EFFICIENT AND ADAPTIVE SCANNING IN MOBILE WIRELESS BODY AREA NETWORK

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By

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CANDIDATE'S DECLARATION

I hereby certify that the work which is being presented in the thesis, entitled **"Efficient and Adaptive Scanning in Mobile Wireless Body Area Network"** in fulfillment of the requirements for the award of the degree of Doctor of Philosophy in Computer Science Engineering and submitted in School of Computing Science and Engineering Galgotias University, Greater Noida is an authentic record of my own work carried out during a period from JULY, 2014 to JULY, 2018 under the supervision of Prof.(Dr.) PARMANAND .

The matter embodied in this thesis has not been submitted by me for the award of any other degree of this or any other University/Institute.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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ABSTRACT

Recently, with the rapid development in wearable medical sensors and wireless communication, wireless body area networks (WBANs) have emerged as a promising technique that will revolutionalize the way of seeking healthcare which is often termed e-healthcare. Instead of being measured face-to-face, with WBANs patient's health-related parameters can be monitored remotely, continuously, and in real time, and then processed and transferred to medical databases. This medical information is shared among and accessed by various users such as healthcare staff, researchers, government agencies, and insurance companies. In this thesis, we have review some wireless body area network protocols and techniques for health care application.

The increasing population needs large medical staff for the excellent healthcare services. Using WSN in healthcare might help to overcome the shortage of the medical staff in medical institutions around the world. The WBAN provides an excellent opportunity to enhance the quality of healthcare. Sensors hubs may be placed on the different parts of body that is known as remote body system that may be used to assemble patient's basic information.

WBANs include variety of heterogeneous biological sensors. These sensors are unit placed in numerous components of the body and may be wearable or deployed below the user skin. Different type of sensors can be used for measuring different parameters. Every of them has specific needs and is deployed for various missions. The wireless sensor network (WSN) having large number of sensor nodes as compare to wireless body area network (WBAN). However, developing a WBAN platform is a very challenging issue as the protocol used for the adhoc network does not perform efficiently in the mobile WBAN. This needs a scanning policy for the WBAN to be added in routing to enhance the performance of existing protocol for WBAN. WBANs for healthcare applications are mainly used in patient monitoring tasks.

Moreover, the sensor nodes remains active at all times whereas the utilization period of the sensor nodes is only 20% of the total time. This results in high energy consumption. This results in need of an efficient scanning technique for WBAN with dynamic active period.

Whereas Square-Odd scanning is an improved method for scan the object. It detects the energy of an object inside scanning area as well as it also saves energy consumption. With this scanning algorithm, detection time of any object can be reduced in Body area network. It focuses on reduction in energy consumption and it improves the life time of sensor. The performance of the Square-Odd approach is better than all other previous scanning algorithms in terms of network lifetime. All the previous techniques focus on energy consumption but our proposed work focus on reducing the detection time as well as energy consumption. This scan based method can achieve significantly better performance than Always-Awake algorithm, Duty cycling algorithm and Virtual scanning algorithm. Last phase of this thesis, contains future scope of networking in wireless body area network.

Dedicated

To

My Family

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PREFACE

Recently, with the rapid development in wearable medical sensors and wireless communication, wireless body area networks (WBANs) have emerged as a promising technique that will revolutionalize the way of seeking healthcare which is often termed e-healthcare. Instead of being measured face-to-face, with WBANs patient's health-related parameters can be monitored remotely, continuously, and in real time, and then processed and transferred to medical databases. In WBAN different sensor nodes are deployed on the body or under the skin of the patient body. It is not necessary to deploy the nodes inside the body of patient. WBAN is similar as WSN. The main difference between WBAN and WSN is that the space covered by WBAN is smaller as compare to the area covered by WSN. This thesis is structured in the following chapters:

Chapter 1: Presents an overview of wireless sensor network and wireless body area network. This chapter begins with introduction of WSN and WBAN, with brief explanation of different routing protocols. This chapter also deals with some fundamental algorithms that used in scanning approach or traverse from one node to another node.

Chapter 2: Efforts have been made to provide an overview of the previous research done on the various facts of routing and scanning in sensor networks. This chapter presents an overall review of studies and research conducted on both wireless sensor network and wireless body area network.

Chapter 3: Show problem occur in routing and previous scanning techniques and proposed solution to overcome that problem. This chapter deals with our proposed work in detail with a mathematical formulation and proposed algorithm.

Chapter 4: All simulation, experimental results with example and analysis are shown in this chapter. Analysis shows the performance of our proposed algorithm with existing other algorithms that is efficient in order to increase the network lifetime and reduce the detection time.

Chapter 5: This is last chapter of this thesis deals with overall conclusion of my work and also provides some suggestion for future work.

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1. Rani Kumari, Dr. Parma Nand "Performance Comparison of various Routing Protocols in WSN and WBAN" IEEE Conference on Computing, Communication and Automation held on 29th -30th April 2016 at Galgotias University, Greater Noida (*ICCCA 2016*). https://doi.org/10.1109/CCAA. 2016.7813814

2. Rani Kumari, Dr. Parma Nand "An optimized routing algorithm for BAN by considering Hop-count, residual energy and link quality for route discovery" IEEE Conference on Computing, Communication and Automation held on 5th - 6th May 2017 at Galgotias University, Greater Noida (*ICCCA 2017*). https://doi.org/10.1109/CCAA.2017.8229884

3. Rani Kumari, Dr. Parma Nand "To improve the performance of routing protocol in mobile WBAN by optimizing the scheduling mechanism" International Journal of Emerging Research in Management and Technology (IJERMT) ISSN–2278-9359 Vol. 6 issue. 9, September 2017. (UGC approved Journal).

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8. Rani Kumari, Dr. Parma Nand "Secure Communication using PFS in a distributed Environment" International Journal of Students' Research in Technology & Management, ISSN 2321-2543, Volume 6, Number 2, March 2018.

9. Rani Kumari, Dr. Parma Nand "Implementation of Square-odd scanning technique in WBAN for energy conservation", International Conference on Innovative Computing and Communications held on 21st-22nd March 2019 at VSB- Technical University of Ostrava.(*ICICC 2019*). (Springer and SCOPUS indexed).

10. Rani Kumari, Dr. Parma Nand "Square-odd scanning for WBAN to reduce detection time" International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN 2278-3075,Volume-8, Issue-8S2, June 2019. (SCOPUS indexed Journal).

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12. Rani Kumari, Dr. Parma Nand "Integration of Blockchain in WBAN", International Conference on Computing, Communication and Intelligent Systems held on 18th -19th October 2019 at Sharda University, Greater Noida.

Chapter – 1

INTRODUCTION

1.1 Problem overview and motivation

1.1.1 WSN and WBAN

A WSN is a network of low cost and small size devices denoted as nodes, deployed in a large geographical area which can sense the environment conditions and transform the electrical signals gathered from the monitored field through wireless links. The data is forwarded via multiple hops, to a sink (controller or monitor or base station) that can use it locally or is connected to other networks through a gateway. Wireless sensor networks are inexpensive networks and there are numerous fields of applications of sensor network where sensor networks are used.

The advancement within the technology desires the wireless body area network (WBAN) for the health care applications. The health care desires the continual observation of the patient and also the readings ought to be delivered to the health care professionals [64][68]. The BAN should be designed in such how that these necessities are often consummated. WBAN may be an edition of the Wireless sensor network (WSN). The main distinction is that the space coated by WBAN is a smaller amount as compared to the world coated by the WBAN. The distinction between the WBAN and also the WSN are going to be mentioned in next section. Within the WBAN numerous sensors nodes area unit deployed round the patient body. It is not necessary to deploy the nodes inside the body of patient; the nodes are often planted over or round the body.

The BAN design is shown within the figure 1.1; all the native nodes within the BAN transfer the information to the bottom station that transfers the information to server via completely different interfaces [62]. Different forms of sensors will be employed in the WBAN having different parameters will be planted on different components of body [51][59]. The temperature detector will be planted to live the temperature go 32-40 ^{o}C with terribly low rate, similarly the blood pressure sensors are used to measure the pressure of blood ranging 10-400 mg/Hg with low data rate and so on.

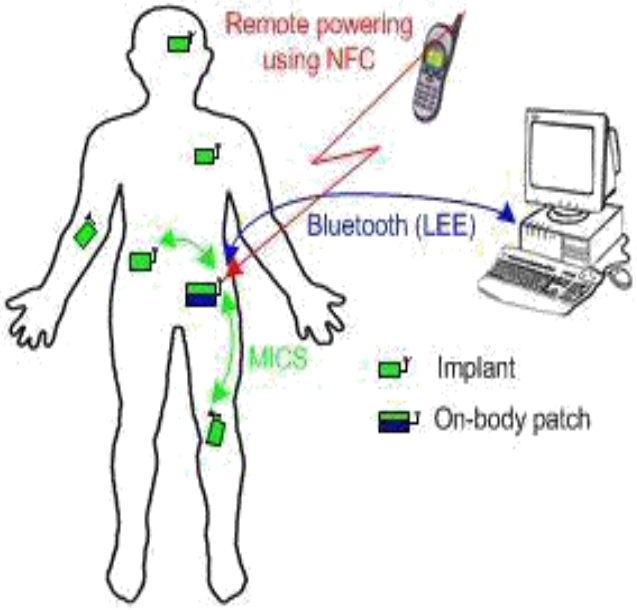


Fig 1.1:- WBAN Architecture

Different sensors with their data rate and functionality are given in table 1.1:

Table 1.1: Different sensors used in WBAN

Sensor	Functionality	Data rate
Accelerometer	Used to measure acceleration	High
ECG	Measures potential difference across electrodes	High
Blood Pressure	Measures the pressure	Low
Blood Sugar	Measures the blood sugar	Low
Temperature	Measure the temperature changes	Very Low

The WBAN as well as the WSN both consists of sensor nodes but the number of nodes in WSN are more than the number of nodes in the WBAN. Moreover, the area covered by the WSN is larger as in WBAN nodes are implanted near by the body. The data rate, node task also differs in both networks described in table 1.2.

Table 1.2: WSN vs WBAN

Challenges	WSN	WBAN
Node Type	Homogeneous Network	Heterogeneous Network
Area Covered	From m to km	From cm to m
Number of nodes	100 to 1000	10 to 100
Node Task	Single Task	Multiple task
End 2 End delay	Higher Delay	Low delay
Node replacement	Easily replaceable	Difficult
Node Lifetime	Long Life time	Smaller Battery with very long lifetime
Security	Lesser Needed	High security required
Data Loss	Tolerated	Can’t affordable
Wireless Technology Standard	802.11.4	802.15.6
Mobility	Stationary	Mobile(Body Mobile)

The tabular examination demonstrates that the WBAN is the constrained version of the WSN. The following area talks about the directing conventions of the portable remote sensor arrange and their usage in the WBAN [67].

Body space Networks hubs speak with each other through assortment of remote advances like Zigbee, Bluetooth and so forth.

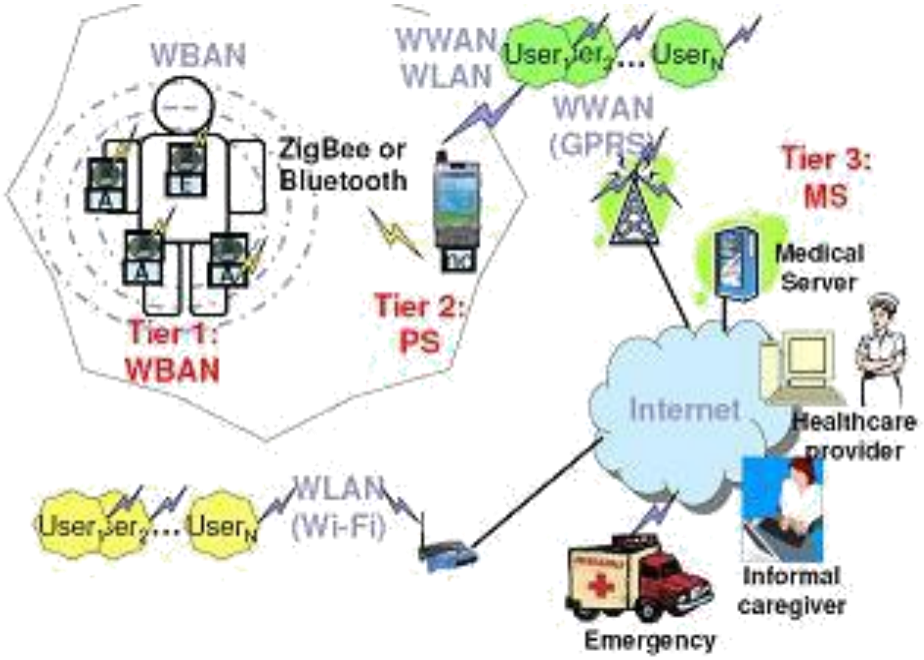


Fig 1.2 :- Wireless body area network

The outline of BAN is part into 3 levels that suits intra-body, between body and on the far side WBAN correspondence as shown in figure 1.2. This strategy comprises of private server and therapeutic server. Totally extraordinary temperature sensors, science sensors, movement sensors, bioelectrical sensors gathers data according to totally unique parameters and sends it abuse some remote innovation to the non-open gadget that go about as an arranger hub. At that point, through remote correspondence, this wellbeing associated gathered data is sent to the therapeutic. There square measure a few issues that square measure required to be managed though misuse this new rising innovation. Some of these difficulties square measure said beneath.

Signal Fading: Body space networks signals goes through a heterogeneous way once hubs are planted inside the figure, that is the reason conceivable outcomes of way misfortune will build parts inferable from retention of vitality[2]. Since the body is not static, it's in moving position, in this manner if Body space Networks hubs are planted on the surface of the body, at that point still inferable from the development of body conceivable outcomes of data misfortune will increment. However still a few systems are anticipated by a few scientists to decrease this abuse multi-bounce

interfaces when contrasted with single-jump connects in the event of some unforeseen issue if learning must travel a larger than average assortment of meters.

Antenna Design: The other ecological test is associate in nursing reception apparatus style of body space networks hubs. As there region unit a lot of developments inside the body, therefore a lot of confinements should be really young looking all through radio wires style. The receiving wire style is straightforwardly connected with the circumstance at that it's profound situated. These radio wires require non-destructive material however the test is that metallic component and nuclear number 78 zone unit non-destructive in nature however not as durable when contrasted with destructive material. The correct exchange offs amongst size and intensity is also pondered all through receiving wire style [2].

Security Challenges: There is very essential learning is dispatched over body space networks. There square measure conceivable outcomes that partner degree individual will meddle in the middle of this learning causation and might alteration the data in the middle of which can be unsafe. For instance, take the case once appallingly secret learning related with are diopathy is transported over the system and in the event that some individual changes this essential information in the middle of, thus it will persuade be perilous for some person. In this way, there's might want of secure administration of knowledge exchange exploitation encoding and cryptography, information honesty, learning classification, information verification all must be overseen at any esteem.

Transport Challenges: During data exchange, nature of administration ought to be kept up and this can be the vehicle challenge that is particularly looked by body space networks. Boycott square measure utilized essentially in actuality applications, along these lines these all applications square measure time-basic. Accordingly there ought to be right technique for convenient conveyance of data with legitimate affirmation with none misfortune.

1.1.2 Routing Protocol [44][46][61][62]

The information in any system is directed from one hub to an alternate to head out from supply to the goal. The steering way ought to be most brief and charming for the high yield of the system. Various steering conventions utilized in the remote gadget organize disagree from each other on the preface of differed attributes. Here we talks

about the steering conventions that territory unit suitable for the portable remote system.

1.1.2.1 AODV

AODV directing convention might be a table driven steering convention that deals with the steering table to search out a course. It's intended for portable spontaneous systems with tens to thousands scope of versatile nodes [17][44][99][104]. It is a receptive directing convention that sits tight for demands before endeavouring to search out the principal best course from one node (source hub) to send messages to an alternate hub (goal). The chief best course is chosen by the space or the measure of bounces between hubs. Arrangement numbers at goal is utilized for circle opportunity. Every hub in AODV keeps up a steering table. AODV does no't keep up the total course to the goal. Each hub exclusively keeps up future bounce information, this lessens procedure and capacity overhead to maintain courses. A hub refresh the steering table once it gets a course bundle, the directing table are checked for presence of passage for that destination. On the off chance that no coordinating passage for that goal is discovered, a substitution table section are made. In the event that the directing table section for the goal is blessing, at that point the grouping range for that goal are refreshed if the administration bundle refreshes the arrangement go for that goal if the parcel has succession run over the goal succession go inside the steering table. A current course to goal is discovered once the RREQ achieves either to the goal or any middle of the road hub has sufficiently late course to the goal. Each middle of the road hub increases the jumps include worth RREQ message by one. Any hub that fuses a course with greater arrangement run when contrasted with the grouping range inside the RREQ message is considered as late course. Switch course is kept up to challenge the RREP to the brains of RREQ by keeping up the antecedent rundown for future bounce from that a hub gets a RREQ message. Each halfway hub once gets a RREQ message refreshes it goal succession run if necessary. It peruses the address of hub from that it gets the RREQ from the RREQ message and refresh it with its own before sending it towards the goal. RREP message is unicasted to the supply hub over the invert course. The supply to goal course is built up once the supply hub get the RREP message. On the off chance that the supply got more than one RREP messages then the RREP message with greater grouping range is considered. To deal with the local property among neighbour hubs welcoming messages territory unit sent with

TTL worth set to one. Every hub that is a piece of dynamic course should send welcoming messages to ensure local property.

1.1.2.2 DSDV

The Destination-Sequenced Distance Vector (DSDV)[17][69] convention could be a table-driven guiding convention visible of the improved adaptation of established Bellman-Ford steering calculation. DSDV depends on the routing info protocol (RIP). With RIP, a hub holds a guiding table containing all the conceivable goals within the system and also the amount of jumps to each goal. DSDV is likewise visible of separation vector guiding and consequently utilizes bidirectional connections. A constraint of DSDV is that it offers simply one course to a source/goal mix. The DSDV directing convention is an improved adaptation of the dispersed Bellman-Ford calculation where every hub keep up a table that contain the most limited separation and the primary hub on the briefest way to each other hub in the system.

Every hub, after getting a refresh, rapidly disperses it to its neighbours so as to engender the broken-connect data to the entire system. In this manner a solitary connection break prompts the proliferation of table refresh data to the entire system.

Directing table updates in DSDV are dispersed by two distinct kinds of refresh bundles [96][106]:

- Full dump: This sort of refresh parcel contains all the directing data accessible at a hub. As a result, it might require a few Network Protocol Data Units (NPDUs) to be exchanged if the directing table is substantial. Full dump bundles are transmitted rarely if the hub just encounters infrequent development.
- Incremental: This sort of refresh parcel contains just the data that has changed since the most recent full dump was conveyed by the hub. Consequently, incremental bundles just expend a small amount of the system assets contrasted with a full dump.

It can be connected to MANETs with couple of alterations. The updates are spread all through the system with a specific end goal to keep up a mode perspective of the system topology at all the hubs. However, the DSDV experiences extreme control overhead that is relative to the quantity of hubs in the system and along these lines is not versatile in MANETs, which have restricted transmission capacity and whose

topologies are very powerful. With a specific end goal to acquire data about a specific goal hub, a hub needs to sit tight for a table refresh message started by a similar goal hub. This postponement could bring about stale directing data at hubs.

1.1.2.3 DSR

The Dynamic Source Routing tradition (DSR) [44] is an essential and viable coordinating tradition made especially for use in multi-hop remote exceptionally designated frameworks of versatile center points. DSR empowers the framework to be absolutely self-dealing with and self-outlining, without the necessity for any present framework structure or association. DSR planned to restrain the information exchange limit ate up by control distributes extemporaneous remote frameworks by forgoing the incidental table-revive messages required in the table-driven approach.

DSR has been finished by various social events, and passed on two or three testbeds. Systems utilizing the DSR custom have been connected with the internet [95]. DSR can interoperate with Mobile IP, and focuses utilizing Mobile IP and DSR have flawlessly moved between WLANs, cell information associations, and DSR versatile casual structures.

The DSR tradition empowers center points to logically discover a source course finished various framework bobs to any objective in the uncommonly selected framework. Each datum package sent by then passes on in its header the aggregate, asked for summary of center points through which the bundle must pass, allowing bundle controlling to be irrelevantly circle free and avoiding the prerequisite for exceptional coordinating information during the street centers through which the package is sent. By joining this source course in the header of each datum divide, center points sending or getting any of these packs may moreover easily store this coordinating information for at some point later.

The tradition is formed out of the two guideline instruments "Obviously Discovery" and "Course Maintenance”, that coordinate to empower center points to find and carry on courses to subjective objectives within the unambiguously delegated framework. All components of the tradition work altogether on-ask for, permitting the coordinative cluster overhead of DSR to scale so to solely that standard to react to changes within the courses by and by being used [105].

