



تحسن اختيار أفضل مسار توجيه للتطبيقات الحساسة الموجودة على شبكات G5 مثل تطبيق الواقع المعزز

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المخلص

نظرا لانشاء بيئة غامرة وتشاركية من خلال دمج العالم الافتراضي والعالم الحقيقي ، تتطور التقنيات الواقع المعزز والواقع الافتراضي في G5 وما بعدها (GB5). يتطلب استخدام هذه التقنيات جودة عالية بوقت زمني قصير ، والذي يمكن تعريفه على أنه تأخير من طرف إلى طرف بين العمل والتفاعل. يمكن القيام بذلك باستخدام خوارزميات التحسين لاختيار مسار أفضل لإجراء التوجيه. وتستخدم في البحث من أجل الحصول على أفضل النتائج ، اليوم تتبادل بيانات الشبكات باستخدام مجموعة واسعة من الطرق. لتحسين جودة الخدمة الطبية (m-QoS) أثناء حالة COVID-19 ، سيخلق بحثنا مسارا موثوقا به في الشبكات بين عدد كبير من العقد لاستخدامها في تطبيقات الواقع المعزز في المجال الطبي (مثل العمليات الجراحية) عن بعد باستخدام التطبيقات الطبية مثل تطبيقات تتبع الرعاية الصحية ، بما في ذلك الجراحة عن بعد. بسبب المشاكل الحالية ، تم منع العديد من الأشخاص من السفر خوفا من انتشار فيروس COVID-19. نتيجة لذلك ، ستقدم ورقتنا طريقة اتصال جديدة بالثقة وجديرة بالثقة بين المريض والطبيب لضمان قدرة الأخير على إكمال الإجراء حتى عن بعد ، من أجل ضمان الحصول على البيانات على الفور ، ستراقب الخوارزمية المقترحة المحادثة بين الطبيب ومريضه. من خلال اختيار المسار والمسار الأمثل خلال الدراسة ، فإننا نحقق في كيفية استثمار مساحة ذاكرة التخزين المؤقت بشكل فعال والتي يمكن استخدامها لتقليل زمن الوصول بين نقطة المنشأ والوجهة ، مما يمنع فقدان حزم المعلومات ذات الأولوية العالية.

الكلمات المفتاحية: تحسين – التطبيقات – الحساسة – شبكات G5 – المعززة

Optimization The Choice of The Best Routing Path For Sensitive Applications That On 5G Networks such As Augmented Reality Application

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Abstract:

Due to their potential to create an immersive and participatory environment by fusing the virtual and real worlds, augmented reality and virtual reality technologies are evolving in 5G and beyond (5GB). The use of these technologies to achieve a high-quality full immersion requires low-latency interaction, which can be defined as an end-to-end delay among action and interaction. This can be done by using optimization algorithms to choose a better path for the routing procedure. and utilized in the research in order to get the best outcomes , Today, networks exchange data using a wide variety of ways. To improve the quality of medical service (m-QoS) during the COVID-19 situation, our research will create a reliable path in the networks between a large number of nodes for use in augmented reality applications in the medical field (such as surgeries) remotely using medical applications like healthcare tracking



applications, including remote surgery. Due to the current problems, many people have been prevented from traveling for fear of the COVID-19 virus spreading. As a result, our paper will offer a very trustworthy and trustworthy method of communication between the patient and the doctor to ensure the latter can complete the procedure even at a distance , In order to ensure that the data is obtained promptly, the suggested algorithm would monitor the conversation between the doctor and his patient. By selecting the optimum lane and path through the study, we are investigating how we can effectively invest the cache space that can be used to decrease the latency between the point of origin and the destination, preventing the loss of high-priority information packets.

keywords :Optimization - Sensitive – Applications - 5GNetworks - Augmented

Introduction:

Recently, new ideas for the use of remote clinical medicine and surgery via telecommunications, known as telemedicine (augmented reality), have emerged as a result of health care based on technology for communication and information and augmented reality applications. Through connections or programs, telemedicine enables medical practitioners to check patients remotely and obtain health data. Telemedicine gives more flexibility to users of teleservices in rural and remote areas with limited medical facilities and resources. Specialized doctors (HPs) can remotely diagnose and consult patients with the help and guidance of local medical staff who treat patients in-person. The main enablers of telemedicine are the communication link and the related technology platform, especially in terms of mobile communication and video conferencing. The Internet's almost universal availability has expanded the scope of telemedicine in recent years. The telemedicine concept is implemented using three methods [1]..

This asynchronous action, known as buffering and forwarding, doesn't need that both parties be in communication at the same moment.

Remote Monitoring: Using real-time communication, the doctor keeps track of the patient's vital signs from a distance.

Real-time interaction traffic: employing the optimal route for data routing and transfer between the two parties (within the context of augmented reality).

The contemporary network that we are aiming for is comparable to the scenario in Figure 1. a large-scale network made up of lots of end users with Internet access and communication tools that make requests for different internet of things to support AR applications like smart health. We presume that there are numerous connected edge access points wherein edge servers are used to host

IoT and AR apps and fog nodes that can be accessed through WiFi. In addition, we consider that a fundamental network architecture exists to link access points with one another. As a result, certain access points can host edge servers but do not have to or, in rare circumstances, some access points can host an edge server but are not compatible with a specific IoT application.

