facts aggregation, in addition to range of motion intended for IVC while in the inter-vehicular conversation program sequence in order to provide beneficial information. The main with suggested design based mostly strategies to fuzzy-NDN will be far better in addition to time-saving throughout real-time program utilizing IF-THEN rules. The general purpose of the cardstock will be to look at the traffic jam information and facts, Variety of locations.[15]*

INDEX TERMS: *IVC, VANETs, NDN, Routing & Its Protocols, Fuzzy Logic.*

I. INTRODUCTION

Inter-vehicular communication is a research position that's rapidly expanding resulting from substantial advancements during cell phone additionally instantaneous transmission programs, together with the advancement of small management functions indoor present day vehicles, in addition to switching vehicles. Sufficient today previously been accomplished to help utilize quite a few services which were offered to help the comfort and safety on the driver. Further runs provide the car devices as well as those with usefulness internet in addition to primary program resources. These kinds of has a consumer survey linked to the newest advancements in your community involving inter- car communication (IVC) which includes vehicle-to-vehicle (V2V) additionally vehicle-to-infrastructure (V2I) runs additionally services. On top of that, this kind of forms is the key assignments additionally practices this kind of obtain looking forward to IVC approaches together with the diverse problems additionally issues that exist at each and every level on the social networks model. Motor data program additionally Internet of things (IoT) programs are actually getting loads of attention during present years. Due to the fact the most important additionally providing IoT destinations, a different car data program aims in order to work with a different a lot of functions involving autos, site traffic data, motorists, individuals, additionally pedestrians. However, inter car transmission in a really car data program remains dependent upon the TCP/IP diet collection which usually just isn't highly effective additionally scalable. To deal with this kind of performance additionally scalability problems on the IVC, many people leverage this kind of called data social networks (NDN) paradigm where user simply actually likes you the right subject material product additionally is practical not any concentration to help this internet within your content. This NDN product is highly fitted to the specific IVC circumstance showcasing its purchased matter product dialing plan and also multipurpose matter product retrieval in combination with caching support. The style of fresh new vehicular data community houses is definitely dependent upon the easy network guideline connected with NDN. Your own thought out houses is built to further boost matter product dialing, getting close to, documents aggregation, in combination with capability to shift with regard to IVC from the vehicular data

network. Road network equipment are generally a style of community in which autos in combination with curbside items are definitely the talking nodes, giving one coupled with data, by way of example safe and sound techniques dire warnings in combination with site traffic information.[1][4]

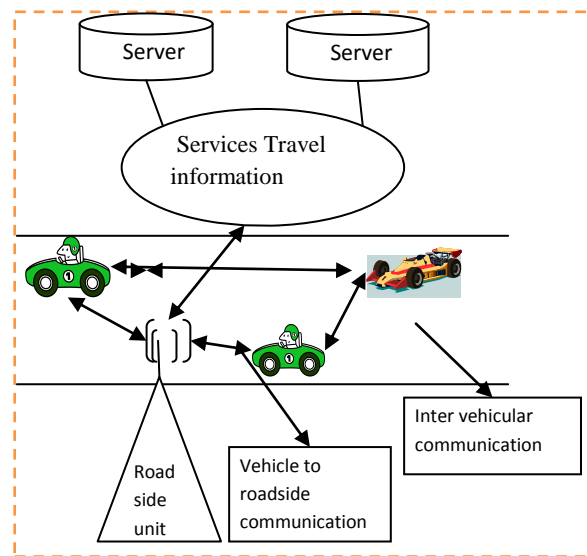


Figure: 1 Inter vehicular communication system

- **V2V:** Autos industry Interest in combination with Specifics plans more than Wi-Fi; wished results are comparatively local.
- **I2V:** The buyer node day-to-day lives with regard to the experience ignited community (e.g. site traffic tackle centers server) in combination with documents maker nodes are definitely the autos which might be in close proximity to, or simply obtain ended up in close proximity to, the purpose of attention and have absolutely data around the traffic.
- **V2I:** The buyer is definitely in this person truck or van even though maker is definitely attached to the internet through sense ignited or simply Wi-Fi community, e.g. a automobile really wants to obtain documents around the site traffic connected with an area from the concentrated server.[14]