The tradition empowers completely different courses to any objective and empowers every sender to choose and management the courses used as a bit of coordinative its bundles, as an example to be used in stack eve changing or for extended physiological condition. Distinctive functions of enthusiasm of the DSR tradition fuse simply warranted circle free guiding, reinforce to be used in frameworks containing one-way associations, usage of merely "sensitive state" in coordinative, and greatly fast recovery once courses within the framework amendment. The DSR tradition is formed usually for labile off-the-cuff frameworks of up to around two hundred center points, and is planned to figure splendidly with even high rates of convey ability.

This tradition uses a responsive approach that executes the necessity to once in an exceedingly whereas surge the framework with table revive messages that area unit needed in an exceedingly table-driven approach. In an open (on-ask for) approach, as an example, this is a course is about up precisely once it's needed and thus the necessity to seek out courses to every different center purpose within the framework by the table-driven approach is shed. The shift center points furthermore utilize the course store data ably to minimize the management overhead. The burden of this tradition is that the course emotionally supportive network does not locally repair a broken association. Stale course save information could in like manner realize anomalies in the midst of the course changing stage. The affiliation setup delay is higher than in table-driven traditions. In spite of the way that the tradition performs well in static and low-movability circumstances, the execution ruins rapidly with extending adaptability. Furthermore, amazing coordinating overhead is incorporated as a result of the source-guiding framework used in DSR. This directing overhead is clearly in respect to the way length.

1.1.2.4 AOMDV

AOMDV remains for Ad-hoc On-request Multipath Distance Vector Routing convention [10] [55]. AOMDV is a multipath augmentation to the AODV convention. In AOMDV conventions numerous courses are established between the source and goal. It utilizes backup courses of action on a course disappointment. In AOMDV conventions new course disclosure is required when every one of the courses fall flat.

In AOMDV a convention multipath steering is the upgrade of unipath directing in which advantage is to deal with the heap in arrange and stay away from the likelihood of blockage and expands unwavering quality.

The principle thought in AOMDV is to process numerous ways during course revelation strategy for fighting connection disappointment. At the point when AOMDV assembles different ways, it will choose the primary way for information transmission which depends on the season of directing foundation. The soonest one will be respected the best one, and just when the principle way is down different ways can be viable. Actually, an extensive number of studies demonstrate that the previously mentioned conspire isn't really the best way. Portable hubs, which as a rule because of lingering vitality are too low or under substantial load and different elements, genuinely influence the execution of the system. With a specific end goal to enhance the execution, in NS-AOMDV convention in light of existing AOMDV, we think about the rate of hub lingering vitality and sit cradle line as the heaviness of hub. At that point in course revelation process, the directing refresh rules figure the hub weight of every way and sort the way weight by plunging estimation of way weight in course rundown, and we pick the way which has the biggest way weight to transmit information parcels. In the meantime, the convention utilizes the innovation of RREQ defer sending and vitality edge to ease arrange blockage, constrain the RREQ communicate storm, and stay away from low vitality hubs to take an interest in the foundation of the way [103]. The upside of AOMDV is that it sets up course on request. It makes circle free hubs, it keeps up availability and quick and productive recuperation from disappointments.

The burden of utilizing AOMDV is that it has more message overheads during course disclosure because of expanded flooding and since it is a multipath directing convention, the goal answers to the numerous RREQs those outcomes in a more drawn out overhead parcels in light of single RREQ bundle may prompt substantial control overhead.

1.2 Body Network surveillance

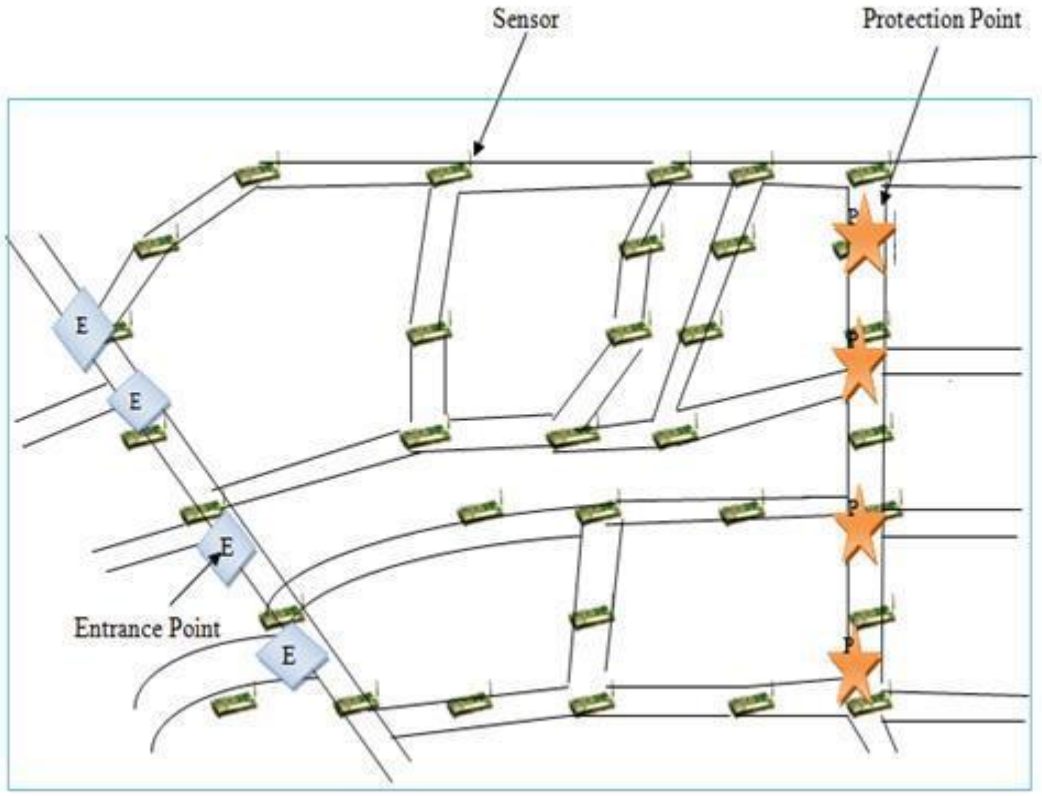


Fig.1.3:- Body networks surveillance

The sensing planning formula for target intrusion detection, utilizing the distinctive options of Body networks. As shown in figure 1.3, there are multiple sensor nodes in the network. These sensor nodes are implanted on the body or under the skin or on clothes like a graph. In this graph, some entrance nodes and protection nodes are present. The entrance node represents the top phase of the body and the protection node represents the bottom part of the body. We assume that objects enter from the left side (Entrance point) and move to the right side (protection point).

The development of wireless sensor networks restricted by battery power, cost, memory limitation, process capability, and therefore the physical size of the sensing element nodes. Wireless sensor network surveillance systems have main focuses on surveillance for two-dimensional spaces. The sensing scheduling algorithm for target intrusion detection, utilizing the unique features of sensor networks.

The detection of targets, getting into from entrance points, before they reach one in all protection points [7]. According to the placement of sensor nodes, each entrance point and protections point to be assigned and altered on demand for quick disease detection. It may solve the problem for body area network with duty cycling and virtual scanning algorithms [74][109]. In which nodes wake up simultaneously for w seconds. The minimum working time before reliable detection may be reportable. The whole network remains silent for some constant time.

Virtual Scanning inside which upgrade essentialness force of work in body sort out inside the sensors blend one by one for w seconds on body segment, making surges of recognizing practices is named virtual looking at the waves cause from one or various security reason P, split at the intersection point and meet on the course till they check most of the body segment work.

Their sleeping time is autonomous of the measure of sensors. Wherever n sensors square measure specifically painted set right now that the left total of the body segment is that the section reason Ep of the goals and moreover the right total of the body segment is that the security reason Pp. We portray nine terms as takes after:

- Neighbouring centres: - Sensors geographically close-by a sensor on the body sort out paying little mind to the property by the correspondence change of a sensor.
- Intersection centres: - Sensors set at an intersection point and having in excess of two neighbouring sensors.
- Non union centre points: - Sensors put at a non crossing point and having a couple neighbouring sensors.
- Virtual Topology: - Let Virtual Topology be, wherever zone unit a social event of sensors inside the body mastermind, and a cross section of way length Vij for sensors Si and Sj. A virtual topology of sensors inside the Body organize, may be a whole chart, since there's a fair balance between two flighty sensors. We tend to chart the sting of the virtual topology as virtual edge. Inside the virtual edges, a solid thick line addresses a strong balance

check (i.e., body segment) between two sensors, which induces that they are adjacent on the Body compose as neighbouring centre points. The spotted thin line addresses a route evaluate between two sensors, which deduces that they are not neighbouring on the Body organize.

- Virtual Graph: - Virtual Graph is may be a plan of sensors inside the Body framework, and essentialness unit a lattice of body section length Vij between sensors Si and Sj. A virtual diagram of the discoverer compose sent on the body organize, wherever the dull center addresses relate merging center and along these lines the diminish center addresses a non crossing point center point.
- Reduced Virtual Graph: - Reduced Virtual Graph is may be a course of action of sensors put solely at intersection focuses inside the Body sort out, and a system of body arrange length Vij between merging center points. The decreased virtual outline ~Gv is procured by deleting non crossing point centers and their edges from the virtual graph Gv through the degree information in Gv. A diminished virtual graph including solely meeting center points of virtual outline.
- Real Graph: - Real Graph is may be a plan of intersection focuses inside the Body arrange round the topographic point, and a lattice of body portion length Rij for merging pi and pj. Bonafide Graph may be overcome direct organizations, like Google Earth and Yahoo Maps. 1f shows a certifiable diagram like the Body orchestrate whose intersection point centers have joining pointer centers.
- Shortest Path Matrix: - Shortest Path Matrix for M such could be a system of the most concise route length between two discretional centers i and j in G. M is enrolled from E by the All-Pairs Shortest ways lead, like the Floyd-Warshall run the show. We tend to graph M in light of the way that the most restricted path structure for the indispensable outline, and plan [45] M in light of the fact that the briefest route grid for the virtual diagram.

1.3 Body network Scanning Algorithms

1.3.1 Always awake scanning Algorithm

In the Always-Awake approach an obviously better style will be outlined upheld the perception that it takes at least l/v seconds for an objective to pass a Body segment of length l at a most speed v. Hence, all sensors inside the Body segment will rest along for l/v seconds, that is laid out as quiet time of the Body arrange. At the point when this quiet time, all hubs stir in the meantime for identification. That the quiet time is zero. Once the objective is distinguished as by and by in light of the fact that it enters the Body segment, the basic location time is zero. Because the target is detect when it is enter the Body segment [83]. So the working time for the sensor T_{life} and the network life time is also T_{life}. Always-Awake Sensor network sleeps during the sleeping time $T_{sleep}=0$.

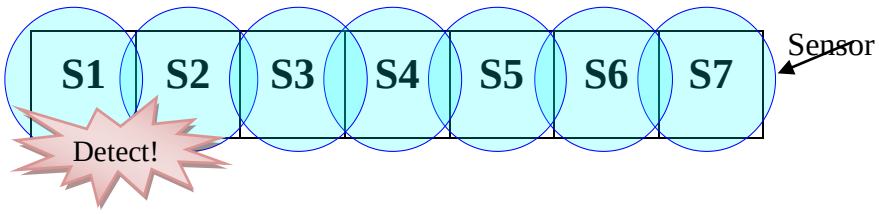


Fig 1.4:- Always-awake sensor network

Advantage:-

- The detection time is zero. So it reduces the detection time.
- Surety for target detection in the scanning area.

Disadvantage :-

- Low energy efficiency.

1.3.2 Duty cycling Scanning Algorithm

In this approach the sensor should be work on the entire sensor network all the time but one sensor is silent that time. The sensor silent time is randomly process. So it may have to work in this type. If the target enter the area that time entrance node is silent then the target is enter the area. So the silent time is considered in the method [25]. The detection time is depend on the entrance node if the target is enter the area

that time sensor is active then detection time is zero. And if the entrance node is not active then the silent time is considered.

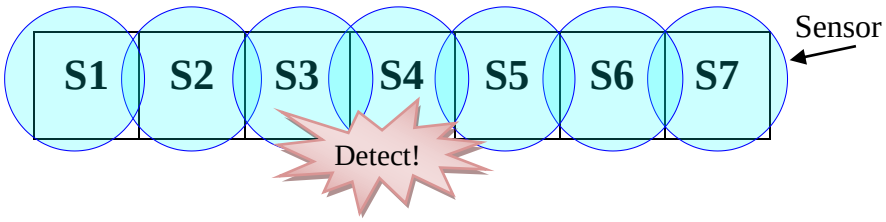


Fig 1.5:- Duty cycling sensor network

Advantage :-

- It improves the energy of sensor comparatively always-awake method.
- The detection time is zero or little one.

Disadvantage :-

- Energy is used more comparative virtual scanning method.
- It uses maximum number of sensors.

1.3.3 Virtual Scanning Algorithm

At the point when the n detecting parts are conveyed on the Body phase so every finder covers the length of l/v in normal. That the objective can arrive either all through sweep time or quiet time, the standard recognition time for every amount so join them to encourage general expected postpone l/(2v). As appeared in figure, regardless sensors rest for l/v seconds, we tend to have a tendency to initiate detecting segments one by one for in operation time w from the right finder S1 toward the left one metal [80]. Plainly, this influx of detecting exercises ensures the discovery and licenses extra dozing time for singular sensors. Contrasted and Duty cycle, this extra dozing time is acquired by the specific indisputable certainty that all sensors yet one can rest all through the sweep [25]. We tend to take note of that the heading of a virtual output should be from the security reason to the door reason. The virtual output of the other way (i.e., from the entryway reason to the assurance point) cannot ensure target interruption identification, if a quick target enters right once the start of the system wide noiseless time.

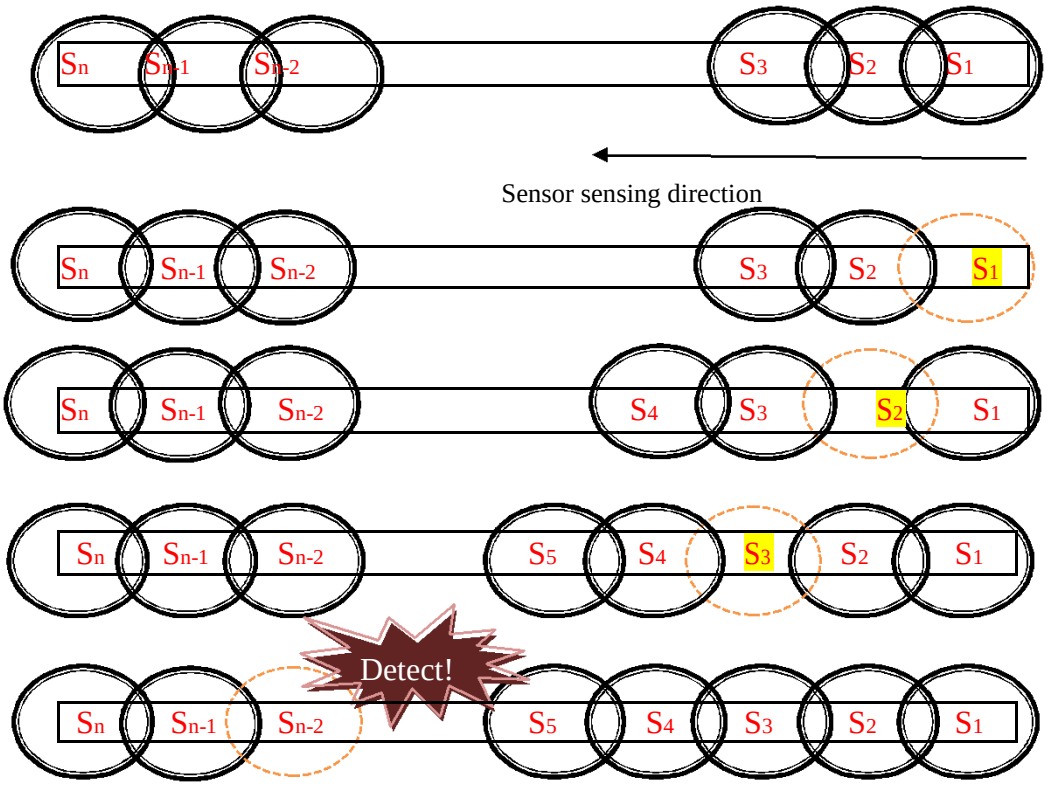


Fig 1.6 :- Virtual scanning sensor network

1.4 Limitation of Scanning Algorithm

All the above technique for scanning algorithms are basically based on graph theory and they are based on real life scanning process but they are far more complex then intrusion detection on scanning area. Some routes have multiple facilities on their way and some may various limitation of time and distance while choosing the right combination of the path. The navigation system which is described above have facilities view with some other landmark but there is a need to improve and extend the functionality of scanning algorithms. Hence there is a need to add some more functionality in the above algorithm [80]. So that they use in real life applications. Therefore time constraint has been included in the algorithms. There are some problem occurs while we discussing route planning, some of them are:

1.4.1 Optimal Scanning Problem

Optimal route can be defined as the shortest path on a given route. There are distinguished vertices source and destination. The optimal path can be defined as the path from source to destination with minimum energy utilization. If there is some

static parameter such as distance than optimal route planning can be formulated and solved efficiently using traditional search algorithms but if distance is dynamic parameter and changes frequently then we need to employ some other approach. Static parameter is unable to provide a real time information on the status of network and unable to reflect time dependent changes in the network.

1.5 Types of ad hoc wireless multi-hop networks

Client late remote sensor frameworks have authorized the setup of ostensible exertion, astute, little, and lightweight restorative sensor centers which can be purposely put on figure, create an outside body locale framework alluded to as Wireless Body space Network (WBAN) to screen completely very surprising physiological key signs for a drawn out extend of your opportunity and giving current contribution to the supporter and intelligent labourers. WBANs certification to reform eudemonia perceptive. Intelligent sensors were acclimated gather physiological data from patients and transmit it to private computerized right hand (PDA) using Bluetooth ordinary and to helpful server using 3G correspondences conjointly we tend to unit taking care of create robot application for gadget in this manner on catch the information from sensors extra because of it will offer office of putting away and sharing the patients results to specialists, doctors and so on through web [70] [95].

1.5.1 Mobile ad hoc networks

Portable unintentional systems (MANETs) are arranges inside which all hubs are versatile and impart totally by means of remote associations. More often than not, the hubs are furnished with one, unidirectional remote radio wire. There is no affixed foundation inside the system, and there is no pecking order: all hubs are on a basic level equivalent, and might play out each as complete purposes of data correspondence, and as switches, sending information for each other in multi-jump mold. One will consider a group of clients conveying neighbourhood empowered gadgets equivalent to cell phones, pda's, workstations, and so on getting a choose space and shaping dynamic remote system among them. See incidentally the MANET [70] made from transportable envisioned in figure 1.7, wherever the specked lines demonstrate the remote connections.

As a result of the over said properties, MANETs are dynamic, level, totally confined systems while not focal administration or rundown. This offers ascend to assortment of vigorous difficulties for systems administration calculations. MANET calculations should be to a great degree adaptative to the ever dynamical climate. They should be solid in order to subsume problematic remote transmissions. They should include a completely appropriated technique. At long last, they should be conservative in their utilization of the limited system assets, practically identical to data gauge, battery control inside the versatile hubs, and so on.

The idea for MANETs originates from investigation into government office parcel radio systems. Extending from the distribution of the Destination-Sequenced Distance-Vector directing principle, MANETs we watch out for the essential kind of incidental multi-bounce remote systems to be explored. The specific difficulties that are experienced in these systems have alluded to as the eye of the numerous analysisers and have made this an extremely dynamic research space. Additionally, the net Engineering Task Force (IETF) hosts set up a MANET working get-together to rule institutionalizations. In any case, once it includes usage, the MANET challenges has tried to be frightfully debilitating to subsume, so there is right now also a developing enthusiasm for unplanned multi-jump remote systems with less quality and a considerable measure of chain of command and association, similar to the remote work networks.

Fig 1.7:- MANET of Mobile Phones

1.5.2 Wireless mesh networks

Wireless Mesh System (WMNs) contains two assortments of necessities: work buyers and work switches. Work buyers region unit, for example, Edouard Manet hubs: they are versatile, and oftentimes impart through one remote interface, that is for the most part a unidirectional radio wire. Like Edouard Manet hubs, they will serve each as complete purposes of data activity and as switches [57]. Work switches, on the either hand, zone unit less portable or maybe static, and territory unit regularly furnished with shifted remote gadgets, supporting totally unique innovations. They ordinarily extra effective gadgets than the work buyers, and occasionally run or outside power offer rather than on battery control. The point of the work switches is to make a remote spine foundation for the WMN. A case of a WMN is given in figure a couple of 1.8: a minor low group of static remote hubs work as work switches, while a greater assortment of heterogeneous cell phones assume the part of work buyers.