Therefore, some devices can access any application on edge servers that are located in the same area as the access points. This means that devices from various locations within the underlying network architecture need to reach the different edge servers running IoT applications. The objective is to identify and transmit all networks by figuring out a trustworthy path between each node to construct the entire path from the source to the conclusion. Telesurgery and other guided operations can be carried out via this approach in the context of healthcare services. A lot of factors can affect the calculated trajectory.[3], including BW, delay, and stress. However, because of the distant learning aspect of e-learning, a large number of people use the Internet, To increase the reliability of our test results, we take into account on/off-peak hours. The suggested approach sends the packets to the intended location, using the path solely to pass the packets that have been marked. When nodes receive a lot of packets, the nodes' buffers will still contain the packets from earlier until they are immediately passed to the destination, preventing any packets from being lost [2][3].

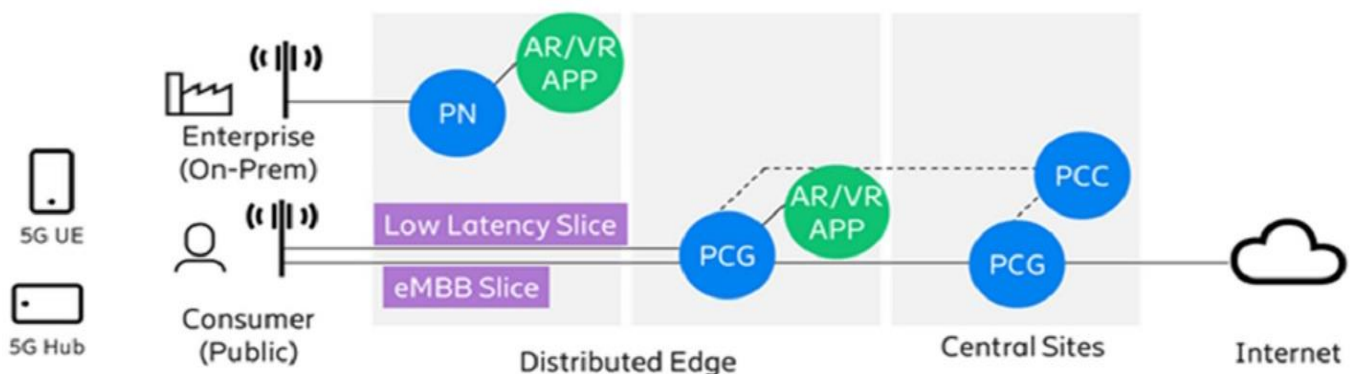


Fig.1 5G networks scheme to provide AR/VR technology

Aim of the study:

In order to improve the use of the best path for guidance for augmented reality applications AR (remote surgeries), this proposed technological advances introduces a special algorithm. It also provides a report that allows health workers to compare their performance to the standard measures of hospital interaction to determine how well they are performing. Our goal is to present a realistic vision of how existing Internet of Things components can be paired with certain routing protocols and clever path control algorithms of the Internet of Everything to support augmented reality applications rather than focusing on

scenarios that include the suitability or drawbacks of IoT and MANET or the Internal Gateway Protocol (IGP) [4].

Proposed study plan:

We use three levels of results presentation. First, we show how to minimize rate variability as much as possible when the surgeon starts a surgery using live streaming. Second, the proposed method reduces traffic on the specific path used for online surgery. Third, we evaluate how the optimal smoothing technique affects network variables such as the peak-to-average ratio and delay to improve the quality of service (QoS). We propose a novel Smart Path Control Algorithm (RCA) [3] to transfer the required data traffic between source and destination while considering the number of hops and the link delay. This provides a reliable connection for the Cal Surgery Health Augmented Reality program that can ensure that all instructions are quickly received and executed. This concept can improve mobile quality of service (QoS) in telesurgery through trusted channels. The new RCA can be adapted to work with the existing routing protocol for direct forwarding over the request path, basic route tracing, and monitoring of contingency packets received in node buffers.[2][3].