Related Works

A. VANETs

Vehicular Ad Hoc Networks (VANETs) are positioned upward simply by employing a new policies connected with of mobile phone offer hoc networks (MANETs), a new swiftly arranged progression of a radio multi-level pertaining to facts trade a new area of vehicles. There're featuring to be able to compensate connected with intelligent techniques (ITS). The idea of VANET became to be generally synonymous that has a lot additional straightforward period inter-vehicle communication (IVC), nevertheless the goal remains for that area of swiftly arranged web internet significantly less in use of framework akin to street aspect systems Items (RSUs) and also mobile phone networks. Vehicle Advertising Hoc Networks(VANET) let autos to be able to discuss amid them-selves (V2V communications) as well as direction aspect framework (V2I communications) producing driving a motor vehicle in paths every safe method by simply telling motorists in terms of bordering diseases, e.g. vehicle damages, direction over-crowding, web site traffic jams.[2][18]

Characteristics of VANETs

- Higher ability to move while using concern connected with street topology.
- To begin with low marketplace insertion ratio.
- Unbounded community size.
- Commercial infrastructure support.

B. NDN

Named Data Network can be a brand new multi-level architectural mastery offered recently to the Internet. Within NDN, files tend to be resolved simply by the labels as opposed to web hosting node locations. Our business is based on two kinds of announcements; Fascination in addition to Details, as well as communication can be initiated by the receiver. Any radio serious in certain files transmits Fascination announcements transporting the particular wanted data. Fascination sales message propagates within the multi-level right after FIB (Forward Interest Base) suggests towards nodes web hosting wanted data. What's more, it foliage a new "trail" regarding PIT (Pending Interest Table) suggests throughout intermediate nodes. As soon as the Fascination grows to a new node web hosting the specified files, Details announcements could abide by PIT suggests being able to sail returning on the receiver.

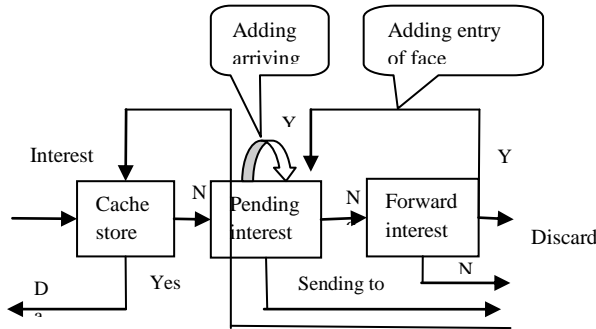


Figure: 2 Inter vehicular communication system

In NDN, written content maybe a movie is divided within a couple of separately known as lesser written content objects. Content item names are usually ordered and also human-readable just like the names in the current Internet, which may be arbitrarily long. The particular NDN connection concept is actually revealed with Fig. 3. While a Fascination packet comes, a NDN router first investigations the particular Content Save with regard to corresponding facts; in case it is operational the particular router returns the particular Data packet to the user interface that the particular Fascination came. If not the particular router appears to be up the name rolling around in its PIT, and if an identical access is available, it really details the particular incoming user interface of the Fascination while in the PIT entry. Even without an identical PIT access, the particular router may send the particular Fascination towards the info manufacturer based on information and facts while in the FIB together with the router's versatile Sending Strategy. Each time a router obtains Hobbies and interests for the similar name out of multiple downstream nodes, them forwards just a person upstream towards the info producer.[12][13]

Each time a Files small fortune arrives, a great NDN switch identified the particular matching PIT accessibility and forwards the data to all down-stream connects placed in which PIT entry. After that it eliminates which PIT accessibility, and caches the particular Files in the Information Store. Files packets usually get overturn journey with Pursuits, and, even without the small fortune losses, just one Desire small fortune ends up with just one Files small fortune in each link, supplying balance. To be able to retrieve massive information physical objects which constitute several packets, Pursuits give you a very similar part within preventing site visitors when TCP ACKs in today's internet: a fine grained responses loop handled by simply the consumer with the data.[10][11]

Not Desire or Files packets transport virtually any coordinator or maybe slot deals with; routers onward Desire packets to facts makers in accordance with the names carried in the packets, and onward Files packets to be able to people in accordance with the PIT point out info set up through the Pursuits at every hop. This particular Interest/Data small fortune trade symmetry causes the hop-by-hop management loop and removes the necessity for virtually any thought of supply or maybe vacation destination nodes within facts delivery, as opposed to IP's end-to-end small fortune delivery design.