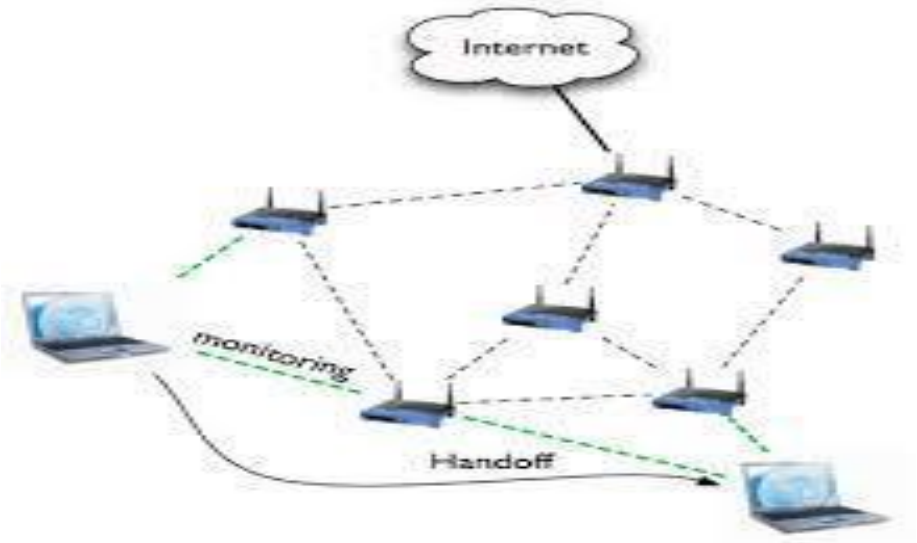


Fig 1.8:- WMN

The utilization of a ton of or less static spine of work switches gives imperative advantages contrasted with MANETs. To begin with, it gives some dependability and association to the system, that licenses higher abuse of system assets. Perhaps data activity is steered fundamentally finished the spine hubs, that square measure normally a great deal of effective and have higher data measure, soothing the arrange of the work customers; second the very certainty that the work switches commonly bolster a spread of different remote correspondence innovations licenses

straightforward combination of heterogeneous gadgets and systems. At long last, the work switches halfway tackle the issues of battery control use.

The said benefits make WMNs less demanding to execute than MANETs. Thus, associate in nursing expanding scope of work arrange execution comes square measure being begun. These grasp originates from instructional exercise investigation, comparing to the roof net trial of the Massachusetts Institute of Technology (MIT), drops by organizations, relating to the Magnets venture of Deutsche Telekom Laboratories (DTL), and even unconstrained endeavors by independent fans, comparing to the losr.freifunk.net try in Berlin. These systems have extensive contrasts in the way they were set up, their structure, the gadgets that are utilized, and so on. For instance, Roofnet and losr.freifunk.net are both absolutely impromptu systems that exclusive comprise of haphazardly put WiFi get to focuses. Manets then again has an arranged spine of five high power switches that are associated through coordinated remote antenna's, giving network to a high number of arbitrarily set, less intense gadgets around them.

1.5.3 Sensor networks

Sensor organizes square measure spontaneous multi-hop remote new works that fuses remote detecting component hubs. Those square measure small gadgets outfitted with one or a ton of sensors, some minor procedure ability, and a sender. The point of detecting component systems is to send an outsized scope of such detecting component gadgets to experience an unequivocal improvement. This will be geologic movement, body working, and so on [57] [65]. By framing a multi-bounce organize among them, the detecting component hubs have an approach to send the data they require measured to a "sink" hub, wherever they will be prepared. The very truth that the system is specially appointed licenses to arrange it according to insignificant outlining. One will for instance toss sensors from a ship into the sea so they will kind a system at absolute bottom, or drop them kind a plane.

Sensing component systems come with their own particular difficulties. First of all, they are once in a while horrendously enormous systems, possible comprising of thousands of hubs or a great deal of, so calculations should scale well. Next, the detecting component hubs square measure typically intended to be untouched low, lightweight gadgets. This infers they require appallingly limited assets of capacity,

process and transmission, so to a great degree conservative calculations square measure might want. This disadvantage is embittered by the very certainty that detecting component batteries will for the most part not get supplanted e.g., once the sensors square measure tossed at absolute bottom of the sea. Besides, the use of minimal effort, flying creature of prey control radio innovation furthermore infers that correspondence is exceptionally temperamental associate in nursing unpredictable. For instance, dynamic nodes reaches will make to unidirectional associations [87] [88]. Along these lines calculations got the chance to be solid and might have the capacity to adapt to unidirectional connections. Another issue in detecting component systems is that their topology is regularly horribly unique. Totally unique kind MANETs, not such a great deal as a result of nature of the detecting component hubs (they are after all frequently static), however last to the straightforward disappointment of light-weight gadgets with limited power, and furthermore the undeniable truth that typically new detecting component gadgets square measure extra. At last, the correspondence designs in detecting component arranges square measure very particular: each detecting component hub procures learning at normal interims, and wants to send this information to the sink hub. It's important to require these examples under thought once arranging system conventions, in order to get higher use of the confined out there assets.

1.6 Issues in ad hoc wireless multi-hop networking

This section builds on the description provided to research necessary issues for networking in spontaneous multi-hop wireless networks. We have a tendency to tend to start with aspects of network property and node quality, then move up the network protocol stack discussing issues relating to the physical layer, the knowledge link layer [70], and additionally the transport layer. Specific attention is given to but these issues have consequences for the task of routing.

1.6.1 Network connectivity

There is a connection between two hubs of a publication hoc multi-bounce remote system on the off chance that they will get each other's radio signs. Along these lines, the topology of the system is specifically plot by the relative arrangement of the hubs and differ of their radio transmitters. Since the area of the hubs in a publication hoc multi-bounce remote system is finished in fortuitous way, with insignificant thinking,

it will be contemplated as an arbitrary technique, from that the topology develops. An essential consider this strategy inside the hub thickness, since it straightforwardly impacts the property inside the resulting topology.

The hypothesis of permeation is utilized to look into the association between hub thickness and system property scientifically. The creators demonstrate that there's a very clear convey to an end reason in hub thickness, alluded to as the essential thickness, underneath that the system falls separated into little, inside associated islands, and over that there is property between the greater part of the hubs inside the system.

For densities that are basically over the critical thickness, this system compose property is somewhat thin, so routes between most combines to hubs depend on the arrangement of numerous imperative connections. The disappointment of any of their essential connections consolidates a monster affect on the steering prospects inside the system. This is frequently in qualification with thickly affect on the directing prospects inside the system. This is regularly in qualification with thickly associated systems, wherever ordinarily a few options are out there to course around a thrashed connect. This suggests in thin systems, it is harder for a steering principle to deliver adaptively out changes inside the topology. Along these lines, we tend to reason that the hub thickness of a notice hoc multi-bounce remote system specifically influences the issue of the directing round.

Hub thickness exclusively has which implies once treated in respect to the transmission change of the hubs radio hardware: if this differ is lessened while the amount of hubs per unit of room says steady, the property of the system diminishes. This infers varieties of the radio fluctuate impact organize property the greatest sum as hub thickness. Radio shift varieties will happen accidently, for instance owing to irregular varieties inside the environment or owing to changes inside the out there control in each hub, or will be evoked designedly, for instance in order to spare heaps of battery control or to curtail radio impedance between totally unique transmitters. Some work treats the matter of molding an insignificant power utilization. For every hub underneath the express requirement that there must be at least on way between each paper on hubs into his system. This is essentially important in detecting component organizes wherever batteries can commonly not get supplanted.

Obviously, the machine of such plans will make to troublesome topologies to keep up directing in.

1.6.2 Node Mobility

Since the arrangement is plot by the position of the hubs, it changes once the hubs move. As a result, the issue of the directing undertaking is also effectively impacted by the attributes of the hub quality. These attributes grasp the speed of the developments, and particular examples took after by the hubs [8]. The last characterizes for instance however the hubs move in respect to each extraordinary, and might deliver to impermanent varieties in hub thickness. The effect of hub quality is extremely key in Edouard Manet, wherever all hubs square measure versatile. Hub quality relies upon the use of the system. Tragically, most examination on incidental multi-bounce remote systems is done in instructive setting, while not a straightforward comprehension of their motivation. Quality is so normally re-enacted with simulated models, of that the Random Waypoint display (RWP) is that the favoured underneath this model, each hub picks an irregular goal, and arbitrary speed, and moves in line to the present goal with the picked speed. At that point the hub stops for a positive time, when that it picks a substitution goal and speed. Distinctive models utilize entirely unexpected methodologies, or model particular conduct reminiscent of e.g. bunch developments. As of late, there's a developing doubt towards these counterfeit quality models, because of they are doing not recreate genuine developments, and since they will unnaturally deliver to beyond any doubt hub appropriations, for instance, under RWP, hubs tend to bunch a considerable measure of inside the focal point of the unintentional multi-bounce remote system space, so there is higher thickness there, giving higher property. There is right now a lot of enthusiasm for gathering hints of genuine developments of people, however hitherto just a couple of such information is possible.

A critical angle comment is made here with connection to the connection between quality, property and system capacity. LF applications will endure high deferrals, correspondence between remote hubs inside the system will capitalize on hub quality by material ownership parcels be rapidly hang on in moving hubs, so they will go closer to their goal this mold. This could expand the capacity of the system, since less remote retransmissions should be finished. It can even empower correspondence in systems wherever there is no immediate property amongst supply and goal hubs. This

can be the universe of defer tolerant systems administration. DTN was inside the first place created as a response for divine body media communications, wherever a few connections will acquire enormous deferrals, and a couple of beneficiaries will rapidly be out of change for correspondence, e.g. a territory station that is hovering around an inaccessible planet.

As of late, there term DTN has furthermore been embraced to clarify unintentional multi-bounce remote systems with discontinuous property, for example, MANETs comprising of people conveying short-go Bluetooth gadgets. Also the terms timeserving systems administration stash exchanged systems administration square measure utilized. While these earthly DTNs can be viewed as a substitution assortment of coincidental multi-jump remote systems, they are commonly still idea of MANETs, operational inside the outrageous case wherever there is awfully confined property. They have particular systems administration calculations, which may adapt to these extreme conditions.

1.6.3 The physical layer

The physical layer is worried about issues with respect to the physical transmission of information between two hubs. While a great deal could be said in regards to various radio transmission advancements that can be utilized, issues tended to in this point have coordinate ramifications for directing. In the first place, we examine about the event of unidirectional connections, and next, we remark on how decisions at the physical layer are characterizing for organize limit.

1.6.4 Unidirectional connections

Most systems administration calculations for spontaneous multi-jump remote systems accept all connections inside the system to be bidirectional: if hub I will hear hub J, at that point hub J will conjointly hear hub I. In purpose of actuality however, a bulletin hoc multi-bounce remote system may likewise contain simplex connections. These will happen for various reasons. One reason might be a qualification in radio change between the hubs: in the event that I even have the following shift than J, it's possible that J will hear I while I can't hear J. Such a refinement in radio change will be picked intentionally, or might be the after effects of a qualification in open battery control inside the hubs. Another, associated explanation behind the rate of simplex connections is radio inconsistency. This has been determined that the radio shift of

remote hubs doesn't kind a perfect over round the hub, however rather indicate very sporadic examples. This can be in the fundamental because of varieties in radio ways that engendering in various ways. Third purpose behind simplex connections might be obstruction by various transmitters. It's possible that the degree of obstruction is very surprising at I and J, all together that one among the two will rapidly not get data from the inverse. The negative effect on organize execution because of the nearness of simplex connections has been archived.

1.6.5 Network capacity

Decisions at the physical layer region unit modelling for the system capacity. Most work on incidental multi-bounce remote systems relies upon WiFi innovation (IEEE 8802.11), which may in principle offer a nearly high yield of up to fifty four Mbps. Other, more up to date innovations, reminiscent of UWB and WiMax guarantee even copious higher yield. In spite of these high data measure esteems, be that as it may, the specific offered ability in an advert hoc multi-jump remote system is way lower. This is frequently because of obstruction between totally unique transmitters. Totally unique sets of hubs inside the system will exclusively impart in the meantime on the off chance that they're set path enough from each other, that they are doing not upset each other's flag. Conjointly referred to with the term spatial reuse: the remote channel can be utilized for different synchronal correspondences [70] if there is spatial division inside the creators research what amount capacity is genuinely offered in an advert hoc multi-bounce remote system if spatial use is ideally utilized. They infer that the offered capacity per hub in bit-meters every second is equally correlative with the foundation of the entire scope of hubs inside the system, which recommends that for mammoth incidental multi-jump remote systems, the offered ability per hub tends to zero. This present outcome is not awfully promising for conditional multi-bounce remote system examination, however must be check with some alert. The examination was done handle review officer systems abuse single-channel, omni directional radio wires. On the off chance that every one channel is utilized, or elective radio wire frameworks, reminiscent of directional receiving wires or multi-reception apparatus frameworks, higher capacity will be gotten in any case. Once creating calculations for fortuitous multi-jump remote systems, one needs to manage as a main priority that the entire offered data measure is path not as much as what remote advances will in principle offer, all together that power is essential.

1.7 Objectives

In this work we present an approach to intrusion detection finding the optimal scanning for a wireless Body network that is dependent on constrained. The solutions are examined with time affecting the performance. Proposed scanning algorithm has satisfied the constraint time, so that user saves time as well as energy on intrusion detection.

The algorithm is evaluated based on computational efficiency and intrusion detection time. Our main objective in this work is as follows:

1. To analyze the performance of various network routing protocols in the mobile wireless body area network.
2. Evaluate the utility of the existing solutions for detecting the target object in sensing area and for time conduct experimental works to show effectiveness of proposed algorithm.
3. Propose Square-Odd scanning algorithm and evaluate their performance experimentally. Time dependent and energy effective are two major constrained for this algorithm.
4. To implement the Square-Odd scanning algorithm using the NS-2 and analyze it using different parameters like detection time, energy efficiency and network lifetime.

1.8 Methodology of work

The proposed work will be completed within four phases.

Phase 1: In this phase we will study existing protocols of the Adhoc network. This phase analyze the performance of various Adhoc network routing protocols in the mobile wireless body area network. The analysis will be done by using various QoS parameters like PDR, e2edelay, throughput etc.

Phase 2: In this phase, we will evaluate and compare the performance of existing scanning approaches for sensing WBAN to find limitations. Depending upon this evaluation we will propose an improved approach for scanning mobile WBAN in next phase.

Phase 3: We will propose square-odd scanning approach so that sensor nodes adapt their wake-up and sleep patterns efficiently in static and dynamic traffic variations. The dynamic adaption of this approach will enhance the network lifetime by saving the energy consumption within the network.

Phase 4: We will implement the proposed square odd algorithm using NS2 and analyze it using different parameters like detection time, energy efficiency and network lifetime. This phase will also compare the performance of proposed algorithm with other existing WBAN scanning algorithms.

Chapter-2

REVIEW OF RELATED LITERATURE

This chapter deals with the review of various operations which used in scanning algorithms to give optimal area. Review of connected literature is extremely essential during a new analysis of topic, as a result of every analysis has its own specific purpose. The aim of analysis is to find answers to queries through the applying of scientific procedure. The most objective of analysis is to seek out the economical algorithmic rule with improvement in existing techniques. In any worthy study during a field of analysis, the scientist should have an adequate information of the work that has already been wiped out the realm of that analysis. This chapter presents an overall review of studies conducted in sensor network related to the research problem.

Here we will centre around interruption identification in examining territory. Remote detecting component systems (WSNs) have an outsized type of military and common applications. We tend to consider a WSN comprising of a few assortment of detecting component hubs. The detecting component hubs are controlled by batteries with confined vitality. For dangerous conditions wherever the detecting component hubs are sent or the entire assortment of the sensors forestalls substitution or energize of the batteries. The measure of sensors inside the WSN is plentiful to supply adequate detecting scope and system property [48][51][54]. Subsequently, it's feasible that futile detecting component hubs might be killed or enter rest mode to spare bunches of their battery control. A detecting component hub is named a pointless hub if it's detecting change is totally covered by various detecting component hubs. Along these lines, the WSN stays deliberate when a pointless hub is killed or enters the rest mode. At the point when a sensor hub is in the rest mode, it expends just a minor area of the vitality devoured in dynamic mode. A killed or resting sensor hub can be taken up by a low power expending clock at a later time or the system part upon ask for from its neighbouring hubs.

2.1 Review of Researches in WBAN

The progression inside the innovation wants the remote body space organize (WBAN) for the social insurance applications. The medicinal services wants the constant perception of the patient and furthermore the readings should be conveyed to the social insurance experts. The BAN ought to be outlined in such how that these necessities are regularly culminated. [73][77][90][102] WBAN might be a version of the wireless gadget organize. The principle qualification is that the space covered by WBAN is a littler sum when contrasted with the world covered by the WBAN. Inside the WBAN various sensors hubs territory unit sent round the patient body. It's not important to convey the hubs inside the collection of patient; the hubs are regularly planted over or round the body. Some of the studies that deserve mention are:-

Feng Wang et al. (2015) proposed an imperativeness compelling medium access control (MAC) tradition for WBAN relies upon human body posture under walking view. Due to person's improvements, WBAN is a dynamic framework, which infers vanithat standard static traditions are no more fitting for it. For dealing with this issue, immediately, the part of human walking around a predictable speed is dismembered and we seclude a spell of advancements into a gathering of key housings basically like a video constituted by amounts of relentless edges. In this way, the dynamic walking process is changed over into a couple of static positions, which the static MAC tradition could be used for. Furthermore, concerning the execution of framework lifetime.

Jing Liu, et al. (2015) proposed an energy efficient MAC protocol named Quasi-Sleep-Preempt-Supported (QS-PS) is proposed. The protocol is mainly TDMA-based: nodes transmit packets in the allocated slots, while entering the Q-Sleep mode in other slots. Moreover, for a node with emergency packet, it can broadcast a special designed awakening message to wake up the whole network and permits the right to use the current slot to transmit that emergency packet, thus decreasing delay. Compared with relevant protocols, QS-PS can achieve high energy efficiency and decrease the delay of both normal packets and emergency packets.

Feng Wang, et al. (2015) proposed an energy-efficient medium access control (MAC) protocol for WBAN is based on human body posture under walking scenery. Due to

person's movements, WBAN is a dynamic network, which means that traditional static protocols are no more suitable for it. For solving this problem, firstly, the feature of human walking at a constant speed is analyzed and we divide a spell of movements into a sequence of key frames just like a video constituted by numbers of continuous frames. As a result, the dynamic walking process is translated into several static postures, which the static MAC protocol could be used for. Secondly, concerning the performance of network lifetime, we design a posture-aware approach for lifetime maximization (PA-DPLM). With analytical and simulation results provided, we demonstrate that PA-DPLM protocol is energy-efficient and can be used under constant speed walking scenery.

Iftikhar Mohsin, et al. (2014) said that wireless body area network (WBAN) has been an active area of research over the past few years due to its tremendous benefits particularly related to healthcare systems. The available research to evolve the QoS in WBAN is immature due to lack of sufficient methodology for modelling the behaviour of different kinds of traffic being generated from different kinds of events. It has been clearly demonstrated that traffic found in multimedia sensor nodes being used in WBAN is having busty nature and cannot be modelled by using Poisson traffic distributions. However, most of the current available literature of traffic modelling related to Multimedia Wireless Sensor Networks (MWSNs) is based on Poisson distributions. To eliminate these kinds of performance evaluation limitations in MWSNs especially in time critical applications, this study proposes a novel analytical framework that relies on a traffic model resembling to an ON/OFF process. Proposed model exhibit self-similar behaviour and is capable to handle long range dependent traffic patterns. For providing enhanced QoS, proposed model deals with various traffic classes that has been judged in the current study through G/M/1 queuing system with a distinct scheduling strategy called as Low Latency Queuing (LLQ) to extract QoS performance metrics such as delay, queue length, throughput and packet loss rate (PLR). We also simulate the behaviour of traffic to further validate the proposed analytical framework.

David M. Davenport, et al. (2014) presented the technical requirements and system issues for wireless Medical Body Sensor Networks (BSNs). Design guidelines were driven by the need to improve ambulatory patient monitoring and care while reducing

logistic constraints for patients as well as healthcare professionals. They presented their study on three key components of Medical BSN: On-body wireless link (to characterize the RF channel for body worn wireless devices), Coupling between bodies (to characterize the RF interaction between bodies) and Coexistence of Medical BSNs in the RF spectrum.

Jie Dong, et al. (2013) said that a cooperative two-hop communication scheme, together with opportunistic relaying (OR), is applied within a mobile wireless body area network (WBAN). Its effectiveness in interference mitigation is investigated in a scenario where there are multiple closely located networks. Due to a typical WBAN's nature, no coordination is used among different WBANs. A suitable time-division-multiple-access (TDMA) is adopted as both an intra-network and also an inter-network access scheme. Extensive on-body and off-body channel gain measurements are employed to gauge performance, which are overlaid to simulate a realistic WBAN working environment. It is found that opportunistic relaying is able to improve the signal to-interference-and-noise ratio (SINR) threshold value at outage probability of 10% by an average of 5 dB, and it is also shown that it can reduce level crossing rate (LCR) significantly at a low SINR threshold value.