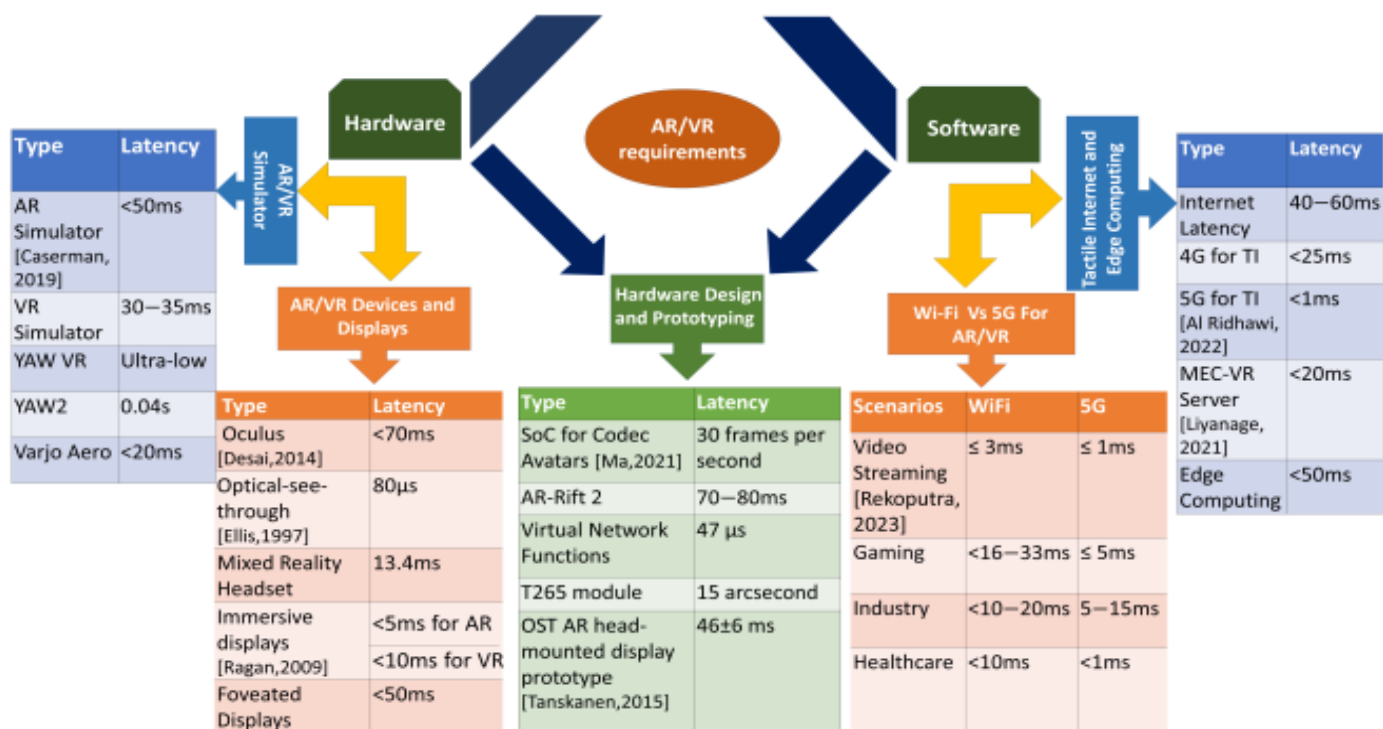


Fig.2 AR/VR Hardware and Software Requirements

AR/VR Hardwa

Create low-latency AR/VR simulations:

The best simulation platform must be chosen in order to analyze and investigate various sorts of latency. Adequate training is needed by engaging with numerous difficult or expensive situations of real external environments in order to model the simulation platform by selecting the optimal path for communication and



routing according to the studied algorithm. The simulator minimizes system latency (the superior path) by simulating an entire AR system in virtual reality [5]. The emulator sets up a system that is in charge of carefully regulating virtual object registration and enabling presence checking in the event of a registration problem. In order to properly regulate the isolation of various forms of registration problems and their independent handling for a low latency system, a method for evaluating perfect registration utilizing virtual reality systems was presented [3][5].

5G networks for AR/VR:

Both 5G and WiFi 6 are promising technologies to meet the market's demands with their higher throughput and better quality of service (QoS) requirements. WiFi technology can help 5G technology overcome its capacity and coverage limitations related to resources by using the open unlicensed spectrum. The coexistence of both technologies enables higher speeds, capacities, and lower latency thanks to orthogonal frequency-d (OFDM) modulation [83]. WiFi is an effective wireless connectivity method for AR/VR applications. Qualcomm introduced new WiFi 6E wireless chips for mobile devices, called FastConnect 6900 and 6700 processors [84]. They offer VR-class latency for WiFi VR streaming. These WiFi 6E Qualcomm chips are an improvement over the WiFi 6 (based on 802.11ax) standard; they offer more channels, bandwidth up to 3.6 Gbps, and less than 3 ms of latency. 5GB communications focused on the performance evaluations of wireless protocols and standards enables cutting-edge applications such as wireless backhauling, AR/VR, 8K video streaming, and sensing [3][4]. The IEEE standard association is looking towards future enhancements for "Beyond be" or "Next-Gen WiFi," which may be marketed as WiFi 8, with the advancement of IEEE 802.11be, which the WiFi Alliance expects to be marketed as WiFi 7. WiFi 7 tries to solve the problems of the half-duplex communication method seen in WiFi 6 and previous versions of WiFi with its full-duplex functionality. WiFi 7 has many advantages, such as increased flexibility in dense deployments due to resource utilization, reliable and fast transmission thanks to the use of hybrid automatic repeat request (HARQ), and time-sensitive net (TSN) for jitter-free, continuous AR/VR scenarios. WiFi 7 is expected to have a very high throughput [9] with a peak data rate that is four times faster than wireless 6 per AP at 30 gigabit per second. Apart from the use of WiFi 7 for the Internet for Everything (IoT), high-resolution video streaming, low-latency wireless services, etc., more innovative solutions are needed to reduce latency and support data rate requirements for AR/VR applications. Artificial intelligence (AI) is one of the main Next-Gen WiFi technologies to ensure the ultra-reliability and minimal latencies of the network. Machine learning (ML) is another important solution. [6][8].

Design of the 5G wireless network structure:

An inventive approach to provide ultra-low latency and dependable communications in emerging and semi-realistic applications including virtual and augmented reality, telesurgery, self-driving cars, and online multiplayer gaming is depicted in Figure 3. The performance of fully immersive virtual reality game scenarios, which are defined by dependable response time and the lowest delay, has been demonstrated for interactive virtual reality game arcades in [95] by testing the optimization method used to select the best path for routing and messaging between both parties within the creation of network. Fifth G, For internal augmented reality tasks, this setup For site synchronisation and user interactions, passes require extremely low latency. Edge HMDs have high operating frequency mmWave broadband access points (mmAP) coupled to an edge computing network. The edge computer network is made up of a number of edge computing machines and a cache to offload player tracking information and state predictions from the forecasting window of all user HD frames collected from their jobs in real time. Through effective job offload choices made for Server positioning and operator choice, this network design arrangement assists in preserving the trade-off among connection delay and compute latency [7].