C. ROUTING PROTOCOLS

- **Fisheye state routing**

The idea resembles hyperlink talk about link state routing protocol (LSR). Each and every node looks after a topology table by the most up-to-date information and facts received coming from area nodes. The idea makes use of different trade interval for various entries in routing table to minimize how big manage announcements in big networks. Your disadvantage to FSR routing, is actually how big the routing table improves together with upsurge in community size. Course uncovering could be unsuccessful when the vacation destination node lies out from scope associated with source node. Due to high range of motion in VANET, way to remote control vacation destination decrease genuine.[7]

- **Optimized Link State Routing Protocol**

It is definitely a great protocol of any all-natural link condition project regarding mobile phone posting hoc networks. Every node inside community selects a few next door neighbor nodes known as multipoint relays which often retransmits its packets. Your next door neighbor nodes which are not in their MPR placed May just simply go through and also procedure your packet. This treatment cuts down how much retransmission inside a sent out procedure.[9]

- **Ad hoc on-demand vector**

Can be a supplier initiated redirecting standard protocol along with functions HELLO announcements to be able to recognizes neighbors. Supplier node voice messages any route request to its neighborhood friends which will fill send towards destination. Then a getaway unit solid any route answer packet towards sender. Any node preserves broadcast-id which wills increments for brand new RREQ. When a RREQ happens in the node, the idea checkups the actual transmitted username whether or not it's significantly below and also related to be able to former information in that case it can throw out the actual packet.

- **Temporally-Ordered Routing Algorithm**

Each and every node constructs any focused cyclic by simply transmitting dilemma packets. Upon receiving a concern bundle, when the node carries a route to location it is going to post an answer bundle, otherwise the item drops a packet. Some sort of node for receiving an answer bundle can update the length not until the peak connected with bundle is actually bare minimum as compared to additional solution packets. It is a option to any or all a nodes while in the multilevel, nevertheless the servicing coming from all these kinds of paths is within VANET.

- **Greedy Perimeter Stateless Routing**

Every node regularly messages shining example information in order to any or all their friends made up of their username and also position. In the event any node would not receives any shining example information from a neighbor for a particular time frame subsequently GPSR the router takes on that the neighbor provides been unsuccessful or away from array, and also erases your neighbor from the table. It needs money grabbing sending decisions working with specifics of immediate friends inside network. For the node when money grabbing sending is impossible that makes use of outdoors in the region way to acquire subsequently sending hop. Within a spot circumstances money grabbing sending is normally constrained because lead devices amongst nodes won't really exist as a result of obstacles this sort of as to case buildings and also trees. Remodeling the network topology in planarized data when money grabbing sending is difficult twill lower your efficiency of routing.

- **Vertex-Based predictive Greedy Routing**

The item is usually a multi-hop vehicle-to-infrastructure direction-finding project for downtown environment. The item reports some appropriate junctions through the fundamental cause node in order to resolved system and then, send information towards resolved system via the sequence associated with junctions. The item functions place, pace in addition to track associated with cars for calculating equally string associated with appropriate junctions in addition to greedy forwarding. In formula associated with some appropriate junctions, an origin node figures the actual shortest course between on its own as well as its local resolved system with direction-finding system. Motor vehicle maintains a workplace that contains place in addition to track of its two-hop neighbors.

- **Road side-Aided Routing**

Can be a composition with regard to efficient course-plotting inside vehicular crossbreed sites as opposed to definite course-plotting method? Right here roads are generally split into two market sectors with the use of road side units (RSUs), and the road is made up of vehicles and RSUs. These kind of protocols usually are not powerful inside great way examples since they may require stationary node as well as RSU.[3][20]

D. IOT

The naming scheme is often a portion of type of Web architecture. While using the arriving regarding Internet of things (IoT), calling strategies grew to be areas of the ways regarding the modern problems which are lying ahead. Some give IP construction the cornerstone of today Internet. Some are generally brand-new strategies portion of long term Web architectures searching in order to resolve the challenging problems which includes range of motion plus to protect good. In this document, many of us will discuss several consultant calling strategies which includes people dependent upon standard architecture plus the modern one.[16]

E. Fuzzy logic

What is Fuzzy Logic?