V. Vaidehi, M. Vardhini, H. Yogeshwaran (2013) the dynamic nature and nature of the operators make them fitting for keeping up these sensors inside the WSN. The arranged MAS comprises of 4 operators especially admin specialist, administration operator, question operator and data specialist. Administrator operator assumes the part of summoning and ending different specialists. Administration specialist is obligated for putting away the data saw by the sensors into the data. Information specialist performs data lessening that is accomplished exploitation alphabetic character guess. The use of data specialist inside the arranged plan diminishes data movement and in this way the request of memory gadget house. Question specialist is obligated for giving one sign points of interest. The arranged operator based for the most part framework has been authorized utilizing java dialect in JADE climate and along these lines the outcomes are legitimate. Body Area Network (BAN) or Body detecting system (BSN) region unit terms acclimated depict the applying of wearable processing gadgets. BSN comprises of a larger than usual assortment of sensible sensors that have limited registering, stockpiling, correspondence and vitality assets.

The sensors that region unit worn inside the physical structure will gather various physiological changes in order to watch the patient's wellbeing standing. The learning will then be transmitted to a framework/home workstation that procedures the information so transmits it to the server at visit interims, wherever the information is keep in an exceptionally uniform configuration in on-line database paying little heed to customer viewpoint frameworks data design.

Song Yang, et al.(2013) recent advances in wireless communication and electronic manufacture have enabled a variety of sensors to be used for Wireless Body Area Networks (WBANs), which can provide real-time body monitoring and feedback for enabling patient diagnostics procedure, rehabilitation, sports training and interactive performance. However, existing single-hop wireless communication scheme faces several major challenges: rapid growth of channel conflicts as more sensors added, impermeability of human body to radio waves and highly dynamic network topology due to human movements. In this paper, a prototype of multi-hop WBAN has been built to quantify the channel conflict and to characterise the network connectivity during human motions. A probability based routing protocol fusing inertial sensor data and history link quality is then developed, which aims at capturing the high spatio-temporal change of network topology on the selection of a reliable relay node in WBAN routing. The performance of the protocol is experimentally evaluated on our prototype system. Compared with a number of existing routings, the proposed scheme is more splendid in terms of average delivery ratio, number of hops and end-to-end delay.

K. Shashi Prabh, et al. (2012) presented BANMAC, a MAC protocol that monitors and predicts the channel fluctuations and schedules transmissions opportunistically when the RSS was likely to be higher. The MAC protocol was capable of providing differentiated service and resolves co-channel interference in the event of multiple co-located BANs in a vicinity. They report the design and implementation details of BANMAC integrated with the IEEE 802.15.4 protocol stack. They presented experimental data which show that the packet loss rate (PLR) of BANMAC was significantly lower as compared to that of the IEEE 802.15.4 MAC. For comparable PLR, the power consumption of BANMAC was also significantly lower than that of the IEEE 802.15.4.

Jan-Hinrich Hauer, et al. (2011) said that the IEEE 802.15.4 standard has been attracting strong interest, but in the academic community so far very little research related to the IEEE 802.15.4 MAC has been evaluated experimentally, with real hardware under realistic conditions. This was mainly due to the fact that a stable, open-source IEEE 802.15.4 MAC implementation has been unavailable for a long time. Vendor-specific implementations are often proprietary, cover the standard only partially or were customized to a specific platform. Their work aimed at closing this gap: they presented their open-source, platform-independent IEEE 802.15.4 MAC implementation, which has been published as a part of the 2.1 release of the TinyOS operating system.

Xiuming Zhu, et al. (2011) proposed body sensor networks, MB Star adopts the star topology for communication, and was designed to support a message rate as high as 400 Hz, which to the best of their knowledge, was the highest among low-power wireless communication protocols implemented at the present time. The physical layer of MB Star utilizes 802.15.4 DSSS compatible radio for which a higher-frequency, reliable, TDMA MAC layer was built. There was a simple application layer designed for security on top of it. MB Star utilizes public/private key encryption for provisioning devices and does not involve any human configuration before device join. Considering the resource limit of most embedded systems, the TDMA requirement of computing a shared global communication schedule presents a practical problem since it may not be feasible for all the devices to communicate in a long hyper-period while the communication schedule between devices is being created or modified as devices depart and rejoin. Then, retransmission is employed to resolve any conflicts between the devices.

Maraiya, K., Kant, K., & Gupta, N. (2011) conducted a study on large-scale wireless sensor networks, which are composed of hundreds or thousands of autonomous sensor nodes. Step by step instructions to oversee remote sensor arranges viably is a major test. This paper presents progressive administration engineering for remote sensor systems. As opposed to past administration engineering on wired systems and remote specially appointed systems, this design depends on remote sensor systems two unmistakable highlights: centralization and assignment introduction. In view of such engineering, the paper additionally builds up a light

weight, undertaking focused grouping calculation to diminish the granularity of remote sensor systems. The re-enactment shows its viability in remote sensor organize in view of vitality examination.

T. N. Quynh, K.-H. Phung, and H. V. Quo (2011) conducted a research on **s**ystems administration together hundreds or thousands of modest miniaturized scale sensor hubs enables clients to precisely screen a remote situation by shrewdly joining the information from the individual hubs. These systems require strong remote correspondence conventions that are vitality effective and give low dormancy. We create and examine low-vitality versatile grouping chain of command (LEACH), a convention design for microsensor systems that consolidates the thoughts of vitality effective bunch based steering and media get to together with application-particular information accumulation to accomplish great execution as far as framework lifetime, inertness, and application-saw quality. Our outcomes demonstrate that LEACH can enhance framework lifetime by a request of greatness contrasted and universally useful multihop approaches.

Li, Huaming, and Jindong Tan. (2010) proposed BSN-MAC, a medium access control (MAC) protocol designed for Body Sensor Networks (BSNs). Due to the traffic coupling and sensor diversity characteristics of BSNs, common MAC protocols can not satisfy the unique requirements of the biomedical sensors in BSNs. BSN-MAC exploits the feedback information from the deployed sensors to form a closed-loop control of the MAC parameters. A control algorithm was proposed to enable the BSN coordinator to adjust parameters of the IEEE 802.15.4 super frame to achieve both energy efficiency and low latency on energy critical nodes. They evaluated the performance of BSN-MAC by comparing it with the IEEE 802.15.4 MAC protocol using energy efficiency as the primary metric.

Y. Hao, et al. (2010) introduced modelling and characterization of on-body propagation channels and presented for narrowband (2.4 GHz) and UWB communication systems. Time domain electromagnetic computational technique (specifically conformal FDTD) proved to be the most suitable choice for initial modelling of propagation channel on complex structures such as the human body. For narrowband propagation, the channel was shown to exhibit high variability caused by relative movements of the body parts. For UWB channel characterization, reduction

in mean RMS delay spread were noticed for cases where surface waves were dominant in the wave travelling along the human body using printed HSCA. In contrast, when PICA was used in the same scenarios, the main radiation cone was perpendicular to the body and mean spread delays were higher due to free space wave domination.

W.B. Heinzelman, A.P. Chandrakasan (2010) networking together hundreds or thousands of shoddy small scale sensor hubs enables clients to precisely screen a remote domain by cleverly consolidating the information from the individual hubs. These systems require strong remote correspondence conventions that are vitality productive and give low inactivity, conducted a research on systems administration together hundreds or thousands of modest miniaturized scale sensor hubs enables clients to precisely screen a remote situation by shrewdly joining the information from the individual hubs. These systems require strong remote correspondence conventions that are vitality effective and give. Our outcomes demonstrate that LEACH can enhance framework lifetime by a request of greatness contrasted and universally useful multihop approaches.

A Milenkovic, et al. (2009) outline of modest, small scale, light-weight, ultra low-control, flexible sensor stage fit for customization and consistent coordination into a remote medicinal strength sensor organize (WBSN) for wellbeing perception applications presents one of the preeminent troublesome assignments. Physiological signs (EEG, ECG, SPO2, temperature, circulatory strain, aldohexose level, and so on.) estimated by wearable or implantable biosensors square measure accumulated by body space arrange head (BAN-Head) remotely. The BAN-Head will be WBSN hub itself or any transportable gadget, similar to a coordinator of a phone. The BAN-Head with plentiful calculation capacity will do learning examination territorially, find variations from the norm of patients' state and supply cautions instantly. The center of

the WBSN hub is that the radical low power TX Instruments MSP430F1611 microcontroller that incorporates 10kb of RAM, 48kb of glimmer, 128b of information stockpiling, and 8-channels of 12-bit A/D gadget. This 16-bit lessened direction set PC processor alternatives phenomenally low current utilization (under 1mA in dynamic mode and concerning ~1μA in standby mode) that allows the hub to persevere through a broadened time. Interior microcontroller simple channels screen

battery voltage and temperature. In this manner, the battery standing and temperature is gotten to by the screen program.

Jing Liu,et al. (2009) proposed body sensor networks, MB Star adopts the star topology for communication, and was designed to support a message rate as high as 400 Hz, which to the best of their knowledge, was the highest among low-power wireless communication protocols implemented at the present time. The physical layer of MB Star utilizes 802.15.4 DSSS compatible radio for which a higher-frequency, reliable, TDMA MAC layer was built. There was a simple application layer designed for security on top of it. MB Star utilizes public/private key encryption for provisioning devices and does not involve any human configuration before device join. Considering the resource limit of most embedded systems, the TDMA requirement of computing a shared global communication schedule presents a practical problem since it may not be feasible for all the devices to communicate in a long hyper-period while the communication schedule between devices is being created or modified as devices depart and rejoin. Then, retransmission is employed to resolve any conflicts between the devices.

X. Chen, et al (2009) the third level is named medical server for social insurance viewing (MSHM). It gets learning from the private server. It's situated at therapeutic focuses wherever restorative administrations are gave. It is fit for learning quiet particular limits and gains from past treatment records of a patient. MSHM keeps electronic therapeutic records (EMRs) of enlisted patients, that are open by totally extraordinary medicinal representatives, together with general professionals, authorities and specialists from their workplaces inside the doctor's facility over the net. The present condition of the patient are frequently found out by the restorative workers. MSHM is responsible for client confirmation, accretive information from individual server, organization and embedded got learning into relating EMRs, break down the data designs. The engineering of wearable sensors for remote medicinal services observing framework which made out of three levels was depicted. A separated administrations plot in view of need planning and information pressure strategies were introduced in second level. The strategy not just lessens transmission postponement of physiological imperative signs yet additionally enhances its transfer speed usage.

Davenport, David M., F. J. Ross (2008) said that a cooperative two-hop communication scheme, together with opportunistic relaying (OR), is applied within a mobile wireless body area network (WBAN). Its effectiveness in interference mitigation is investigated in a scenario where there are multiple closely-located networks. Due to a typical WBAN's nature, no coordination is used among different WBANs. A suitable time-division-multiple-access (TDMA) is adopted as both an intra-network and also an inter-network access scheme. Extensive on-body and off-body channel gain measurements are employed to gauge performance, which are overlaid to simulate a realistic WBAN working environment. It is found that opportunistic relaying is able to improve the signal to-interference-and-noise ratio (SINR) threshold value at outage probability of 10% by an average of 5 dB, and it is also shown that it can reduce level crossing rate (LCR) significantly at a low SINR threshold value.

R. Biradar, S. Sawant et al.(2008) conducted a study on wireless remote sensors, these are arranges that comprise of countless power, brief, temperamental sensors, one of the fundamental outline challenges is to get long framework lifetime, and also keep up adequate detecting scope and unwavering quality. In this paper, we propose a hub booking plan, which can diminish framework general vitality utilization, in this way expanding framework lifetime, by killing some excess hubs. Our scope based on holiday qualification control and backoff-based hub booking plan ensures that the first detecting scope is kept up subsequent to killing repetitive hubs. We actualize our proposed conspire in NS-2 as an expansion of the LEACH convention. We contrast the vitality utilization of LEACH and without the augmentation and dissect the viability of our plan regarding vitality sparing. Recreation comes about demonstrate that our plan can safeguard the framework scope to the greatest degree. Furthermore, after the hub booking plan kills a few hubs, certain repetition is still ensured, which we accept can give enough detecting unwavering quality in numerous applications.

Y.G. Iyer, S. Gandham (2008) transport conventions for Wireless Sensor Networks are utilized to take out clog and diminish parcel misfortune, to give decency in data transmission designation, and to ensure end-to-end unwavering quality. The vehicle conventions in WSN should bolster congestion control, reliable information conveyance, energy proficiency. The scientists working here need to analyze the

execution of the new convention with the current conventions to demonstrate that new convention is better. In this article we give audit specialized qualities of existing transport convention plan in WSN.

Chieh yih Wan, et al. (2007) event-driven sensor systems work under a sit without moving or light load and afterward all of a sudden wind up dynamic because of an identified or checked occasion. The vehicle of occasion driving forces is probably going to prompt shifting degrees of blockage in the system relying upon the detecting application. It is during these times of occasion motivations that the probability of blockage is most noteworthy and the data in travel of most significance to clients. To address this test we propose a vitality productive blockage control conspire for sensor systems called CODA (COngestion Detection and Avoidance) that involves three instruments: (i) collector based clog location; (ii) open-circle jump by-bounce backpressure; and (iii) shut circle multi-source direction. We show the itemized plan, execution, and assessment of CODA utilizing re-enactment and experimentation. We characterize two vital execution measurements (i.e., vitality expense and constancy punishment) to assess the effect of CODA on the execution of detecting applications. We examine the execution benefits and commonsense designing difficulties of actualizing CODA in a trial sensor arrange testbed in light of Berkeley bits utilizing CSMA. Reproduction comes about demonstrate that CODA altogether enhances the execution of information scattering applications, for example, coordinated dispersion by relieving hotspots, and diminishing the vitality impose with low constancy punishment on detecting applications. We additionally show that CODA is equipped for reacting to various clog situations that we accept will be predominant as the arrangement of these systems quickens.

Shang, Y., et al. (2007) transport conventions for Wireless Sensor Networks are utilized to take out clog and diminish parcel misfortune, to give decency in data transmission designation, and to ensure end-to-end unwavering quality. The vehicle conventions in WSN should bolster congestion control, reliable information conveyance, energy proficiency. The scientists working here need to analyze the execution of the new convention with the current conventions to demonstrate that new convention is better. In this article we give audit specialized qualities of existing transport convention plan in WSNs and we at that point thought about them.

O.B. Akan and I.F. Akyildiz (2007) wireless sensor systems (WSNs) are occasion construct frameworks that depend in light of the aggregate exertion of a few microsensor hubs. Solid occasion discovery at the sink depends on aggregate data. Consequently, the WSN worldview requires an aggregate occasion to-sink unwavering quality thought as opposed to the conventional end-to-end idea. To the best of our insight, dependable transport in WSN has not been examined from this point of view before. In request to address this need, another solid transport conspire for WSN, the occasion to-sink dependable transport (ESRT) convention, is introduced in this paper. ESRT is a novel transport arrangement created to accomplish solid occasion discovery in WSN with least vitality consumption. It incorporates a clog control part that fills the double need of accomplishing unwavering quality and rationing vitality. Imperatively, the calculations of ESRT mostly keep running on the sink, with insignificant usefulness required at asset compelled sensor hubs. ESRT convention task is controlled by the present system state in view of the dependability accomplished and blockage condition in the system. This self-arranging nature of ESRT makes it strong to irregular, dynamic topology in WSN. Moreover, ESRT can likewise oblige different simultaneous occasion events in a remote sensor field. Systematic execution assessment and recreation comes about demonstrate that ESRT focalizes to the coveted unwavering quality with least vitality consumption, beginning from any underlying system state.

Anfeng Liu, Ju Ren (2007) Wireless Sensor Networks will be frameworks of colossal number of little, battery controlled sensor center points having compelled on-board storing, dealing with, and radio capacities. Center points sense and send their reports toward a getting ready concentration which is called base station. Since this transmission and get-together process uses stacks of imperativeness as stand out from data taking care of, designing traditions and applications for such frameworks must be essentialness careful to draw out the lifetime of the framework. All things considered, real applications oversee such heterogeneity instead of homogeneity. In this paper, a tradition is proposed, which is heterogeneous in essentialness. We analyze the essential flowed gathering coordinating tradition LEACH , which is a homogeneous system, and a short time later we consider the impact of heterogeneity in imperativeness of center points to drag out the life time of WSN. Re-enactment

happens using MATLAB exhibits that the proposed Leach-heterogeneous structure basically decreases essentialness usage and addition the total lifetime of the remote sensor organize.

Chee-Yee Chong, S.P. Kumar (2007) coordinated an examination on Sensor frameworks: improvement, openings, and challenges. Particular troubles in sensor orchestrate change join framework exposure, control and coordinating, group situated banner and information planning, entrusting and addressing, and security. The paper closes by presenting some flow examine achieves sensor arrange counts, including limited computations and facilitated scattering, circled following in remote extraordinarily delegated frameworks, and appropriated portrayal using neighbourhood administrators.

Iftikhar Mohsin, et al. (2007), said that remote Body Area Network (WBAN) has been a dynamic locale of research over the span of late years due to its huge favourable circumstances particularly related to social protection systems. The available research to build up the QoS in WBAN is young in view of nonattendance of sufficient theory for exhibiting the lead of different sorts of movement being delivered from different kinds of events. It has been unmistakably shown that action found in intelligent media sensor centers being used as a piece of WBAN is having busty nature and can't be shown by using proposed an imperativeness compelling medium access control (MAC) tradition for WBAN relies upon human body posture under walking view. Due to person's improvements, WBAN is a dynamic framework, which infers that standard static traditions are no more fitting for it. For dealing with this issue, immediately, the part of human walking around a predictable speed is dismembered and we seclude a spell of advancements into a gathering of key housings basically like a video constituted by amounts of relentless edges. In this way, the dynamic walking process is changed over into a couple of static positions, which the static MAC tradition could be used for concerning the execution of framework lifetime.

Philip Abidoye, Nureni Ayofe Azeez1 (2006) here client late remote detecting component frameworks have approved the setup of ostensible exertion, smart, little, and light-weight remedial detecting component center points which will be purposely put on human body, make an abroad body locale framework known as Wireless Body

territory Network (WBAN) to screen totally unique physiological vital signs for a drawn out extend of time and giving current contribution to the shopper and reflective staff. High data rate suggests fundamental signs that should be trade speedy with high unfaltering quality while low idleness infers time deferment to the response of transmission of essential banners and should be yet especially like may reasonably be normal be short.

V.C. Gungor, O.B. Akan. (2006) said that advances in inserted frameworks have brought about the improvement of remote sensor systems, which give exceptional chances to observing as well as controlling homes, urban communities and the conditions. Late progressions in remote sensor arrange have come about into numerous new conventions some of them are particularly intended for sensor organize for recognizing the occasion and directing the occasion related data to the base station in productive way. This paper overviews late occasion driven directing conventions for remote sensor organize. We have looked at different occasion driven directing conventions utilizing distinctive parameters like Sink Centric, Node Centric, Reliability, Congestion control, Energy Efficiency, Loss unwavering quality and misfortune recuperation. We have additionally depicted LEACH and MECN conventions. Along these lines, we require behaviour for bunch head determination in remote sensor arrange, it is run at the base station and tumbling the hub's exuberance utilize and developing their life expectancy. We execute a fluffy rationale with the end goal of select a group head hub alongside the hubs of system, it is relying upon two parameters one is contemporary vitality of the hub and second is remoteness of the hub from the base station.

Giuseppe Anastasi et al., (2006) one essential supposition made by most LBR conventions is the accessibility of an area administration or system to discover other hubs' positions. Albeit a few systems exist, the greater part of them depend on a type of flooding strategy inadmissible for expansive scale remote sensor systems, particularly with different and moving sinks and sources. In this paper, we present the Anchor Location Service (ALS) convention, a framework based convention that gives sink area data in a versatile and productive way and along these lines underpins area based directing in expansive scale remote sensor systems. The area benefit is assessed numerically and by recreations and furthermore contrasted and a notable framework

based steering convention. At that point, we show a precise and far reaching scientific classification of the vitality preservation plans, which are along these lines talked about top to bottom. Extraordinary consideration has been committed to promising arrangements which have not yet gotten a wide consideration in the writing, for example, strategies for vitality proficient information obtaining. At last we finish up the paper with experiences for examine headings about vitality protection in WSNs.

Khaled Matrouk, Bjorn Landfeld (2006) we assess the execution of the RETT-gen convention by means of recreations, and contrast it with the execution of understood directing conventions. Recreation comes about demonstrate that by evening out the sensor hubs vitality, RETT-gen protects that the lifetime of the whole sensor organize is amplified, the availability in a sensor arrange is kept up for whatever length of time that conceivable, and that the lingering vitality of the whole system is of a similar request. To accomplish this objective, RETT-gen utilizes warm conductivity as a similitude and utilizations the warmth scattering distinction conditions. In RETT-gen, we change the normal lifetime of every sensor hub to an identical temperature, and afterward by utilizing the warmth dissemination conditions, we locate the most sizzling way to send information to the base station.

Sanjeev Jain, Vinay Kumar (2006) at that point, we display an efficient and extensive scientific categorization of the vitality protection plans, which are therefore examined inside and out. Exceptional consideration has been dedicated to promising arrangements which have not yet gotten a wide consideration in the writing, for example, methods for vitality effective information securing. At last we finish up the paper with bits of knowledge for investigate headings about vitality preservation in WSNs.