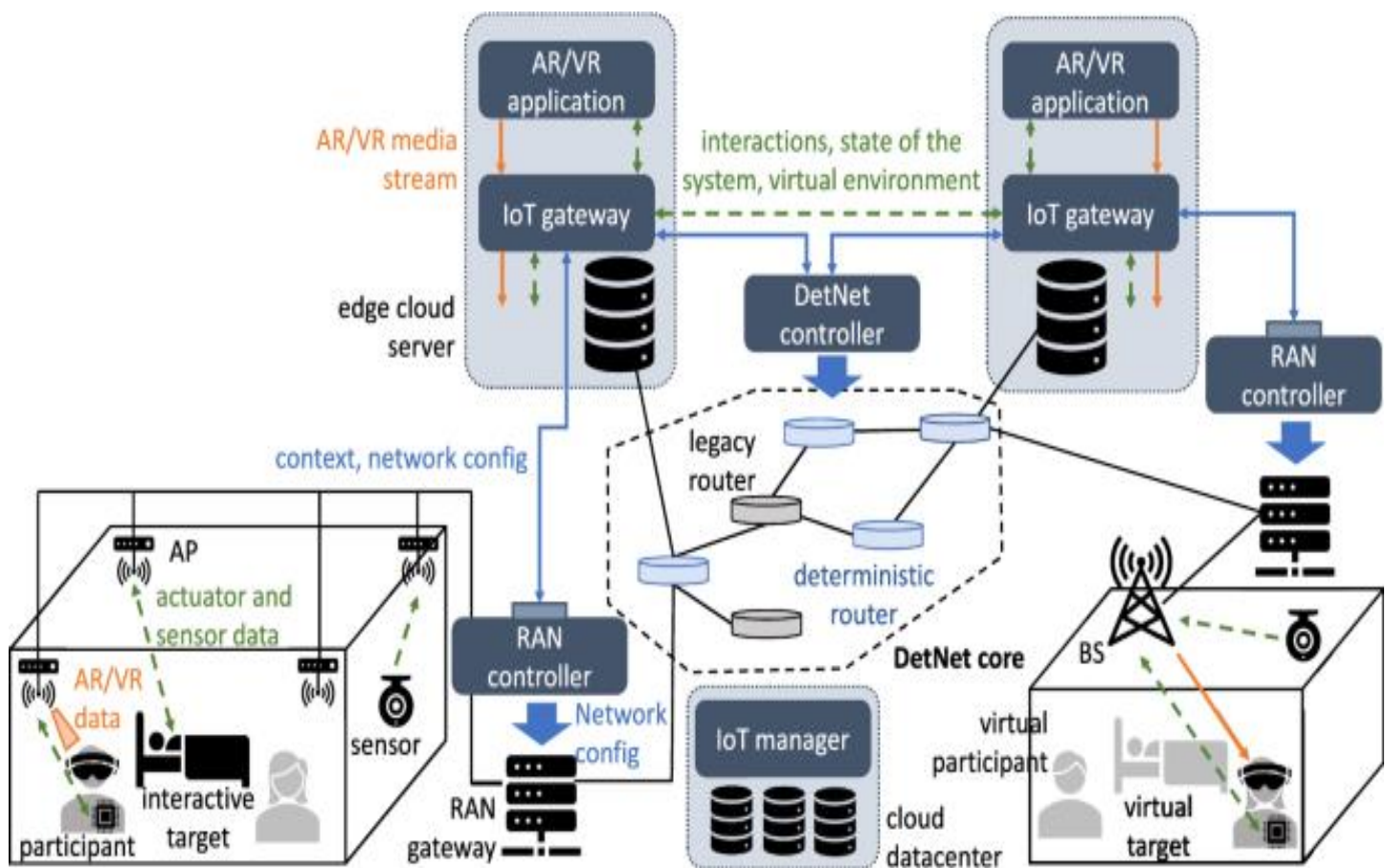


Fig.3 AR technology with IoT and 5G network through best routing path



The proposed method:

Nodes are moveable characters that can move in any direction along the 5G environment in 5G networks with AR. The sending party makes an effort to deliver the communication to the target node.. It is particularly managing the amount of information during conversation is difficult. The routing node connection is not evaluated, and the random packet drops determine the weak connectivity between moving nodes when using the optional single path and packet sharing.. To achieve legitimate packet sharing, the cost of packet transmission is also calculated. Data packets make maximal resource or cost use since the longest path is picked for forwarding. It enhances energy efficiency and packet drop rate The scattered path selection for communication methodology is utilized as the proposed strategy to determine the most efficient and brief distance communication path. These paths must be handled using a line of difference, which manages data packet maintenance in the waiting list and pushes the duration of the slot's limit during connection time.. Data packets in the queue have space reserved, which should improve communication [8]. The purpose of the multiple paths blocking detection method is to establish a connection based on the detection of path packet overload in order to measure the rate of data packet traffic.. It also divides the route according to its behavior in order to regulate the volume of traffic. Both the amount of packets and energy usage are decreased [7][9].

The suggested dispersive choice of paths technique for applications in AR is shown in a block image. is shown in Figure 4 [9]. Determine the separation between the planned node of origin and the goal in mind node for the multiple paths transmission of packets.. Different rates of transmission are obtained by using several pathways. A dispersed route selection strategy is used for distributing packets across several paths based on the success rate of the packet in order to separate the effective route in the remainder of the network and increase the packet delivery ratio. obtains a viable route and a short distance to conserve resources [11] .

The following box diagram shows the steps of the algorithm used to improve the selection of the best path for the contract in order to create compliance that will speed up away from noise and congestion, since augmented reality applications never accept delays, especially with regard to medical and surgical work that is conducted remotely.