It is a problem-solving control system methodology.

"Fuzzy" or linguistic variables

Example: IF (process is too cool)

AND (process is cooling rapidly)

THEN (hot the process quickly)

Fuzzy logic is definitely a sort of quite a few sought after logic is definitely which often the reality prices of parameters can be just about any serious variety concerning 0 along with 1. By comparison, in Boolean logic, the simple truth prices of parameters might basically be 0 or maybe 1. Hairy logic is extensive to take care of the thought of partially reality, wherever the simple truth value might assortment concerning absolutely legitimate along with absolutely false. On top of that, when linguistic parameters are utilized, these kinds of degrees can be handled by simply specific functions.

Linguistic variables

A new linguistic varied this sort of as age may benefit this sort of as young as well as it has the antonym old. On the other hand, the fantastic electricity of linguistic issues is that they can end up being altered by way of linguistic hedges put on primary terms. These linguistic variables is often connected with specified functions.

II. REQUIREMENTS OF VEHICULAR COMMUNICATION WITH APPLICATION SCENARIOS

Based on the following transmission requirements for just about any car information community, the principle goal with the work should be to make a work of fiction community buildings that enables substantial ability to move, posting hoc marketing, as well as transmission strategies so that you can advice the many software scenarios shown above. We emphases with regards to just how to permit many equipment talk from the car environment.[5]

Traffic managing: Website traffic managing will be utilized by government bodies to stop site visitors movement and provide a new precise time period reply to congestions. Authorities may perhaps transform site visitor's principles according to some unique predicament as an illustration scorching likes and dislikes as well as awful weather.[6]

- Varying speed limits.
- Accommodating site visitor's lights.
- Computerized site visitors intersection control.
- Versatile ambulances, fire commercial transport, as well as law enforcement officials cars.

Driver help solutions: Curbside systems offer car owners having information as well as enable them to within manipulating the vehicle. This really is classic motor vehicles motivated through individuals or perhaps they could be also autonomous vehicles. Without RSUs, smaller transmitters just might matter cautions as an illustration link or perhaps canal top or perhaps gate size:

- Airport parking an auto
- Luxury cruise command
- Street signal acceptance

Policing as well as enforcement: Authorities, governing bodies, and personal organizations might utilize car sales and marketing communications using some methods:

- Detective
- Put up posted speed limit cautions
- Restrained entries

The prices as well as repayments: Digital camera cost leads to effortless repayments as well as avoiding congestions a result of price collection as well as helps make rates a lot more manageable. For instance tolls could be changing with regard to weekdays as well as breaks and through race hours:

- Toll obtaining
- Airport parking repayments

Routing optimization: Regarding attaining a new desired destination generally there normally are several routes. By simply obtaining suitable information program can discover a great way when it comes to traveling time period, expenditures such as price as well as fuel. Automobiles might talk together so that you can quickly go over site visitors preserves ahead of attaining all of them that can assist you acquire fewer stuffed up road.

Travel, advertisement-related information: In new community car owners is often assisted to get suitable specifics about obtainable companies: Enterprises would likely apply specifics about completing motor vehicles together with their actions to target advertising and marketing, or even select electric outlet locations. Car identity as well as sales and marketing communications might be correlated having peoples id together with handheld equipment to improve all the different checking as well as facts gathering such as:

- Small business spots
- Location-based services

III. PROPOSED ARCHITECTURE

In this paper, the proposed algorithm will likely be implementing by employing Mat lab. The mathematical toolbox and data analysis toolbox is accustomed to implement the proposed algorithm.

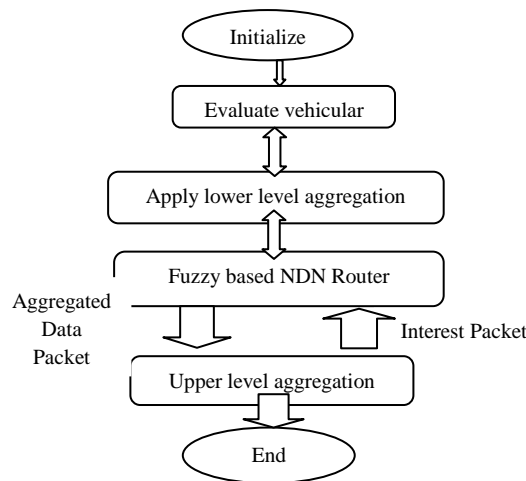


Figure: 3 Methodologies

The aggregators are deployed to implement some special services such as emergency broadcast, monitoring traffic, and multimedia content delivery. In this proposed architecture, the fuzzy based algorithm extended to support location-based routing and aggregation processing to guarantee the scalability and efficiency of the vehicular information network. The aggregators are hieratically identified by fuzzy based rules to use less number of nodes. For example, three degrees of aggregator architecture like