Y.G. Iyer, S. Gandham, and S. Venkatesan (2005), centers around "Stcp: a nonexclusive transport layer tradition for remote sensor frameworks". They show the arrangement, use, and appraisal of pump step by step, bring quickly (PSFQ), a clear, versatile, and overwhelming transport tradition that is customizable to address the issues of rising strong data applications in sensor frameworks. PSFQ addresses a clear approach since it makes minimum doubts about the essential coordinating establishment, it is versatile and imperativeness powerful in light of the way that it supports slightest hailing, thusly diminishing the correspondence cost for data

unflinching quality, and fundamentally, it is solid in light of the fact that it is responsive to a broad assortment of operational both conditions found in sensor mastermind, considering the productive task of the tradition even under significantly both slanted conditions.

X. Wu, G. Chen, and S. K. Das (2005) provide an examination on "Dst: postpone delicate transport in remote sensor systems". Advances in implanted frameworks have brought about the improvement of remote sensor systems, which give special chances to checking as well as controlling homes, urban communities and the situations. Late headways in remote sensor organize have come about into numerous new conventions some of them are particularly intended for sensor arrange for recognizing the occasion and directing the occasion related data to the base station in productive way. This paper overviews late occasion driven directing conventions for remote sensor organize. We have analyzed different occasion driven steering conventions utilizing diverse parameters like Sink Centric, Node Centric, Reliability, Congestion control, Energy Efficiency, Loss dependability and misfortune recuperation. We have additionally portrayed LEACH and MECN conventions.

Chieh yih Wan, et al. (2005) the center of this framework is that the shopper known as the patient. Wearable sensors square measure molested to the patient body framing remote body zone organize (WBAN) to screen changes in patient's essential signs intently and provides continuous criticism to assist continue a perfect upbeat standing. The healthful sensors unremarkably comprise of five elementary elements: Sensor, Microcontroller, Memory, Radio Transceiver, Power supply. Sensor hubs will detect, test, and technique one or extra physiological signs. For instance, associate in nursing analytic method (EKG) detecting component are regularly utilized for watching heart action, a power for each unit region detecting component are frequently utilized for watching power per unit territory, a breath detecting component for watching breath, associate in nursing megrim (EMG) detecting component for watching muscle action, associate in nursing an electroenphalogram (EEG) detecting component for watching mind electrical touch base for each detecting component. Inside the style over, a muddled detecting component is incorporated into the WBAN alluded to as Medical Super detecting component (MSS).

Alumona T.L. (2005) here client as of late, the clarification for a patient remaining inside the clinic isn't that he or she really wants dynamic treatment. Frequently, the vital explanation behind a delayed keep inside the doctor's facility is simply consistent perception. Thusly, endeavors are made to dodge intense confirmations and long lengths of keep inside the healing center. Remote sensor Networks (WSNs) with keen sensor hubs are getting crucial facultative innovation for enormous choice applications. Late mechanical advances in coordinated computerized material science and contracting of physical sensors, microchip, and recurrence gadgets into one smaller scale chip has semiconductor diode to the rise of awfully light-weight, ultra-low power, perception sensor gadgets.

X. Chen, et al. (2005) in this paper directed an investigation on client outline of modest, smaller than expected, light-weight, ultra low-control, flexible sensor stage equipped for customization and consistent reconciliation into a remote restorative claim to fame sensor organize (WBSN) for wellbeing perception applications presents one of the chief troublesome errands. During this paper, we tend to propose a WBSN hub stage that incorporates relate radical low-control microcontroller, relate IEEE 802.15.4 perfect handset, and an adaptable amplification connective. The anticipated determination guarantees a shabby, flexible stage that empowers clear customization, vitality productive calculation and correspondence. The occasion of a standard stage for various physical sensors can expand utilize and lighten costs of change to a substitution age of sensors. Remote sensor network is changing into a promising innovation for various applications. One in everything about potential organizations is inside the sort of remote restorative strength sensor arrange (WBSN) for measure physiological signs. The smaller than expected remote clever module which might be coordinated with some very biosensor is alluded as WBSN hub.

V. Jones, et al.(2004) late remote detecting component frameworks have approved the design of ostensible exertion, shrewd, little, and light-weight remedial detecting component center points which will be intentionally put on human body, make an abroad body district framework known as wireless body zone network (WBAN) to screen totally unique physiological fundamental signs for a drawn out extend of time and giving current contribution to the purchaser and thoughtful staff. WBANs assurance to change eudemonia attentive. In this paper, reflective sensors were

utilized to gather physiological information from patients and transmit it to individual computerized right hand (PDA) using Bluetooth ordinary and to remedial server using 3G correspondences. In this paper, we tend to blessing new patterns, various advancements like we have a tendency to abuse Bluetooth innovation that is not utilized before. Additionally we territory unit coming to create robot application for electronic gadget in order to catch the data from sensors advance since it will give office of putting away and sharing the patients results to specialists, doctors and so on through net. There are different physiological signs that are normally transmitted between the sensor centers and patient server. High data rate suggests fundamental signs that should be trade snappy with high faithful quality though low fixed status infers time delay to the response of transmission of essential banners and should be however particularly like may modestly be normal be short.

O.B. Akan, I.F. Akyildiz (2004) revolves around "Event to-sink strong transport in remote sensor frameworks". Remote sensor structures (WSNs) are occasion construct frameworks that depend in light of the aggregate exertion of two or three microsensor focus on solid occasion affirmation at the sink depends upon add up to data gave by source fixate focuses and not on any individual report. Regardless, customary end-to-end unwavering quality definitions and courses of action are inapplicable in the WSN association and would basically incite a mishandle of extraordinary sensor assets. Accordingly, the WSN point of view requires an aggregate occasion to-sink faithful quality idea rather than the standard end-to-end thought. To the best of our understanding, solid transport in WSN has not been investigated beginning here of view already. In request to address this need, another time tested transport plot for WSN, the occasion to-sink dependable transport (ESRT) custom, is appeared in this paper. ESRT is a novel transport game plan made to achieve tried and true event area in WSN with slightest imperativeness utilization. It fuses an obstruct control section that fills the twofold need of achieving steady quality and sparing essentialness. Basically, the counts of ESRT overwhelmingly continue running on the sink, with immaterial convenience required at resource obliged sensor center points. ESRT tradition movement is controlled by the present framework state in perspective of the constancy achieved and blockage condition in the framework. This self-planning nature of ESRT makes it energetic to sporadic, dynamic topology in WSN. Also,

ESRT can similarly suit distinctive concurrent event occasions in a remote sensor field. Explanatory execution appraisal and re-enactment occurs exhibit that ESRT centers to the desired immovable quality with slightest imperativeness utilize, starting from any hidden framework state.

Duan, Xiaobu Yuan (2003) investigating chain of command engineering for remote sensor systems administration. Remote Sensor hubs need to arrange among themselves to get data about the physical condition. The data gathered by sensor hubs is steered to the Base Station either straightforwardly or through other sensor hubs. The Base Station is a settled hub or versatile hub, which is competent to associate the sensor system to a foundation arranges or to the Internet where clients can access and process information. In this paper an incorporated convention for novel cluster head determination in WSN is talked about, which is keep running at the base station, along these lines decreasing the hubs vitality utilization and in-wrinkling their life-time. The essential thought is executed utilizing a fluffy rationale based choice of cluster head from among the hubs of system, which is closed relying upon two parameters, the present vitality of the hub and the separation of the hub from the base station.

R. A. Santos, et al. (2003) bases on "A geographic directing figuring for remote sensor frameworks". Remote Sensor Networks incorporates number of downsized scale sensor focus focuses to screen a remote zone by utilizing gathered information from specific focus indicates and exchange this information the base station for moreover reason. Here the centrality of worked focus focuses is slight store of the Wireless Sensor Network, which is senseless at a rate when data is transmitted, in light of the way that transmission noteworthiness is liable to the degree of transmission. In social occasion approach, the bunch head focus point slack a vital measure of criticalness during transmission to base station. So hear the affirmation of pack head is essential assignment. A practical lead must pick gather heads in light of regular position of focus point and its extraordinary vitality. Thusly, we require lead for group head confirmation in remote sensor make, it is continue running at the base station and tumbling the inside point's essentialness utilize and developing their future. We understand a padded premise with the genuine goal of select a bunch head focus point adjacent the focuses of system, it is relying on two parameters one is contemporary vitality of the middle point and second is remoteness of the inside point

from the base station. The conduct is named TRICKLE in context of hugeness out and is spurn at base station where another sort out of gathering heads are picked at each round, and it is expansion the system life cross. The replication works out as expected display that the proposed approach is more persuading than the present etiquette.

Rui Zhang, et al. (2002) the grapple area benefit convention for extensive scale remote sensor systems". Area based directing (LBR) is a standout amongst the most broadly utilized steering techniques in huge scale remote sensor systems. With LBR, little, modest and asset compelled hubs can play out the steering capacity without the need of complex calculations and a lot of memory space. Further, hubs do not have to send vitality devouring occasional ads on the grounds that steering tables, in the customary sense, are not required. One imperative suspicion made by most LBR conventions is the accessibility of an area administration or instrument to discover other hubs positions. Albeit a few systems exist, the vast majority of them depend on a type of flooding methodology inadmissible for substantial scale remote sensor systems, particularly with numerous and moving sinks and sources. In this paper, we present the Anchor Location Service (ALS) convention, a framework based convention that gives sink area data in a versatile and effective way and in this manner underpins area based directing in vast scale remote sensor systems. The area benefit is assessed scientifically and by re-enactments and furthermore contrasted and a notable framework based directing convention. Our outcomes show that ALS not just gives an effective and adaptable area benefit yet in addition diminishes the message overhead and the state multifaceted nature in situations with numerous and moving sinks and sources.

Wenli Chen, et al. (2002) proposed a vast scale remote sensor systems are made out of hundreds or thousands of self-governing sensor hubs. Instructions to oversee remote sensor arranges adequately is a major test. This paper presents progressive administration engineering for remote sensor systems. As opposed to past administration design on wired systems and remote specially appointed systems, this engineering depends on remote sensor systems two unmistakable highlights: centralization and errand introduction. In view of such engineering, the paper likewise builds up a light weight, assignment arranged bunching calculation to diminish the granularity of remote sensor systems. The re-enactment shows its adequacy in remote

sensor arrange in view of vitality investigation.

Sanjeev Jain, VinayKumar and Sudharshan Tiwari (2002) proposed a center around energy effective bunching calculations in remote sensor systems. To augment organize lifetime in Wireless Sensor Networks (WSNs) the ways for information move are chosen such that the aggregate vitality expended along the way is limited. To help high versatility and better information conglomeration, sensor hubs are frequently assembled into disjoint, non covering subsets called groups.

Abderrahim beni hssane, et al. (2001) led an examination on advanced low vitality versatile bunching pecking order. Remote sensor networks will be frameworks of tremendous number of pretty much nothing, battery controlled sensor centers having limited on-board accumulating, getting ready, and radio capacities. Center points sense and send their reports toward a taking care of center which is called base station. Since this transmission and social affair process eats up clusters of imperativeness as stand out from data planning, Designing traditions and applications for such frameworks must be essentialness careful in order to defer the lifetime of the framework. Generally, certifiable applications oversee such heterogeneity rather than homogeneity. In this paper, a tradition is proposed, which is heterogeneous in imperativeness. We analyze the basic passed on gathering coordinating tradition LEACH (Low Energy Adaptive Clustering Hierarchy), which is a homogeneous structure, and a short time later we ponder the impact of heterogeneity in imperativeness of center points to draw out the life time of WSN. Re-enactment comes to fruition using MATLAB exhibits that the proposed Leach-heterogeneous structure through and through diminishes imperativeness usage and addition the total lifetime of the remote sensor sort out.

Giuseppe Anastasi, et al. (2001) directed an investigation on energy protection in remote sensor systems. In the most recent years, remote sensor systems (WSNs) have increased expanding consideration from both the examination group and genuine clients. As sensor hubs are by and large battery-fueled gadgets, the basic angles to confront concern how to decrease the vitality utilization of hubs, with the goal that the system lifetime can be reached out to sensible circumstances. In this paper we first separate the vitality utilization for the segments of a normal sensor hub, and examine the primary headings to vitality protection in WSNs. At that point, we show an

orderly and far reaching scientific categorization of the vitality protection plans, which are in this manner talked about top to bottom. Extraordinary consideration has been dedicated to promising arrangements which have not yet acquired a wide consideration in the writing, for example, systems for vitality proficient information obtaining. At long last we finish up the paper with experiences for inquire about bearings about vitality preservation in WSNs.

Mehmet C. Vuran and I.F. Akyildiz (2001) bases on low power scattered mac for exceptionally delegated sensor radio frameworks. Centering at multi-bounce remote sensor organizes, a course of action of low power MAC layout norms have been proposed, and a novel ultra-low power MAC is planned to be spread in nature to help adaptability, survivability and adaptability necessities. Direct CSMA and spread range framework are united to trade off exchange speed and power profitability. A passed on count is used to do dynamic channel errand. A novel wake-up radio arrangement is solidified to misuse new radio developments. The prospect of flexibility care is familiar into an adaptable tradition with reduce arrange bolster overhead. The came to fruition tradition shows altogether higher power capability for common sensor sort out applications.

M.J. Advantageous, M. Haase, and D. Timmermann (2000) drove an examination on low noteworthiness adaptable packaging dynamic system with deterministic social event head confirmation. To accomplish this objective, these sensor gadgets have the capability of detecting, process and transmitting essential physiological signs exploitation remote innovation. In opposition to the typical sensor organizes that are thoroughly arranged and conveyed inside the arranged positions, WSNs might be sent in relate degree imprompt way that make them solid, adaptation to internal failure, and increment in spatial scope. They' will incredibly be acclimated screen and track states of patients in every city relate degrade provincial territories exploitation a PC system or net consequently decreasing the strain and strain of consideration providers, wipe out medicinal mistakes, cut back business, increment strength of healing center laborers, cut back long haul cost of consideration benefits, and enhance the solace of the patients. Additionally, these frameworks give accommodating strategies to remotely secure and screen the physiological signs while not the need of intrusion of the patient's ordinary life.

Melody Yang, et al.**(2000)** revolve around late advances in remote correspondence and electronic make have enabled a grouping of sensors to be used for Wireless Body Area Networks (WBANs), which can give steady body checking and contribution for engaging understanding diagnostics framework, recuperation, sports getting ready and instinctive execution. In any case, existing single-hop remote correspondence plot faces a couple of critical challenges: quick improvement of channel conflicts as more sensors included, impermeability of human body to radio waves and exceedingly intense framework topology in view of human advancements. In this paper, a model of multi-bounce WBAN has been attempted to assess the channel battle and to depict the framework accessibility in the midst of human developments. A probability based controlling tradition joining inertial sensor data and history associate quality is then made, which goes for getting the high spatio-transient distinction in orchestrate topology on the assurance of a tried and true hand-off center point in WBAN coordinating. The execution of the tradition is probably surveyed on our model system. Differentiated and different existing routings, the proposed contrive is additionally amazing with respect to ordinary movement extent, number of hubs and end-to-end delay.

Giuseppe Anastasi, et al. (2000) led an investigation on energy preservation in remote sensor systems. In the most recent years, remote sensor systems (WSNs). As sensor hubs are for the most part battery-controlled gadgets, the basic viewpoints to confront concern how to decrease the vitality utilization of hubs, with the goal that the system lifetime can be reached out to sensible circumstances. In this paper we first separate the vitality utilization for the parts of a normal sensor hub, and talk about the fundamental headings to vitality protection in WSNs. At that point, we display a methodical and exhaustive scientific categorization of the vitality preservation plans, which are accordingly talked about top to bottom. Extraordinary consideration has been dedicated to promising arrangements which have not yet gotten a wide consideration in the writing, for example, procedures for vitality effective information securing. At last we finish up the paper with bits of knowledge for look into bearings about vitality protection in WSNs.

Khaled Matrouk and Bjorn Landfeldt. (2000) all inclusive proficient directing convention for remote sensor arranges by adjusting sensor vitality and maintaining a strategic distance from vitality openings. Remote sensor frameworks are made out of a far reaching number of sensor center points with obliged essentialness resources. When sent, the sensor centers are for the most part hard to reach to the customer, and hence substitution of the essentialness resource is not achievable. An application specific tradition designing for remote microsensor frameworks. Frameworks organization together hundreds or thousands of unassuming scaled down scale sensor centers empowers customers to unequivocally screen a remote circumstance by keenly combining the data from the individual centers. These frameworks require healthy remote correspondence traditions that are essentialness capable and give low in action. We make and separate low-imperativeness adaptable gathering hierarchy of leadership (LEACH), a tradition building for littler scale sensor sorts out that joins the musings of essentialness capable pack based directing and media get to together with application-specific data aggregate to achieve incredible execution to the extent system lifetime, idleness, and application-saw quality In RETT-gen, we change the normal lifetime of every sensor hub to a comparable temperature, and after that by utilizing the warmth dissemination conditions, we locate the most smoking way to send information to the base station, which won't generally be the briefest way. We assess the execution of the RETT-gen convention by means of reproductions, and contrast it with the execution of understood directing conventions. Reproduction comes about demonstrate that by adjusting the sensor hubs vitality, RETT-gen safeguards that the lifetime of the whole sensor arrange is expanded, the availability in a sensor organize is kept up for whatever length of time that conceivable, and that the remaining vitality of the whole system is of a similar request.

W.B. Heinzelman, et al. (2000) centers around "An application-specific tradition designing for remote microsensor frameworks. Frameworks organization together hundreds or thousands of unassuming scaled down scale sensor centers empowers customers to unequivocally screen a remote circumstance by keenly combining the data from the individual centers. These frameworks require healthy remote correspondence traditions that are essentialness capable and give low in action. We make and separate low-imperativeness adaptable gathering hierarchy of leadership

(LEACH), a tradition building for littler scale sensor sorts out that joins the musings of essentialness capable pack based directing and media get to together with application-specific data aggregate to achieve incredible execution to the extent system lifetime, idleness, and application-saw quality. Deplete consolidates another, scattered cluster game plan technique that engages self relationship of tremendous amounts of center points, figuring for modifying gatherings and turning bundle scramble toward similarly scatter the essentialness stack among each one of the center points, and methods to enable passed on signal getting ready to save correspondence resources. Our results exhibit that LEACH can improve system lifetime by a demand of size differentiated and comprehensively helpful multihop approaches.

Shangwei Duan and Xiaobu Yuan (2000) investigating chain of command engineering for remote sensor systems administration. Remote sensor hubs need to arrange among themselves to get data about the physical condition. The data gathered by sensor hubs is steered to the base station either straightforwardly or through other sensor hubs. The base station is a settled hub or versatile hub, which is competent to associate the sensor system to a foundation arranges or to the Internet where clients can access and process information. In this paper an incorporated convention for novel cluster head determination in WSN is talked about, which is keep running at the base station, along these lines decreasing the hubs vitality utilization and in-wrinkling their life-time. The essential thought is executed utilizing a fluffy rationale based choice of cluster head from among the hubs of system, which is closed relying upon two parameters, the present vitality of the hub and the separation of the hub from the base station.

I.F. Akyildiz, et al. (2000) directed an investigation on" An overview on sensor systems". The headway in remote correspondences and gadgets has empowered the improvement of minimal effort sensor systems. The sensor systems can be utilized for different application regions (e.g., wellbeing, military, home). For various application territories, there are diverse specialized issues that analysts are at present settling. The present cutting edge of sensor systems is caught in this article, where arrangements are talked about under their related convention stack layer segments. This article additionally calls attention to the open research issues and plans to start new interests and improvements in this field.

Chapter – 3
RESEARCH METHODOLOGY

The increasing population needs large medical staff for the excellent healthcare services. Using WSN in healthcare might help to overcome the shortage of the medical staff in medical institutions around the world. The advancement within the technology desires the wireless body area network (WBAN) for the health care applications [59][62][64]. WBANs include variety of heterogeneous biological sensors. These sensors are unit placed in numerous components of the body and may be wearable or established below the user skin. Different type of sensors can be used for measuring different parameters [65]. Every of them has specific needs and is employed for various missions. The wireless sensor network (WSN) having large number of sensor nodes as compare to wireless body area network (WBAN).