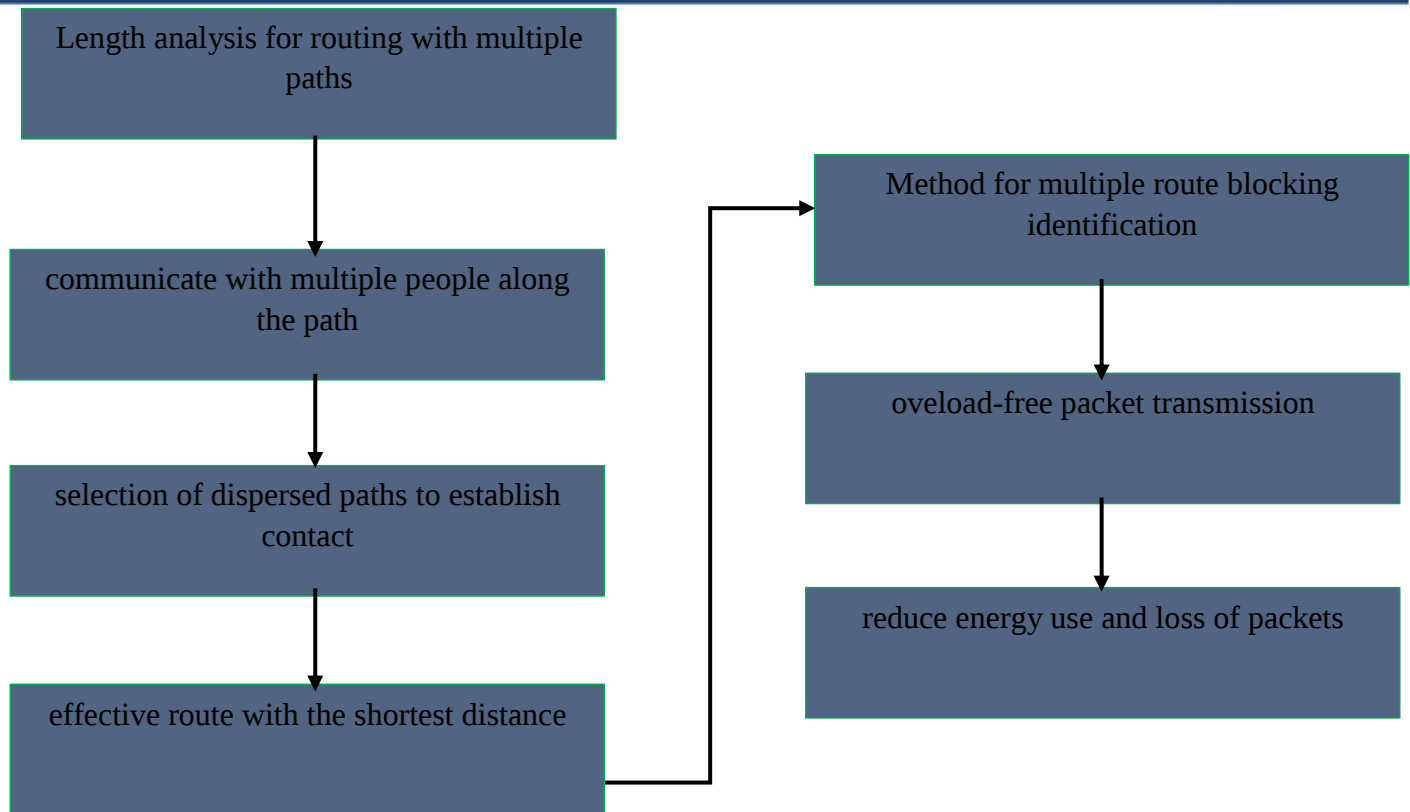


Fig.4 the steps of the algorithm used to improve the selection of the best path

Analyze the Multipath Distance, There are multipaths accessible throughout the network to calculate the separation within the routing channel connecting nodes with mobility that are accessible. In accordance with the hybrid approach to communication, which is advantageous when dealing with nodes that are When dealing using long-gone nodes in a nearby by and disregarded. Order the node distances from shortest to greatest length, and traffic volume as distance decreases also affects packet latency. For both capacity and energy use, it is required to rank time utilization from greatest to lowest due to the greatest rates of transmission convey a huge quantity of packets over the shortest distance possible [13] . Since the greatest amount of time that information packet can remain in a queue is increased, there is still a lot of traffic despite the decreased rate of transmission. It shows that the speed of transmission is not suitable for actual uses on its own. [12][14]. Transmission rate, traffic overload, delay, and energy consumption are network metrics for the process. To improve the transmission rate for audiovisual interactions, choose the best route To the node of departure form the initial node. Er is the energetic routing, VD is the different distances, and Mp is the multipath.



$$T = V(D) * E_r ; T = M(p) \quad . \quad V(D) = HD + SD \quad 1$$

One of the factors that should enable packet transfer when choosing a communication path is the road distance. The design of the minimum node count serves as the basis for dynamic source routing. The main goal of the net is to show the maximum amount of packet transmission in the network environment and use the higher remaining energy of each node to compensate for the loss of a lot of traffic in order to establish an optimization approach for the highest level of remaining energy [16]. The main system overload should be considered when selecting a communication path, which means that the balancing of the power of the jamming nodes in the specific routing scheme should be able to support increasing the network's lifespan as a whole. Min D is the shortest distance that can be covered in the given time, Min D is the longest distance that can be covered in the given time, and P1, P2, and Pn are the paths..

$$VD = \{p1 \rightarrow pn\} * (HD + SD) \quad ; SD = ts * the \min D \quad 2$$

according to a hyperlink set, the network nodes must connect with their closest neighbors. Every node in a network ought to have a special identification. The target node and the source node both serve as identifiers; the remaining nodes transmit information to nodes along a certain path [11][17].

$$the \max D * ts = H(D) \quad 3$$

It makes sense that the mobile nodes' packet overload should not exceed their capacity for change. It fits perfectly providing an overview of the jammer node in the internet architecture. Through each accessible transmission, the analogous node connection has the remaining energy of the limiting circuit. In order to transfer information with more remaining energy when using the least distance route path technique, an optimization strategy with an increased leaving energy level had been launched.. The most efficient transmission path is chosen from a variety of routing paths in this fundamental design, which was developed from a less expensive concept [13][18].