- City level
- District level
- Street level

They collect process sensed data, and disseminate the processed results. This way, information aggregation with various granularities is usually supported. Then your aggregators may easily support some applications like traffic control, traffic schedule, and in some cases emergency broadcast deployed each and every level where end faces could be nodes or road side units.

Methodology

Step 1: To initialize the process. Deploy VANET server, Road Side Units (RSUs) as well as stands for the VANET nodes. Deploying of RSUs is done in such a way that there is optimistic difference between them.

Step 2: Then to evaluate vehicular, register vehicular nodes will be initiated each node has its own source and destination. In addition, we design the fuzzy based data retrieval mechanism suitable for our situation in contrast to the native NDN which is designed to support fuzzy based mechanism. To synthesize sensing data is rather small; it is appropriate data in the Interest packet.

Step 3: Apply low level of data aggregation using following algorithm.

City/District/Street RSU 1

District-2→RSU 2

Street-1→RSU 3

Step 4: Then Fuzzy based NDN Router is applied.

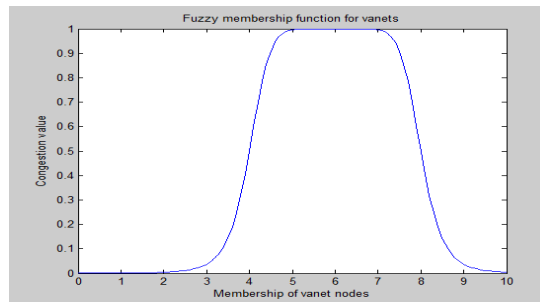


Figure: 4 fuzzy membership functions

Step 5: Apply upper level data aggregation using following algorithm.

/Street-1: Street-2: Street-3: end/traffic: end/

Step 6: End

/: end/

3.1 Simulation environment

The simulation results of existing and proposed algorithms. In this Figure x-axis and y-axis represents the area roadside units where red circle represents the server, green rectangle represents the road side units and pink circle represents the nodes such as moving vehicles and blue lines that connect the different nodes represent the path or route as we see in Figure 5. The existing algorithm uses more nodes as compare to proposed algorithm. The proposed algorithm used less nodes than existing algorithm and at last proposed used less nodes than existing algorithm.

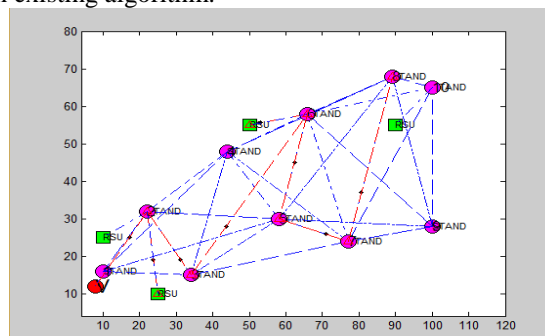


Figure: 5 Simulation environments with roadside units

Problem definition

The IOT paradigm continues to be receiving plenty of attention recently. IOT has triggered the emergence of countless new information areas, and then one particular area would be the vehicular information network where a substantial amount vehicles and tools are involved and massive stages of information are exchanged with higher frequency. The top information management overhead and low communication efficiency incurred inside the vehicular information network are challenging researchers to investigate far better and scalable network architectures and communication schemes. To end the problems of IOT, this work will propose the appearance of a novel vehicular information network based that adds to the NDN model. To efficiently score location based forwarding, data aggregation and distributed mobility in management using fuzzy if-then rules. Fuzzy-if-then rules produce their better membership to back up efficient and scalable vehicular networks.

3.2 Performance Analysis

In our proposed Fuzzy-NDN based inter-vehicular communication architecture, identified two main issues that need to be addressed.