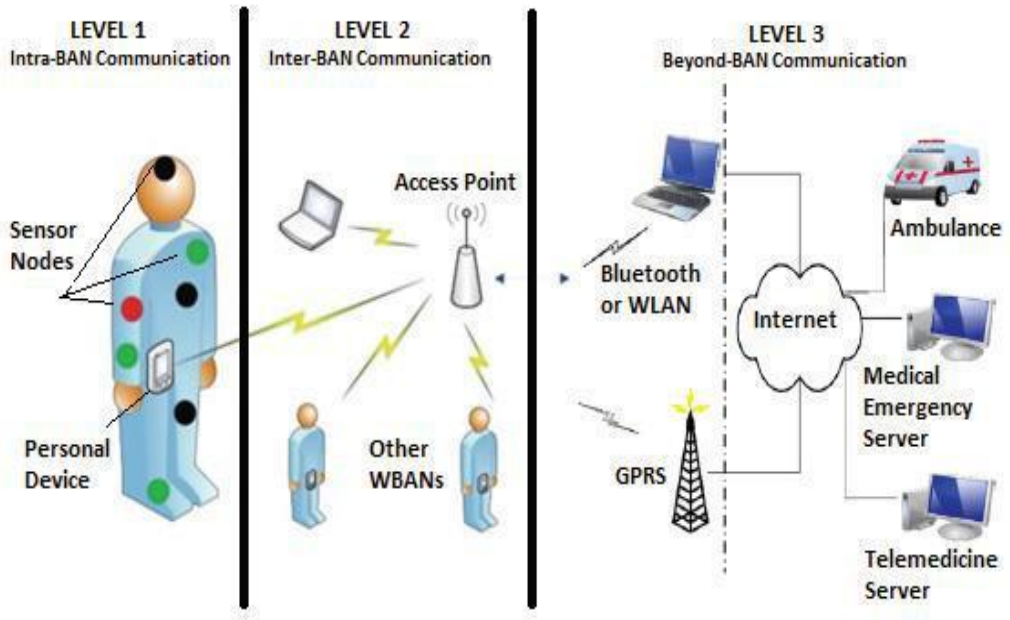


Fig 3.1:- General architecture for Wireless Body Area Networks

Figure 3.1 depicts three different levels of wireless body area network architecture. Level 1 represent Intra-BAN communication which contains in-body and on-body BAN nodes (BNs). In the wireless body area network all nodes send the information to the base station and then base station send this information to the server through

different interfaces. Level 2 represent Inter-BAN communication which contains a BAN network coordinator (BNC) or access point that gathers patient's vital information from the BNs and communicates with the base-station. Level 3 contains a number of remote base-stations that keep patient's medical/non-medical records and provides relevant (diagnostic) recommendations.

WBANs for healthcare applications are mainly used in patient monitoring tasks. In this type of network, the sensors are distributed on the human body measuring different physiological parameters [112]. A typical WBAN network as shown in figure 3.2 includes (i) a small network around the body (about 1-2 meters), (ii) a gateway (sink) bridging to another network types that can be another node with some routing and data aggregate features, (iii) a wide network that can be an internet or intranet network, and (iv) applications with GUI for medical or other healthcare personnel.

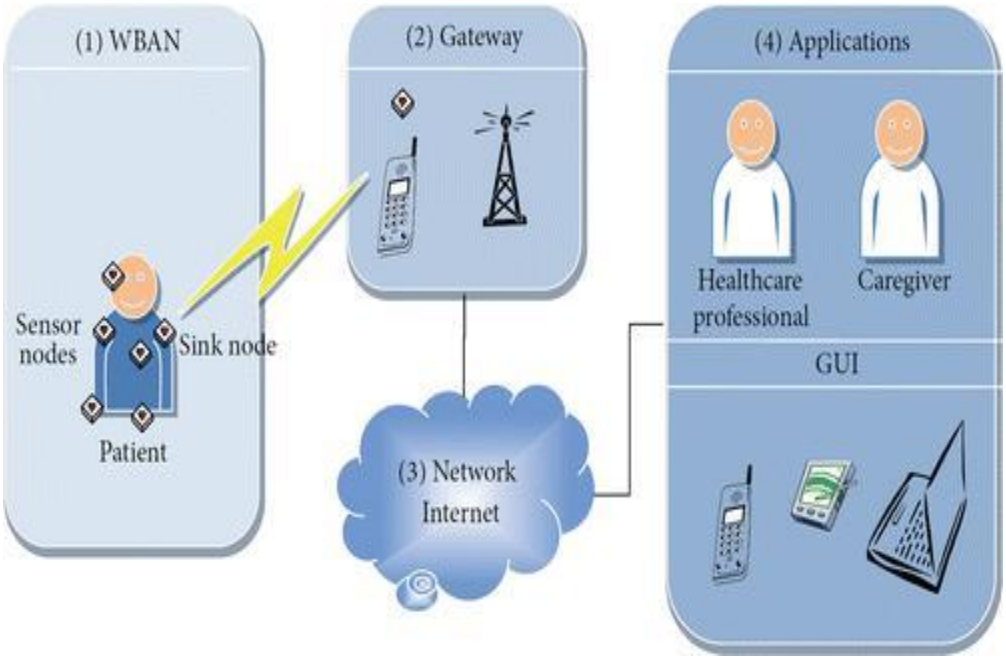


Fig 3.2 :- WBANs for healthcare applications

The WBAN as well as the WSN both consists of sensor nodes but the number of nodes in WSN are more than the number of nodes in the WBAN. Moreover, the area covered by the WSN is larger as in WBAN nodes are implanted near by the body.

3.1 Problem Statement

Developing a WBAN platform is a very challenging issue as the protocol used for the adhoc network does not perform efficiently in the mobile WBAN. This needs an optimal scanning policy for the WBAN to be added in routing to enhance the performance of existing scanning algorithms for WBAN [82][89].

Moreover, the sensor nodes remains active at all times whereas the utilization period of the sensor nodes is only 20% of the total time[12][18][113]. This results in high energy consumption. This results in need of an efficient scanning algorithm for WBAN with dynamic active period [79].

Therefore, enhancements within the current technologies and higher solutions to those challenges are needed. These two phenomenon time dependent and energy effective are necessary for every WBAN.

3.2 Objectives

1. To analyze the performance of various network routing protocols in the wireless body area network.
2. Evaluate the utility of the existing solutions for detecting the target object in sensing area and for time conduct experimental works to show effectiveness of proposed algorithm.
3. Propose Square-Odd scanning algorithm and evaluate their performance experimentally. Time dependent and energy effective are two major constrained for this algorithm.
4. To implement the Square-Odd scanning algorithm using the NS-2 and analyze it using different parameters like detection time, energy efficiency and network lifetime.

3.3 Software tools to be used for research

The simulation tool used for the proposed work implementation will be NS-2. These tools will be installed on the Linux that can be fedora, ubuntu etc. Network Simulator (Version 2), widely known as NS-2, is simply an event driven simulation tool that has proved useful in studying the dynamic nature of communication networks. Simulation of wired as well as wireless network functions and protocols (e.g., routing algorithms,

TCP, UDP) can be done using NS-2[8]. In general, NS-2 provides users with a way of specifying such network protocols and simulating their corresponding behaviours.

Sensor system will be built with a few of indistinguishable arrangements of conventions and qualities as those realistic inside the world. The portable systems administration in NS-2 incorporates bolster for everything about ideal models and conventions. The remote model conjointly incorporates bolster for hub developments and vitality imperatives [10].

NS is a particular occasion test system focused at systems administration examination. NS gives generous help to re-enactment of interchanges convention, steering, and multicast conventions over wired and remote (nearby and satellite) systems. Very surprising factors will be acclimated anticipate the conduct of the framework. System test are used by people from totally extraordinary territories like instructional exercise specialists, mechanical engineers, and Quality Assurance (QA) to style, reproduce, check, and break down the execution of different systems conventions. Structure are acclimated help the demonstrating and investigation in numerous normal frameworks.

Utilization of recreation innovation into systems administration space like system movement re-enactment is relatively new. Normally a system machine can contain an expansive differ of systems administration innovations and conventions and encourage clients to make propelled systems from essential building squares like bunches of hubs and connections.

The main basic aspect of detecting component systems missing in NS-2 was the idea of an advancement, for example, synthetic mists or moving vehicles, that would trigger close sensors through a channel, similar to air quality or ground vibrations. Once a detecting component identifies the "ping" of an advancement in that channel, the sensor demonstrations steady with the detecting component application delineated by the NS-2 client. This application characterizes however a detecting component can respond once it distinguishes its objective improvement.

They focus on each finder's detecting plan in order to amplify the timeframe of a sensor arrange, where as making certain single meddlesome target territory unit recognized before they achieve assurance focuses.

3.4 Scanning algorithms

3.4.1 Always-Awake Scanning Algorithm

In Always-Awake approach, we consider the object to cover a body section whose length is l and target speed is v. So, all nodes (sensors nodes) within the body section will sleep along for l/v seconds that is considered as silent time of the body network. As shown in figure 3.3, different type of sensor nodes are implanted on the body for different purposes. All sensor nodes are in awake condition for all the times.

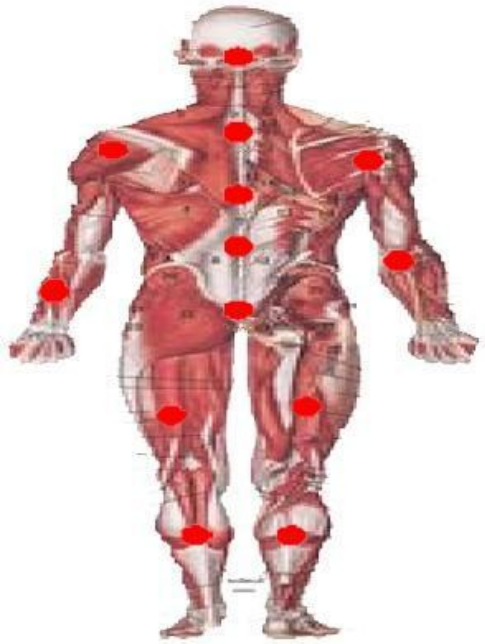


Fig 3.3:- Always-Awake scanning

The object is detect when it enters in the body segment. So the working time for sensor node is T_{life} and the network life time is also T_{life}. Always-Awake sensor network sleeps during the sleeping time $T_{sleep}=0$. When all sensor nodes wake up at the same time for detection, then the silent time is zero [19][45].

Advantage of Always-Awake approach:-

1. The detection time is zero. So it reduces the detection time.
2. Object detection is 100% in the scanning area.

Disadvantage of Always-Awake approach:-

1. Low energy efficiency.

3.4.2 Duty Cycling Scanning Algorithm

In this approach all sensor nodes are always in awake state but only one sensor node is in sleep state during the scanning time as shown in figure 3.4. The sensor silent time is randomly process. If a target enters during the active period, then the detection time is zero. On the other hand, if a target enters during the silent time, then the common silent time is l/v. Where l is the length of body segment and target speed is v. The detection time [89] is depend on the current state of entrance node.

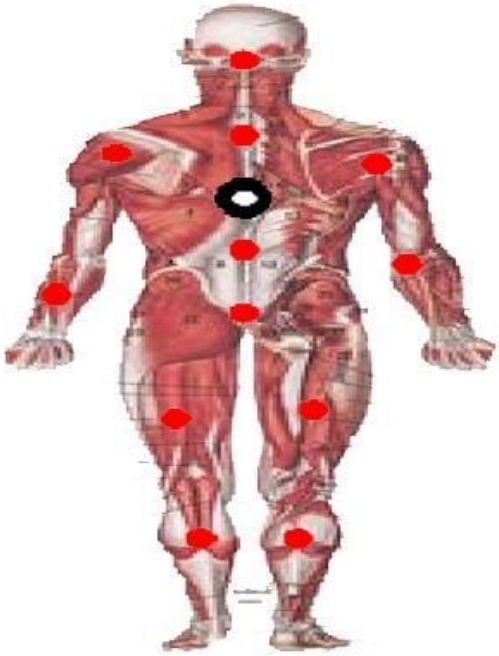


Fig 3.4:- Duty cycling scanning

If an object enters in the body segment during the active time of entrance node, then the detection time is zero. While if an object enters in the body segment during the silent time of entrance node, then the detection time is l^2 /(2v(wv+l)).

Advantage of Duty Cycling approach:-

1. It improves the energy of sensor node comparatively always-awake method.
2. The detection time is zero or little one.

Disadvantage of Duty Cycling approach:-

1. Energy is used more comparative to virtual scanning method.
2. It uses maximum number of sensors.

3.4.3 Virtual Scanning Algorithm

When n sensor nodes are deployed on the body section then every node pass through the body segment length of l/v in average [80]. However, the object will pass through the body segment either during scan time or silent time. After finding detection time of every node and then combine them to find average expected delay of l/(2v). Finally all sensors nodes goes in to sleep state for time period of l/v seconds [37][85], as shown in figure 3.5. After that activate sensor nodes one after one for working time w from right sensor to the left sensor. So, this pattern of scanning give the surety for the detection of object and provide extra sleeping time for every individual node.

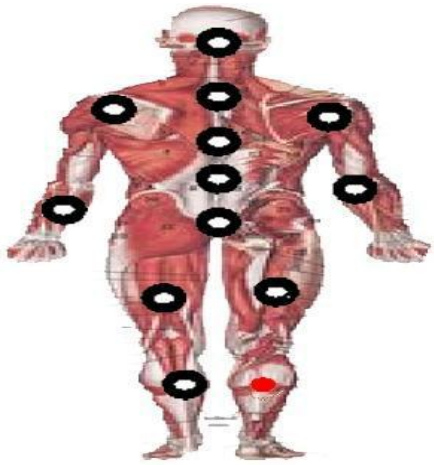


Fig 3.5:- Virtual scanning sensor network

Advantage of Virtual Scanning approach:-

1. It improves the energy of sensor comparatively always-awake & Duty Cycling approaches.

Disadvantage of Virtual Scanning approach:-

1. Detection time is used more comparative to always-awake & Duty Cycling approaches.

So, the brief overview of all three existing scanning algorithms are given in next table:-

Table 3.1: Overview of three scanning algorithms

S.No.	Title	Work	Remark
1	Always-Awake Approach	Sensors are always awake its never to sleep during the scanning time. So detection of object is surely.	But sensor life is very low so the energy efficiency is poor.
2	Duty – cycling Approach	Sensors are always awake but one sensor is sleep during the scanning time. One sensor is sleep in randomly time.	The energy efficiency is poor. But better as compare to Always – Awake method.
3	Virtual canning Approach	All sensors are sleep during the scanning time but one sensor is in active mode. The scanning process starts from right to left.	But the detection time is bed as compare to all other approach.

3.5 Proposed Solution:- Square-Odd (SO) scanning algorithm

The WBANs are one amongst necessary areas where the two phenomenon

1. Time dependent
2. Energy effectiveness are necessary for everyone for detection area.

In this we propose a solution for scanning sensor network for a healthcare monitoring. To increase the network lifetime, they can mainly observe the sensing schedule of every sensor and improve the detection time for sensor, gives the surety of detecting of all objects before they create health issue.

Wireless sensing network uses very light sensors which have very low power backup. An algorithm “Square Odd (SO) scanning” is used to detect any object efficiently, effectively and also focus on the power consumption in wireless sensors. It periodically switches the sensors between sleeping and awake mode while the detection of objects (targets), enter from the right side or entrance point(E). Here user detects the object

which are moving in the scanning area, saves power consumption and then increase the total life time of network.

WBAN systems have main focuses on sensors for the moving object where we apply the scanning technique for target detection which is the main feature of the network. In this, for w seconds node goes in to wake up state simultaneously and n sensors are linearly placed at the body segment.

Wearable health observance systems integrated into a telemedicine system square measure novel data technology which will be ready to support early detection of abnormal disease and interference of its serious consequences [112].

3.5.1 Notation

1. Start from a source node denoted as S
2. Silent time – time in which complete network remains silent; and an object passes through the body part (segment) of length l.
3. Lifetime- time in which a sensor can work corresponding to energy budget denoted by T_{life}.

3.5.2 Terminology

The terms used in this approach as:-

- n_i denotes sensor nodes
- D denotes destination
- S denotes Source
- w denote the constant time to sensor active time

3.5.3 Square-Odd Scanning for Surveillance Human Body

We place unit assumptive number of n sensors are linearly placed on a person's body (segment) of length l. Every detector contains a conservative sensing circle of radius r, that is long enough to hide the dimension of the figure. This assumption holds true for many commercially offered sensors (e.g., PIR sensors will observe moving object). Therefore, we will represent sensing coverage employing a linear detector network model as shown in figure 3.6, wherever n sensors are unit linearly placed on body. At

the instant, let the highest finish of the body phase be the entrance point E of objects and therefore the bottom finish of the body phase is that the protection point P. Assume that w is the minimum operating time required by a detector so as that the detector will faithfully observe an object over multiple samplings. We assume that objects enter from the right side (entrance point) and move to the left side (protection point). During this situation, we will use the standard full coverage algorithms wherever sensors nodes activate all the time.

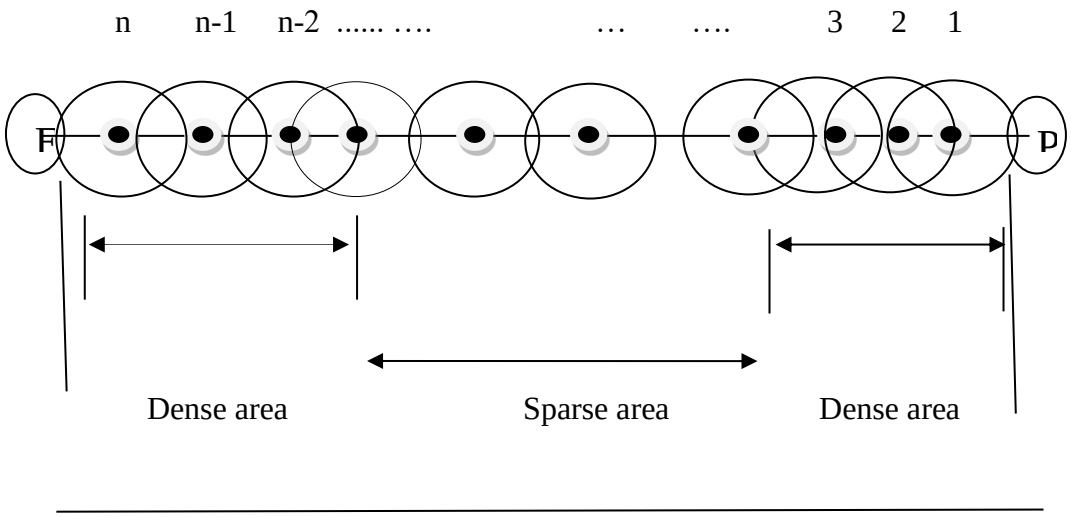


Fig 3.6:- n sensors linearly placed on body

In Always-Awake approach, a higher style will be engineered supported the observation that it takes a minimum of l/v seconds for associate in scanning object to cover a body section whose length is l at most speed v. So, all nodes (sensor nodes) within the body section will sleep along for l/v seconds that is outlined as silent time of the body network. When all sensor nodes wake up at the same time for detection, then the silent time is zero.

We propose a new method for the irregular scanning for build. Therefore supported the actual fact that objects move solely on the build, we tend to propose a new style known as square-odd scanning. We can see in the diagram, in spite of everything sensors sleep for l/v seconds, we tend to activate two devices for working time w from the right sensor S1 or S3 toward the left from S_{n-2} to Sn. So, this pattern of sensing give the surety for

the detection of object and permits extra sleeping time for every individual node. Compared with Duty cycling, this extra sleeping time is obtained by the actual fact that every one sensors however one will sleep throughout the scan jointly by one conjointly. We tend to note that the direction of square-odd scan shall be from the protection point to the entrance point. The square-odd scan of the alternative direction (from the entrance node point to the protection node point) cannot guarantee disease intrusion detection, if any disease enters right when the start of the sensor network during silent time.

3.5.4 Square-Odd Scanning Algorithm Design

We design the basic idea on body segment. Here, describe that how we apply the Square-Odd scanning on body networks.

Definitions and Assumptions

Body Network Graph: Assume that Graph G = (V,E), is a body network graph wherever V = may be a combination of intersections, protection point and entrance points, within the body network, and E = $[e_{ij}]$ may be a matrix of body section length e_{ij} with vertices vi and vj .The graph G resembling the body network. It is assume that the sets of entrance point and the protection point are not static. These two sets may be modified according to the demand.

Network Lifetime: Assume that network time be the period from the beginning of a sensing element network for sensor detection till an object will probably reach one among the protection points while not detection. In different words, period of time ends once there exist an attainable breach path among associate in nursing entrance points to a protection point.

SOSA Scheduler: Let SOSA be a source node which initiate the sensing programming formula. The SOSA style is predicated on the subsequent considerations:

- Body structure and positions of sensing element nodes are a unit best-known to SOSA hardware. The sensing element location may be gathered from localization scheme. Sensors are roughly time-synchronized at tens of time unit level. It may be simply achieved as a result of existing solutions, can do time unit level accuracy.

- Sensors solely have easy sensing devices for binary object detection, like PIR sensors. No refined hardware is in the market.
- The circular sensing model is employed within the conservative approach exploitation the minimum sensing varies for irregular sensing modelling.
- Object move solely on predefined with the finite most speed.

3.5.5 Square-Odd method with time algorithm

This approach is applied to calculate the time dependent scanning to all the sensor node and then check the constraint.