Estimation of Unit Mobility:

The network topology changes randomly as a result of device movement, which also has an impact on routing efficiency. Therefore, when choosing the best



path, it is necessary to take the device's mobility into account. To do this, the devices' movement pattern is predicted using the well-known Random Way Point (RWP) motion model [45]. Based on the location, direction angle, and trace time of the devices, the RWP model calculates the mobility of the devices. The following formula can be used to determine the mobility $[M(x,y)(t)]$ of the intermediary device c:

$$M_{x,y}(t) = \frac{\sum_T \sqrt{\text{pos}_c^t(t) - \text{pos}_c^t(t-t_0) + \{\theta(t) - \theta(t-t_0)\}^2}}{\sum_c n(t)}$$

4

We use T to represent the total tracing time of the devices. The terms “posTc(t)” and “posTc(tt0)” mean the current and initial positions of the devices c in trace time T, respectively. We also define Tc(t) and Tc(tt0) as the current and initial vector angles of the mobile device c in trace time T, respectively. Moreover, n(T) is the number of time samples collected during the trace period T [16]. We increase the device mobility value, which is measured by the RWP mobility model, to improve the route robustness and maintain the stability of the established route [20].

Estimation of Device Link Quality:

Detecting failed network links quickly and correctly is essential for ensuring reliable data packet delivery and network reliability optimization. Therefore, the link quality of the intermediate device plays a major role in choosing the best path to minimize network data packet losses. For this reason, we use the expected transmission count (ETC) concept on the link, which means the number of transmissions and retransmissions needed for successful data packet transfer to the destination device over the link [46]. We send probe packets without data information to the link before data transmission. We use the probe packets and the forward delivery ratio pf and reverse delivery ratio pr to calculate the value of the link as: $1/(pfpr)$. This metric works well in networks with light traffic to measure the link quality. However, when the network is heavily loaded, the metric causes a lot of RREQ packets to flood the network to find the best path. So, we introduce the idea of High load like ETX to reduce the impact of RREQ packet flooding in the network. We use an extended version of the metric, which uses both the current and previous time windows as well as the current one, called [21]. We use ten times more probe packets in our time window. We use the discrete window time scale $[t_{i1}, t_i]$ to scale the window time. We calculate the value of the link as follows:

$$the\ value = \frac{D_{x,y}}{Pf(t_t) * Pr(t_t)} \frac{S_p}{\mu(x,y)} ; t \in \{t_1, t_{t+1}\}$$

5



We use $D(x,y)$ to represent the distance between the source and destination devices. S_p and (x, y) are the size and rate of data packet transmission, respectively. We use periodic probe packets to measure the forward delivery ratio $pf(t_i)$ and reverse delivery ratio $pr(t_i)$ for all network devices. The probe packets are sent every seconds for a window w_i . Each probe packet has the total number of probe packets and the previous window data w_{i1} , which is collected from the nearby devices. We use the data in the probe packets to calculate the forward and reverse delivery ratios [20][22]. $r(t_i) = \text{Num}(t_{i1}, t_i) / (w_i)$, where $\text{Num}(t_{i1}, t_i)$ is the number of probe packets received in the current and previous time windows, and w_i is the number of probe packets sent before the data transfer. This metric helps us to evaluate the link quality between devices, which reduces the RREQ packet flooding in the network, lowers the chance of link failure, and improves the overall QoS performance of the network.

$$H = V(D)$$

By changing the route determined by the typical caloric value, an approach to source covering is implemented for energy in the practical area. This is one of the first adaptive approaches available for energetically changing time periods on a regular basis. There should be a sufficient number of nodes among all the active the senders ready for interaction with the subsequent node in the chain. The packet is sent using the technique while taking time slot allotment into account. It goes over the time limit that divides the path in half. In order to maintain a higher packet success rate and a lower communication overhead, considerable benefits are produced and used for recipient scanning the safety system. It offers a workable routing route for sending packets. The method's drawback is that, even if one sender node is positioned farther away from the intermediary node in a specific location, it still needs to increase its coverage, which results in a maximum overhead for communication rate [19][22].

$$H = (\text{the min } D * ts + \text{the max } D * ts) * \{p_1 \rightarrow p_n\}$$

6

The suggested approach expands the routing channel for the occupied time period allocation update that fixes network architectural faults in the amended maxima receiver covering report. Introduce four recent actions, such as minimal distance pathfinding and energetic neighbour node finding. The multipath communication is established, and the positive neighbor nodes that are still available are divided. Using sooner than transmitting packets ensures that communication overload is produced based on a lower packet success rate and allows for the verification of the routing path prior to commencing the packet transfer. Simply put, the specific coverage range should lessen packet overflow



while the quantity of reactive active sources requires node links with one another. It should also reach a certain threshold level differentiated by positive energetic transmitter nodes [21].

$$H = \{p1 \rightarrow pn\} * (the\ min\ D * ts + the\ max\ D)ts \quad 7$$

$$H = (the\ minDp1+..+pn + the\ maxDp1+..+pn)ts \quad 8$$

It should be understood that such nodes continue to operate continuously throughout the designated lifespan of the network., regardless of whether the individual neighbor's difference from the other neighbor nodes (which are moving through the network to interact with an analogous node) is less. In the network, the intermediate node with the fewest connection discrepancies is measured to determine the best path. During the hello packet, several information may be delivered. By adding one additional field to the hello packet, it can be found. This link difference determines which additional stable node will be used. The intermediate node forwards the token shortly before the neighbor node, giving the node a smaller connection difference. Its steadfastness value increases after accepting all packets [23].