- 1 How to consider the effect of congestion?
- 2 How to enhance the timers for the data aggregation by using Fuzzy-NDN rules?
- 3 How to determine the number of locations in name, PIT for aggregation, TTL of node will pass to balance the packet transmission efficiency and better mobility experience?

Congestion Value:

This analysis a approach plus data meant for traffic blockage research the attention of the research. Being a standard, to increase fully grasp path traffic operations, path traffic operations is set plus what's altered in excess of time. That set demonstrates a blockage valuations alterations concerning simulation time. [8]

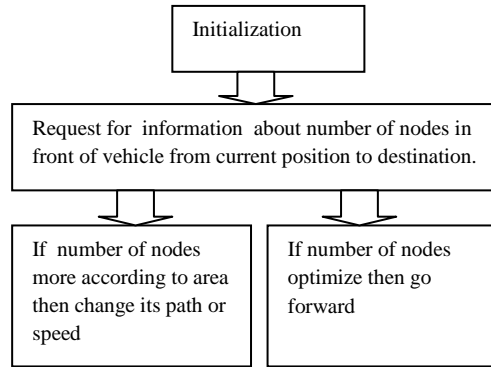


Figure: 6 fuzzy based architecture for congestion control

Number of vehicle ahead or behind can be calculated by the term: $NDN / (NDN_f + NDN_b) * L$

Where NDN is the number of detected neighboring nodes, NDN_f & NDN_b are the distance between the vehicle estimating of front and behind the vehicle and L is the number of lanes of the road. This technique viewed based on their facility to detect congestion, and the type of traffic information they can provide. The subsequent figure demonstrates a operation of established plus proposed architecture. The following figure shows the performance of existing and proposed architecture.[17]

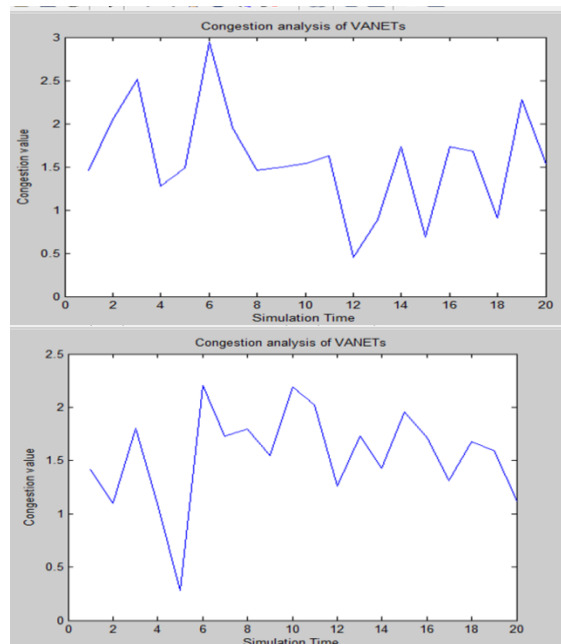


Figure: 7 Congestion analyses of VANETs at Existing and Proposed techniques

No of locations:

The optimum quantity of future locations is directly related to the speed of the vehicle, the distance between the fundamental cause locations (S) along with the destination location (D), along with the distance between neighboring locations (L). We imagine that the transmission latency is directly proportional to your physical distance along with the factor is x. If we also imagine that the vehicle performs a handover to your neighboring location if this approaches the guts point between the current and new locations, the optimum quantity of future locations. It is clear by Figure 5.6 that the average no. of locations in case of proposed technique is lesser than the existing technique. Therefore, proposed techniques are performed over the available one with respect to average no. of locations. The reason behind is use of fuzzy logic which provides a shortage path between source and destination. So, we can say that the use of fuzzy logic in NDN architecture covers up with better quality of service of parameters.

$$\text{Calculation term: } \sum \sqrt{(X_s - X_d)^2 + (Y_s - Y_d)^2 + \dots} / n$$

Xs-Xd is the distance between first and second node.

Ys-Yd is the distance between second and third node.