Approach

There are several sensor nodes which shown in figure 3.7, it may be describe the process of the examine graph. User can draw a scanning process as a sub graph. In this user describe the scanning process:

Step 1: Here user may choose the one entrance point and one protection point from the different points of entrance and protection points in the graph.

v1→Source point or node (protection point)

v13→Destination point or node (Entrance point)

Step 2: Figure 3.7 represent the entire process of Square-Odd scanning.

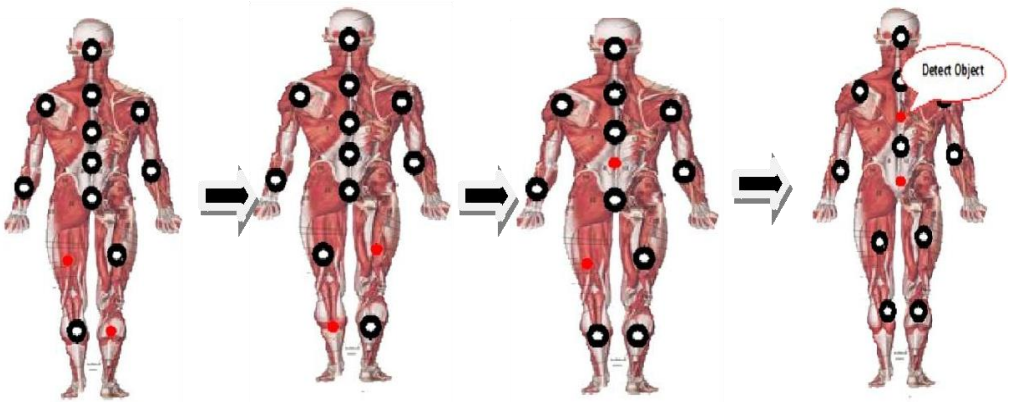


Fig. 3.7:- Square-Odd (SO) Scanning

Step 3: The scanning mechanism as follows, it may start from the right side of protection point and the sensor active first for v1 and v3 at a time since all other nodes are in sleeping mode.

Step 4 : The active time for each sensor is w (fixed time) and after completion of scanning for step 3, it just move on the active for v2 and v4 sensor node then after v3 and v5 sensor active.

Two sensors active at a time so the object is detect definitely, so it may improve the performance and energy level. So it may also improve the performance of Square-Odd scan method.

The performance of the Square-Odd approach with time algorithm is best as compare to all other previous scanning algorithms. All the previous approach work only on energy consumption but here we work on reduce the detection time as well as energy consumption.

3.6 Mathematical Formulation

In this we consider the following parameters for scanning of network. The parameters are shown in table 3.2.

Table 3.2: Parameters for network scanning

Notation	Definition
T_{silent}	Time in which network goes in to silent mode
T_{life}	Lifetime of individual sensor node
T_{period}	Addition of scanning time and silent time
T_{sleep}	Time in which sensor goes in to sleep state for a short period
T_{net}	Lifetime of entire network system
T_{scan}	Time in which scanning wave passes through the body
l	Length of body section
w	Working time of sensor
v	Speed of target node

3.6.1 Average Detection Time in Square-Odd Scanning

We determine the Average Detection Time (ADT) for Square-Odd scanning approach in a human body segment. To start with, we accept infection/target speed is constant, denoted as speed v.

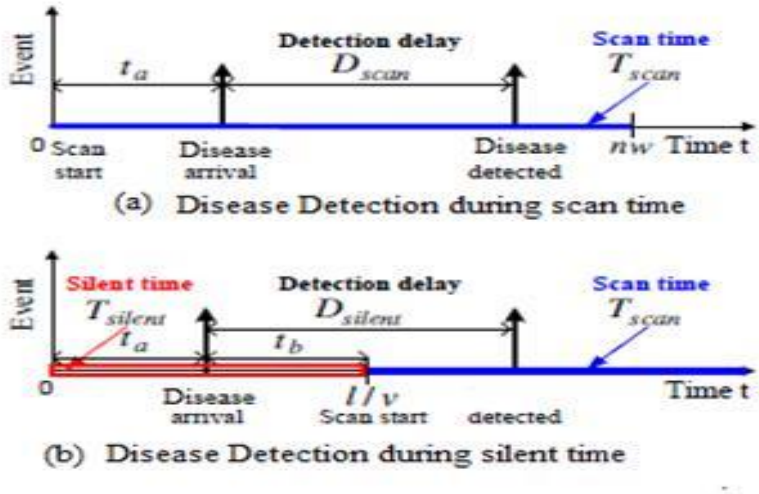


Fig 3.8:- Disease detection case during scanning for body area network

Enter during Scan Time: Figure shows an object enters during the scan time T_{scan}. Since each sensor covers human body segment of length *l*/n, the square odd scan wave moves with the human body portion with the speed $v_{scan} = l/(nw)$. The corresponding speed between the scan wave and the target is $l/(nw) + v$.

Assume that any object or disease enters in the network or body at t_a after the beginning of scan, the scan wave has already passes through $lt_a/(nw)$. Hence it takes $(l - \frac{lt_a}{nw})/(\frac{l}{nw} + v)$seconds before the scan wave reaches the target, which is the detection delay D_{scan}. Integrated t_a over the interval [0, nw], expected detection delay (indicated as $E[D_{scan}]$) during scan time is:

$$E[D_{scan}) = \int_0^{nw} \frac{(nwl - lt_a)}{2(nwv+l)} \frac{1}{2nw} dt_a .$$

$$= \frac{nwl}{4(nwv+l)} \qquad \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Enter during Silent Time: Figure 3.8(b) shows that an object enters during the silent time T_{silent}. Assume that any disease enters at t_a after the beginning of silent time. As shown in figure 3.8(b), since it enters at t_b before the beginning of scan, the object has

already passes through $t_b v$. Hence it takes $(l - t_b v)/(l/nw + v)$ seconds before the scan wave reaches the target. For the detection delay, we also need to count the object movement time t_b along with the past detection delay after the beginning of the scan. Note that $t_b = l/v - t_a$. Integral t_a over the interval $[0, l/v]$, expected detection delay (indicated as $E[D_{silent}]$) during silent time is

$$E[D_{silent}] = \int_0^{l/v} \frac{(nwl - lt_a + l^2/v)}{2(nwv + l)} \frac{v}{l} dt_a$$

$$= \frac{2nwl + l^2/v}{4(nwv + l)} \quad \text{.....(2)}$$

By combining both equations, we can calculate expected ADT for the square odd scanning:

$$E[D] = \frac{nw}{nw + l/v} E[D_{scan}] + \frac{l/v}{nw + l/v} E[D_{silent}]$$

$$= \frac{l}{4v} \quad \text{……..….(3)}$$

3.6.2 Network lifetime in Square-Odd Scanning

In Always – Awake scanning approach the network life time T_{net} is the same as T_{life} because sensors work continuously without sleeping.

In Duty Cycling scanning approach the network lifetime T_{net} is the number of periods $[T_{life} / w]$ multiplied by the length of the period T_{period} (the addition of the silent time l/v and the working time w).

$$T_{net} = \left[\frac{Tlife}{w} \right] \left(\frac{l}{v} + w \right) \quad \text{……..(1)}$$

In Virtual Scanning approach the network lifetime T_{net} is the number of $[T_{life} / w]$ multiplied by the length of period T_{period} . T_{period} is the addition of the scan time nw and silent time l/v.

$$T_{net} = \left[\frac{Tlife}{w} \right] (T_{silent} + T_{scan})$$

$$T_{net} = \left[\frac{Tlife}{w} \right] \left(\frac{l}{v} + nw \right) \quad \text{……..(2)}$$

So, with the help of equation 1 & 2 and from the above figure we can compute network lifetime for square-odd algorithm. In this technique we describe the lifetime of sensor network T_{net} is the number of $[T_{life} / w]$ multiplied by the length of period T_{period} . T_{period} is the addition of the scan time wv(n-1) and silent time l/v.

So network life time with the silent time

$$T_{silent} = \left[\frac{Tlife}{w} \right] \left(\frac{l}{v} \right) \quad \text{…….. ……..(3)}$$

The network life time in during scan time

$$T_{scan} = \left[\frac{Tlife}{w} \right] (wv(n-1)) \quad \text{……...…….. (4)}$$

By combining both equations, we can calculate the network life time for the square odd scanning technique:

$$T_{net} = \left[\frac{Tlife}{w} \right] (T_{silent} + T_{scan})$$

$$T_{net} = \left[\frac{Tlife}{w} \right] \left(\frac{l}{v} + wv(n-1) \right) \quad \text{…….(5)}$$

So from above equations 5 we describe the sensor network lifetime for square-odd scanning technique.

3.7 Algorithm Analysis

There are several entrance node and protection node; it may be define the process of the scanning graph. Here user defines the process of scanning:

Step 1:- There are n sensor nodes which are plot in the sensing area. Each sensor is active for working time w sec. v is the speed of target which is entering in the sensing area. E denotes the entrance node and P denotes the protection node in the sensing area.

Step 2:-When object enter in the sensing area. If sensor is active then target is detected otherwise target is continues running.

Step 3:- There are two sensor nodes active at a time in sensing area. If sensor detects the target then it sends signals to server node.

Step 4:- The detection time should be reduced and improve the energy of sensor.

Chapter - 4

EXPERIMENTAL RESULTS AND ANALYSIS

Part A:-

4.1 Comparison among the routing protocols (DSR, DSDV, AODV and AOMDV)

This part of our work compares the performance of the various routing protocols for the Wireless Body Area Network and the Wireless Sensor Network [4]. The main focus of this simulation is to check the performance of these routing protocols in the Wireless Body Area Network environment. Different parameters are analyzed like PDR, e2e delay and the throughput.

We use following metrics to compare the performance [1]:-

1. **Packet delivery ratio-** The ratio of the data packets delivered to the destinations to those generated by the sources. It describe the packet loss rate, which bounds the maximum throughput of the network .
2. **End-to-end Delay-** This metric represents average end-to-end delay and indicates how long it took for a packet to move from the source to the destination. It is measured in seconds.
3. **Throughput-** Throughput is total packets successfully delivered to individual destination over total time.

The comparison between these parameters under the Wireless Sensor Network environment with different number of sensor nodes are shown in figure 4.1: here we take example with 100 nodes for AODV protocol.