- 1: There is established multiple path networking.
- 2: Separate each of the network's multiple pathways.
- 3: Conduct dialogue along several channels.
- 4: start sending packets
- 5: If the maximum path distance is reached.
- 6: Choose another route
- 7:, if not Next
- 8: If the minimum path distance is reached.
- 9: choose that option.
- 10: Continue exchanging packets.
- 11: Strengthen connection stability.
- 12: terminate if
- 13: Finish up
- 14: Data packets are transmitted in order in step one.
- 15: The routing table is used to compile the necessary information for each node.
- 16: If "packet ==jam," .
- 17: blocking of packets
- 18: Look for the best communication route.
- 19: Lower the rate of packet loss
- 20: Next, if not
- 21: If "packet ==forward," go to .
- 22: The best communication route is selected.
- 23: Reduce energy usage.
- 24: finish if
- 25: the end of



The results:

In accordance with the quantity of emergency packets obtained, the method shortens the buffer waiting period.

Each of the classic techniques uses a higher buffer size, which results in an increase in delay. When compared to the conventional technique, our technique's delay and forward are significantly reduced according to the node buffer size. With threshold thresholds for delay and jitter for real-time video medical applications of 250 ms along with 20 ms, accordingly; Our proposed method offers delay values of 250 ms as well as 0.60 ms, accordingly, for the two directly passed on states, such as the buffer time; The delay of our proposed algorithm satisfies the requirements for medical uses such as telesurgery, telephone consultations, and virtual and augmented reality for these kinds of applications.

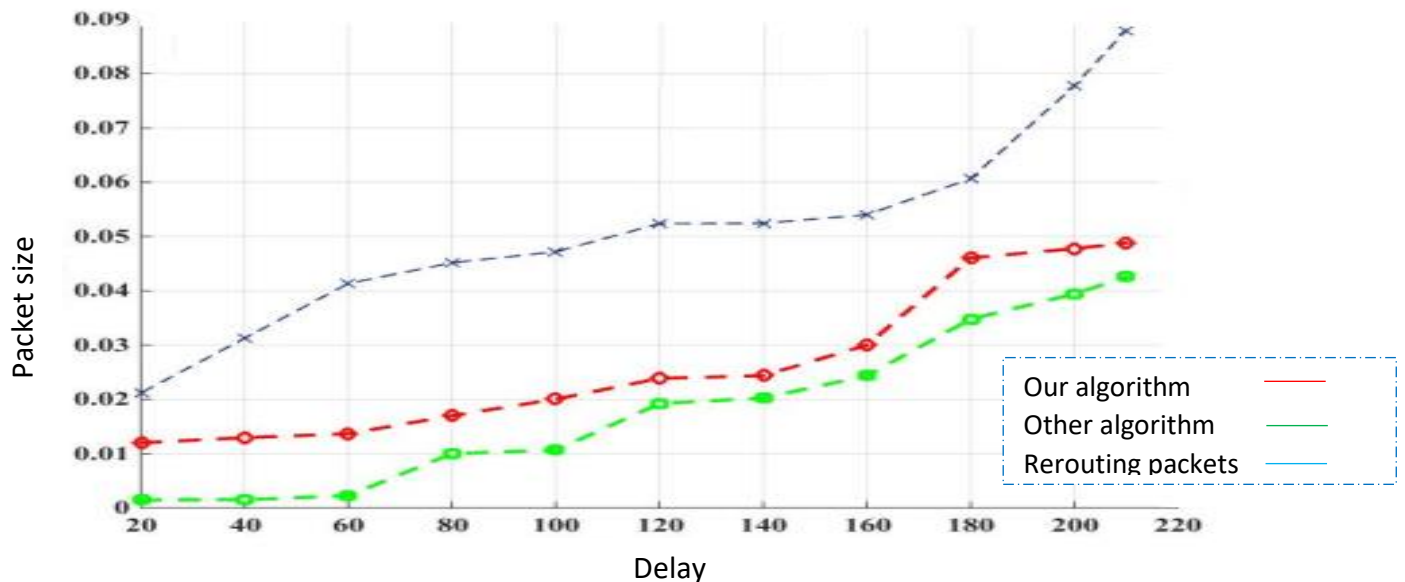


Fig.5 Comparison of the delay in the proposed algorithm and the traditional algorithms in the field of choosing the best revision

The ratio of loss of packets and delay for various methods plotted against buffer size is shown in Figure 5. compares the overall packet loss of the conventional and forwarding packet methods with various buffer sizes, noting that the optimization algorithm's package loss is less affected by the buffer size than the traditional and forward methods' packet loss is. The proposed method has smaller delays compared to it and forwarding data packets.