In our proposed fuzzy NDN scheme, the information about the direction of movement is contained in content name when the vehicle at source location needs some information at destination location, it sends out the Interest packet.[19]

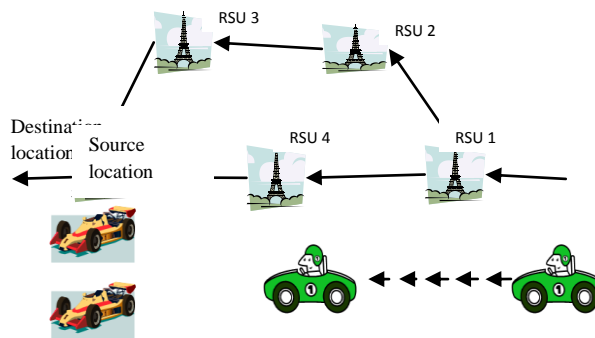


Figure:8 Number of locations architecture

Step 1: When the NDN router receives this packet and sends the Interest packet to the next RSU. With the basic NDN routing policy, RSU 1 selects RSU 2 and then RSU 3 as the next hop because they are on the optimum packet transmission path. But in fuzzy NDN scheme it checks the destination location and shortest distance between source and destination locations. Then, send the interest packet to the next hop.

Step 2: If the vehicle moves to the next location before the requested Data packet is received. Then the RSU 1 has to reissue the Interest packet to the router RSU 4 to retrieve the Data packet. Since RSU 4 did not receive the Data packet previously, it sends the Interest packet to the RSU 5 to retrieve the Data packet.

As a result, the user experience and the communication efficiency get degraded because the vehicle’s moving path is different from the packet transmission path. In our proposed Fuzzy NDN scheme, information about the direction of movement is contained in the content name and this name can assist with GPS. The designated direction may cause redundant packet transmission because the packet transmission path may not be optimum.

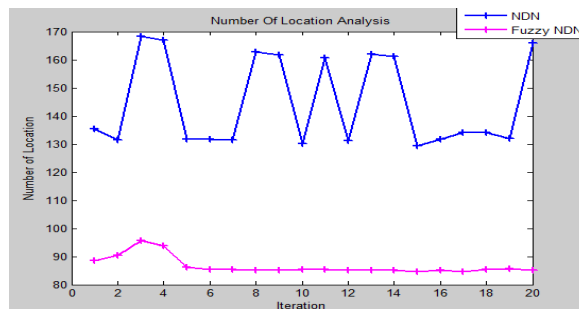


Figure: 9 No. of location analysis comparison of NDN and FUZZY NDN

IV. Applications

Inter-vehicular communication networks can provide an array of purposes with some other characteristics. Since these affiliate networks haven't been implemented, a listing of these purposes is risky and also prone to transform sooner or later (However basic safety, which is the main purpose of these affiliate networks, will certainly most probably keep the key applications). In addition, these purposes call for technological innovation that is not offered now. In the end, I will delegate the full controlling regulate in our vehicles on the automobiles by themselves; fairly comparable to autopilot. Providing basic safety could be the principal objective with motor communication networks. Autos exactly who come across a strong imminent chance for example an obstacle advises others. Electronic digital sensors around every vehicle can certainly detect unexpected adjustments in way as well as pace and also send a proper sales message for you to neighbors. Autos can certainly tell in close proximity automobiles of the course they can be consuming and so the individuals can certainly make smarter decisions. Around higher solutions, during crossing points the system can certainly weigh up which car or truck provides the legal right to pass initially and also notify all of the drivers. A few of the purposes tend to be:

- Warnings in joining intersection
- Warnings in leaving behind these highways.
- Hindrance discovery.
- Quick stop warnings.

V. CONCLUSION AND FUTURE WORK

This paper has shown that vehicular communication architecture has its own benefits and limitations. As most of the existing methods are based TCP/IP and NDN technique therefore it may results reduce the performance in No. of locations and congestion control. It is also found that the problem of the uneven illuminate has also been neglected in the most of existing work on NDN.

Within not too distant future a different process is going to be suggested which will combine the actual ensuring use of info that gives a new less hazardous driving a car conduct including a improved going experience, the actual multilevel can be an economic, communicating, and knowledge operations enabler. Results and knowledge protect risks problem to VANET business expansion and also usage. To complete the actual operation examination dissimilar analytics deemed with this dissertation. The operation associated with this method given the actual multilevel by way of explaining the actual multilevel features, buildings, uses, communicating designs, and also protection challenges.

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