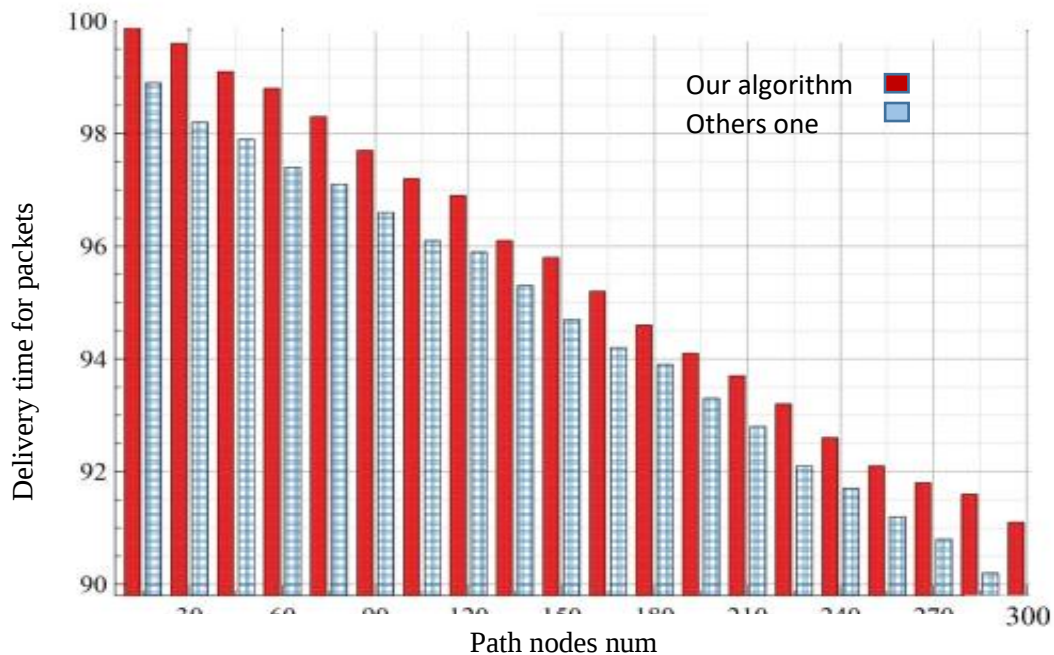


Fig.6 the performance between our algorithm and traditional ones

The previous figure 6 explains the result of reading the algorithm for the closest path to augmented reality applications according to the delay time in delivering packets and messaging according to the best routing path and comparing our proposed algorithm with traditional algorithms to show speed in the proposed algorithm.

The following figure 7 shows the output of the code according to the proposed algorithm in order to connect two routers according to the best routing path according to the algorithm testing of the paths between the nodes that make up the network in order to support and enhance sensitive applications such as augmented reality applications (surgical and medical operations) remotely via fifth generation networks

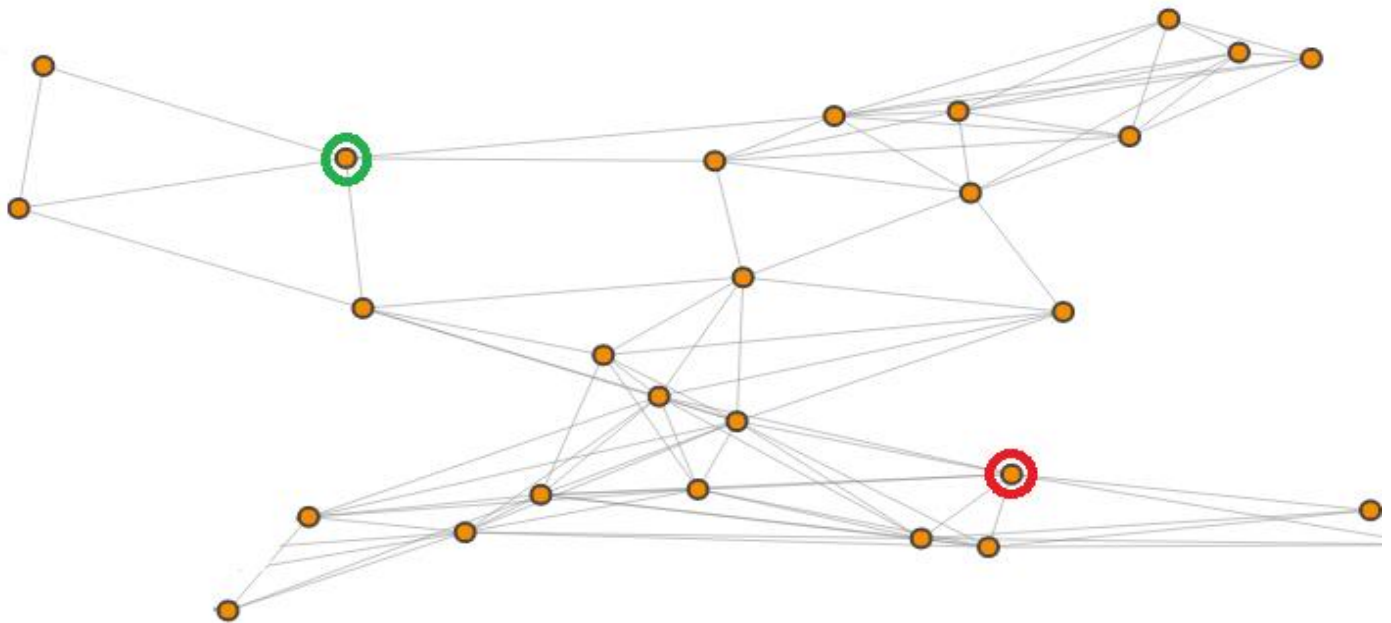


Fig.7 Choosing the routing path according to the proposed algorithm

Conclusion:

We propose a novel approach to create a smart path between source and destination in the network for this research. This path can be used to speed up the delivery of emergency packets during a surgery. It reduces the load and time on the critical path and solves the problems of network congestion, latency, and throughput. We transform the emergency detection problem into a classic network flow problem. Our goal is to mark the traffic as emergency by using an IoT smart algorithm to create a high-priority path. We use a reliable method that combines a multi-level priority scheme with an event-aware back-pressure scheduling system to handle the emergency situation. This method allows regular packets to transmit data through real-time live streaming from source to destination within the deadline. We also use the node buffer to store the emergency packets if we receive them in large numbers quickly. The buffer also helps to avoid losing any regular packets that may be received by mistake from other nodes. These regular packets are immediately forwarded to nearby nodes that are not on the smart path. Our priority scheme helps to manage the congestion issues in the network. Our simulation results show that our approach performs much better than existing systems in terms of network congestion, efficiency, delay time, loss ratio, and overheads, among other metrics..

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