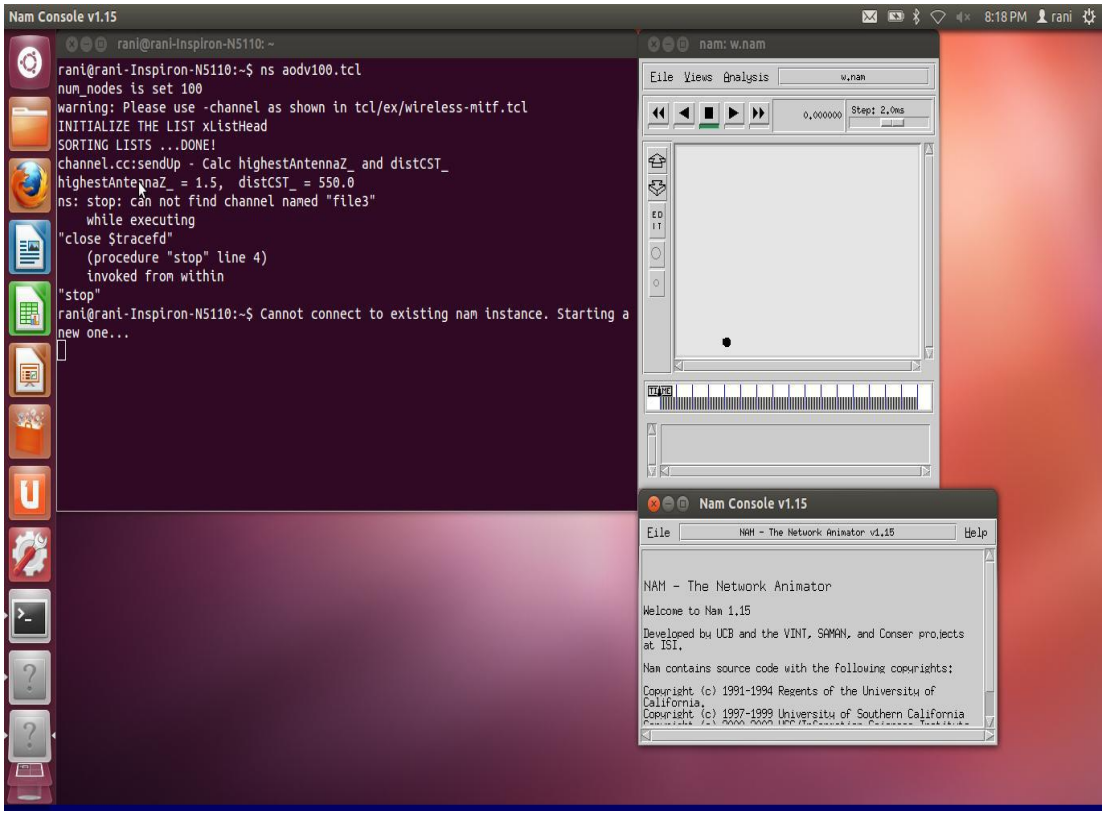


Fig 4.1:- Sensor Network with 100 nodes for AODV protocol

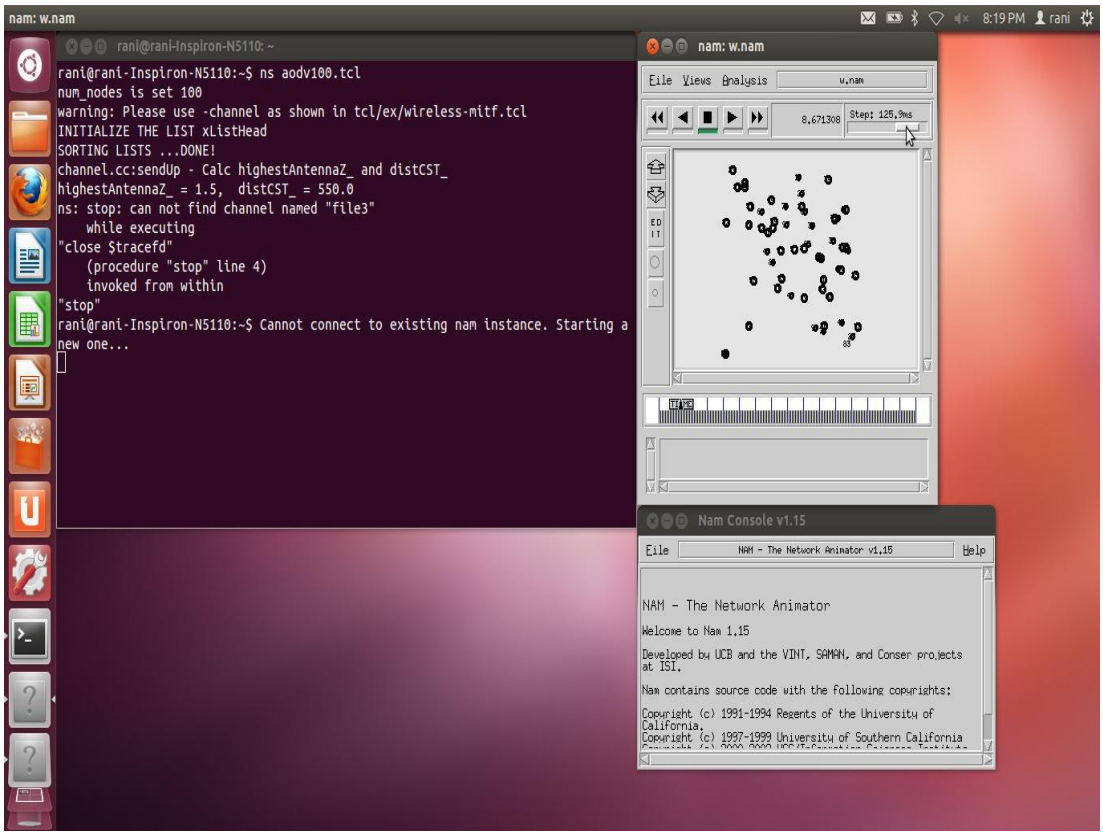


Fig 4.2:- Node's movement in Sensor Network with 100 nodes for AODV protocol

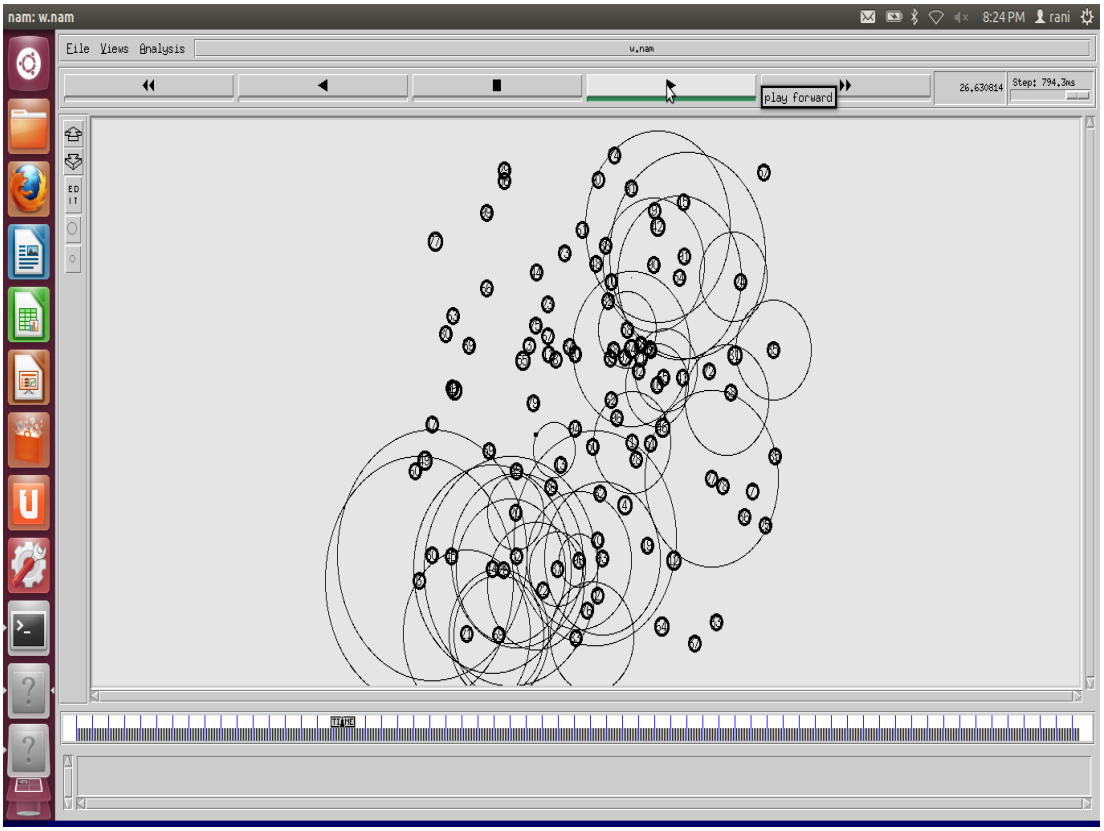


Fig 4.3:- Simulation of 100 nodes

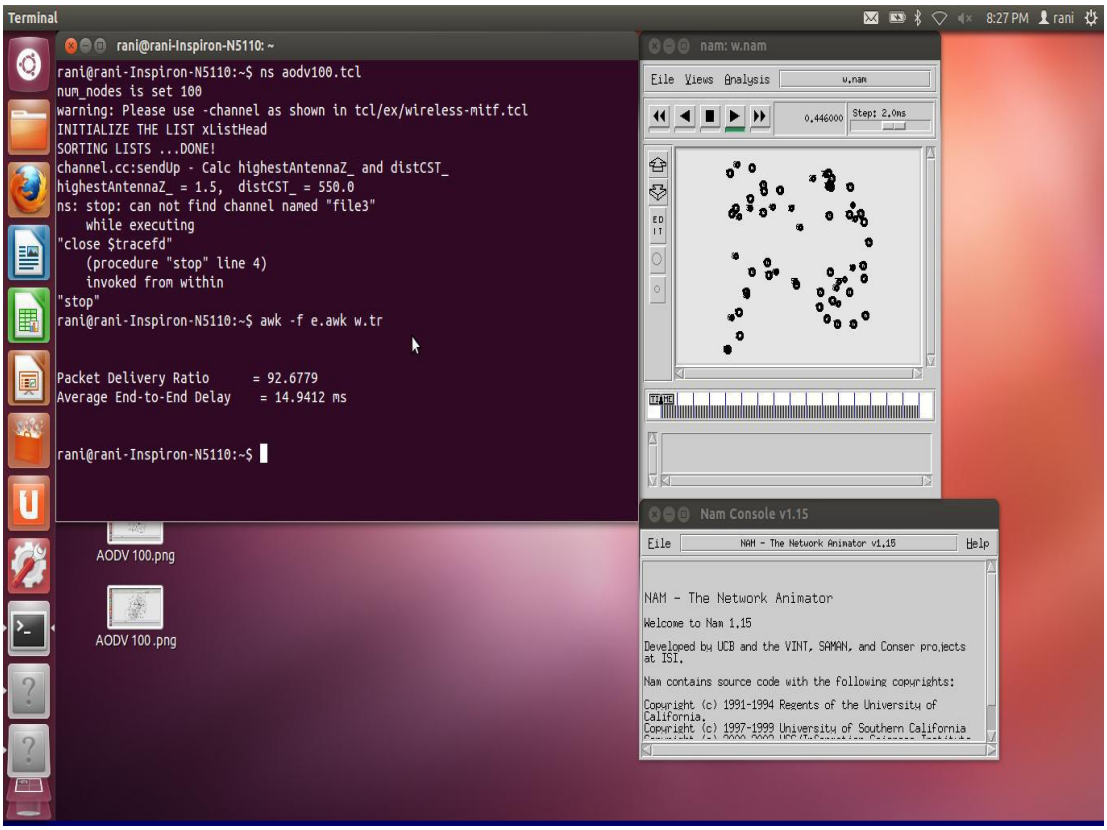


Fig 4.4:- PDR and e2e delay for AODV Protocol with 100 nodes

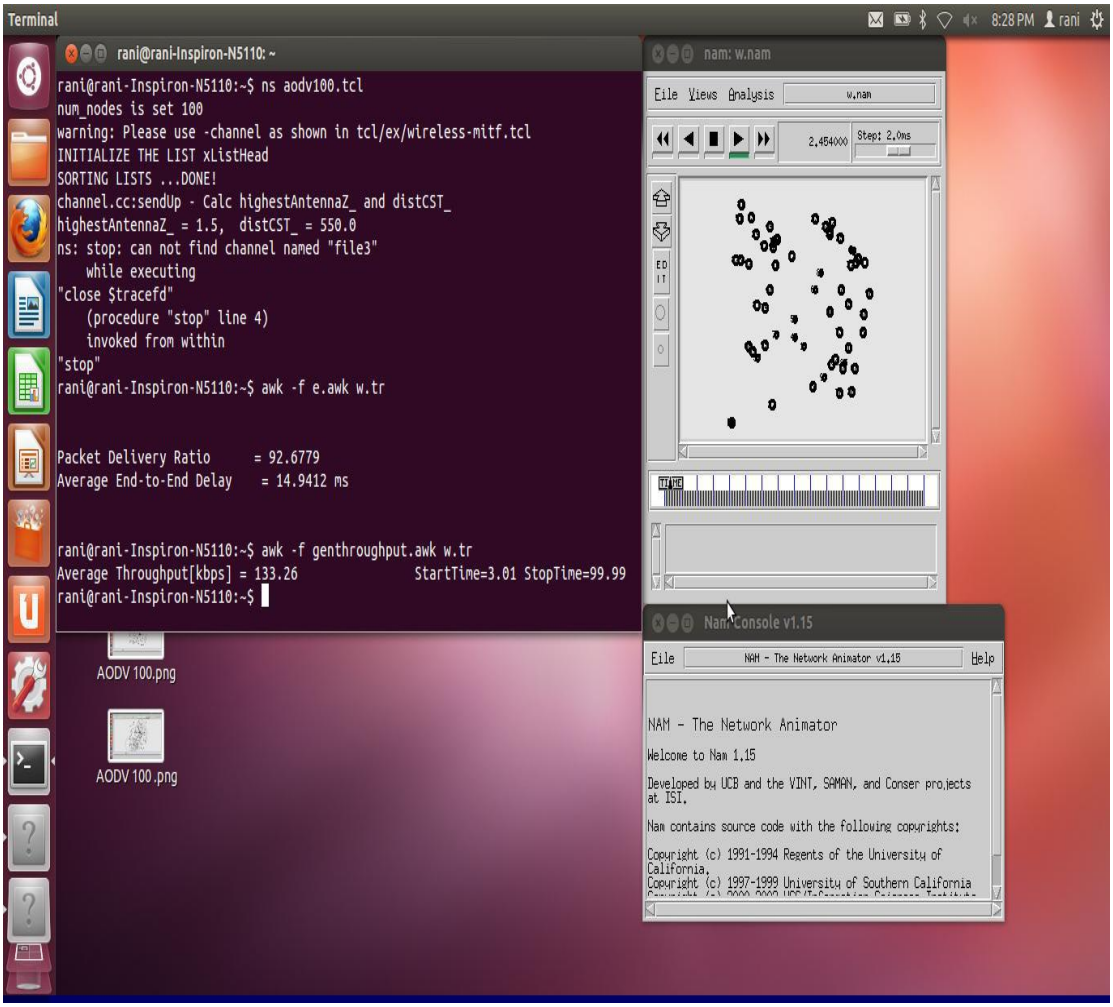
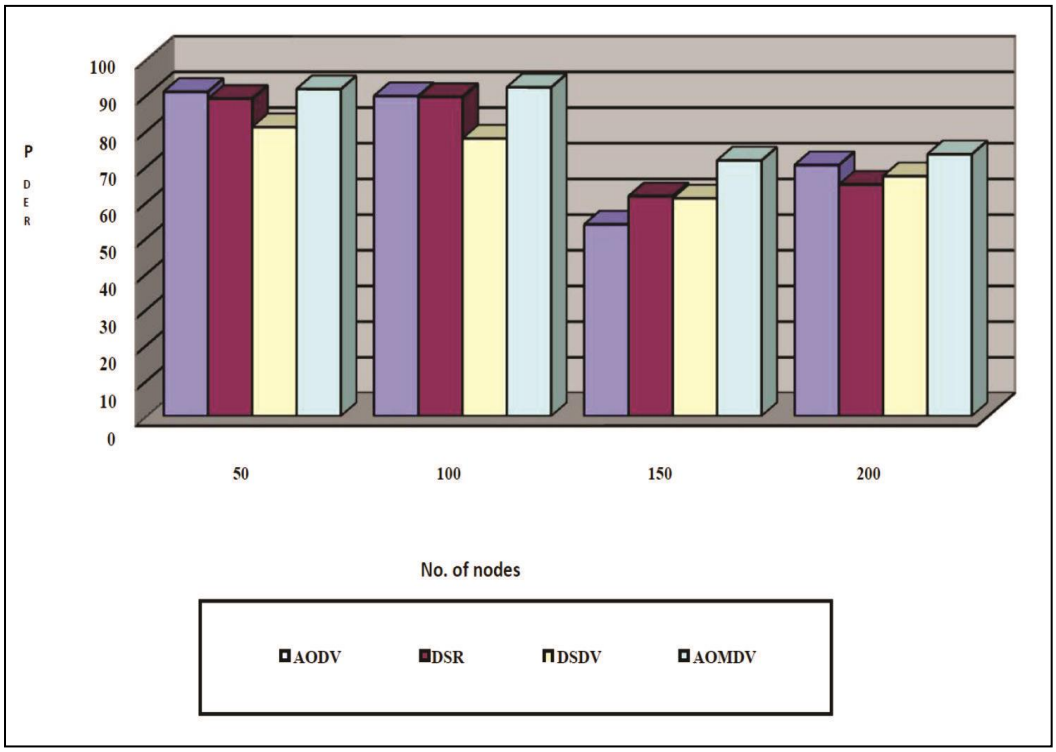


Fig 4.5:- Throughput for AODV Protocol with 100 nodes

Here we have shown simulation diagrams only for AODV protocol with 100 nodes. The performance comparison of these routing protocols in WBAN and WSN environment is also done in different scenario having different number of nodes shown in next graphs and tables.

Packet Delivery Ratio(PDR):-



+

Fig 4.6:- Comparison of AODV, AOMDV, DSR and DSDV on basis of PDR

From the graph 4.6 we can see that at pause time 0 sec; DSR has a better PDR value as compare to AOMDV, AODV and DSDV for each set of connections. But AOMDV gives better performance result after increasing pause time [1][3][4]. At time 100 sec, AOMDV has best PDR value as compare to AODV, DSR and DSDV for both WBAN and WSN scenarios.

End-to- End Delay:-

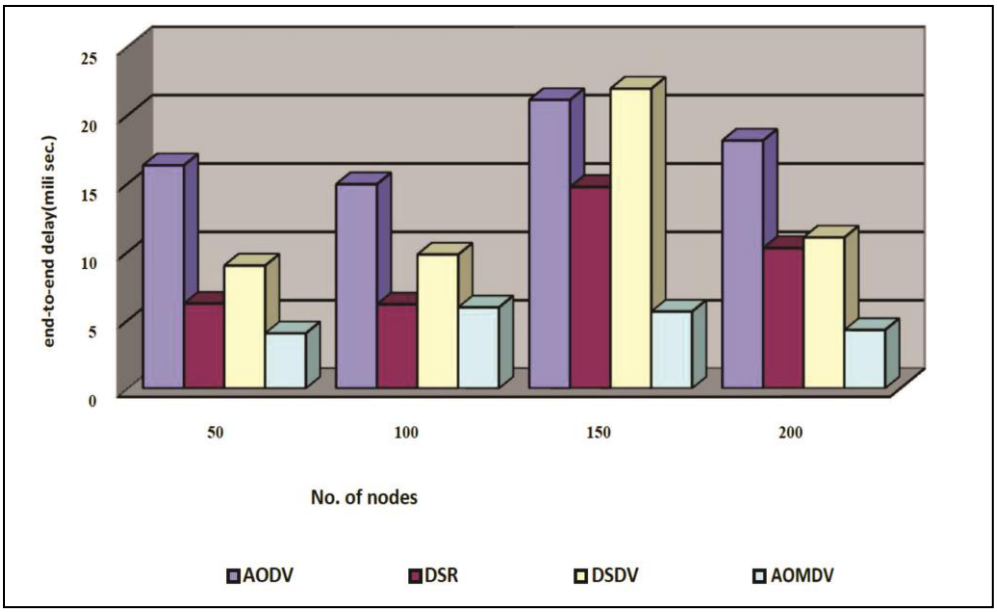


Fig 4.7:- Comparison of AODV, AOMDV, DSR and DSDV on basis of end-to-end delay

In the graph 4.7, we can see that AOMDV has better end to end delay from AODV, DSR and DSDV protocoals. AODV has worse end to end delay as compare to AOMDV, DSR and DSDV in both WBAN and WSN scenarios.

Throughput:

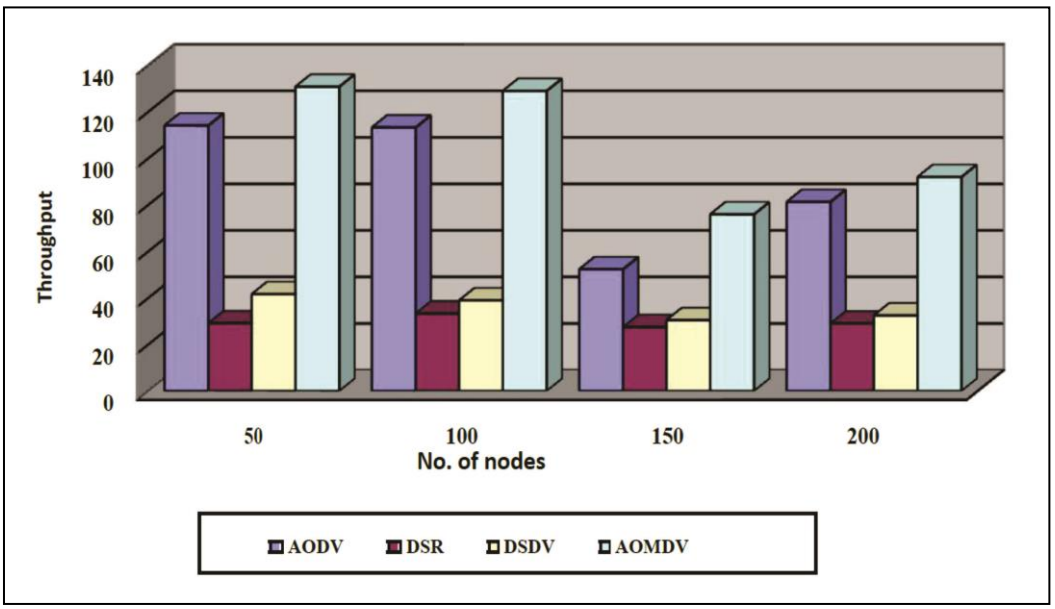


Fig 4.8:- Comparison of AODV, AOMDV, DSR and DSDV on basis of Throughput

From the above figure 4.8, we analyze that after increasing pause time, average throughput of AOMDV is better as compare to AODV, DSR and DSDV for different set of nodes. The above comparison result shows that the performance of the AOMV protocol is better than the other routing protocols.

PDR(Packet Delivery Ratio):-

Table 4.1 : Comparison of AODV, AOMDV, DSR and DSDV on basis of PDR in WSN and WBAN environment

No. of nodes	AODV		DSR		DSDV		AOMDV	
	WSN	WBAN	WSN	WBAN	WSN	WBAN	WSN	WBAN
50	90.8724	53.61472	88.9281	46.24261	80.9653	38.86334	91.6004	51.29622
100	89.6779	52.90996	89.4461	46.51197	77.7541	37.32197	92.1107	51.58199
150	53.7004	31.68324	61.6149	32.03975	60.9889	29.27467	71.6148	40.10429
200	70.3302	41.49482	64.8718	33.73334	67.2016	32.25677	73.368	41.08608

Throughput:-

Table 4.2:- Comparison of AODV, AOMDV, DSR and DSDV on basis of throughput in WSN and WBAN environment

No. of nodes	AODV		DSR		DSDV		AOMDV	
	WSN	WBAN	WSN	WBAN	WSN	WBAN	WSN	WBAN
50	114.09	63.8904	29.15	16.324	41.63	23.3128	130.76	73.2256
100	113.26	63.4256	33.3	18.648	38.93	21.8008	128.95	72.212
150	52.31	29.2936	27.45	15.372	30.43	17.0408	75.89	42.4984
200	81.25	45.5	29.02	16.2512	32.45	18.172	91.96	51.4976

The values in the table 4.1 & 4.2 clearly shows that the performance of above described routing protocols gets degraded in the WBAN environment.

So after finding these results of comparison, we find that there is a need of optimal scanning approach for wireless body area network with two main constraint network lifetime and detection time.

Part B:-

As we have explained in previous chapter, proposed Square-Odd scanning algorithm for wireless body area network with network lifetime and time dependent phenomenon. There are several entrance node and protection node; it may be define the process of the scanning graph. Here user defines the process of scanning:

Step 1 :- There are n number of sensor nodes are plot in the sensing area. Each sensor is active for working time w sec. v is the speed of target is entering in the sensing area. E denotes the entrance node and P denotes the protection node in the sensing area.

Step 2:-When object enter in the sensing area. If sensor is active then target is detected otherwise target is continues running.

Step 3:- There are two sensor nodes active at a time in sensing area. If sensor detects the target then it sends signals to server node.

Step 4:- The detection time should be reduced and improve the energy of sensor.

So, for this we have create a sensor network with 13 nodes, in which only two nodes are active at a time and remaining nodes are in sleep state. The complete sensor network for scanning is shown in figure 4.9:

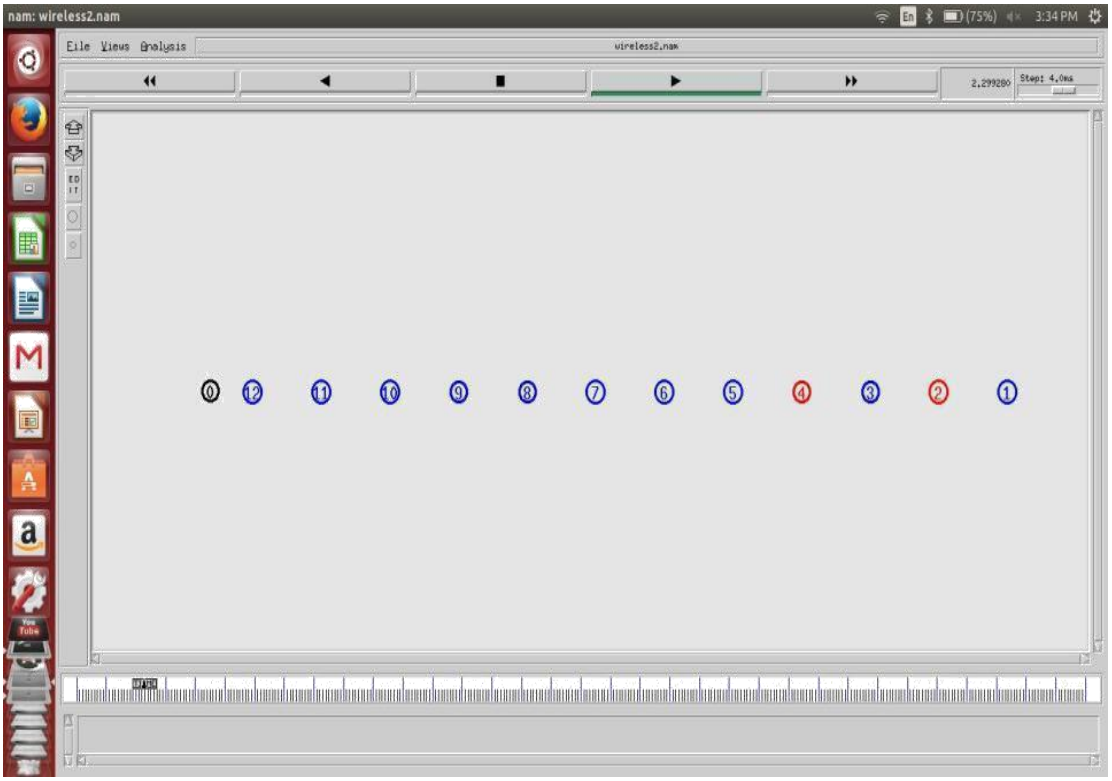


Fig 4.9:- Network area for scanning sensor detection

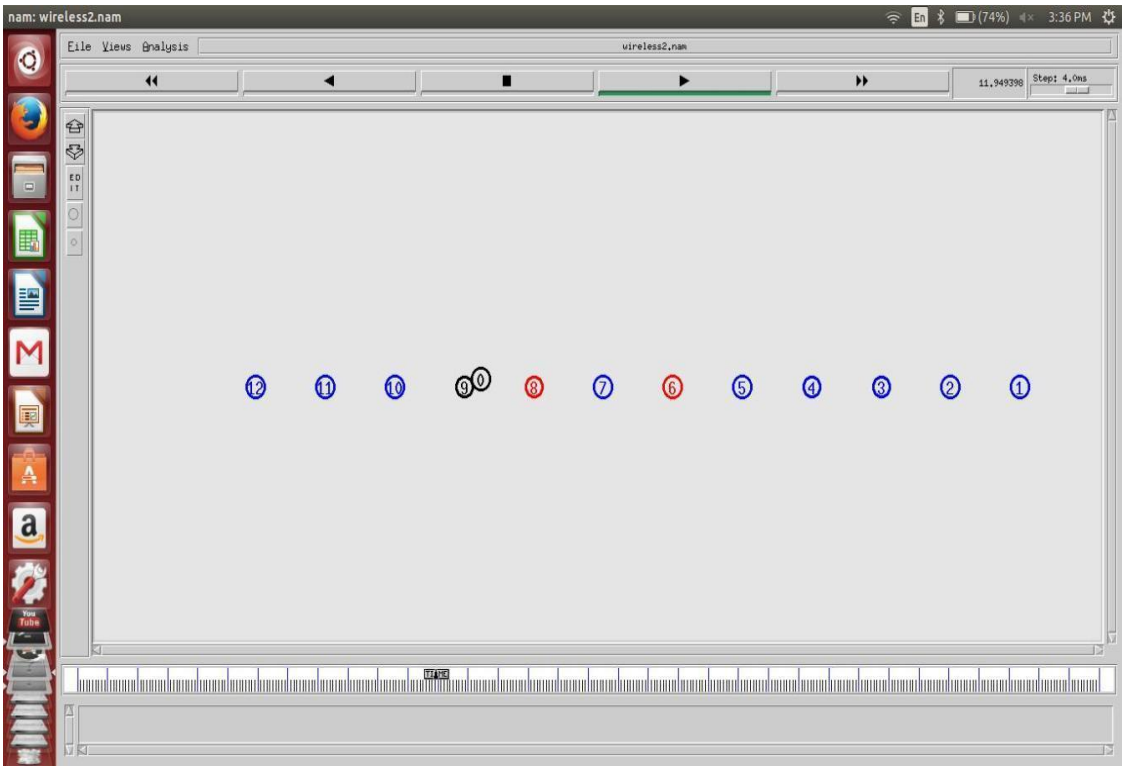


Fig 4.10:- Object Detection

As shown in figure 4.10, when scanning start from right to left for detecting object then first sensor 1 and 3 are in active state, after that 2 and 4 nodes are active, then 5 and 7, then 6 and 8 and so on. Sensor nodes with red colour represent the active state of sensors and blue colour represent the sleep state of sensors. When target object is detected then it also change the colour of that target node to black colour.

4.2 Analytical Network comparison

4.2.1 Analytical network energy comparison

To understand the network design parameters, here we compare network lifetime for our proposed algorithm Square-Odd with Always – Awake, Duty Cycling and Virtual Scanning method. These parameters are used for different purpose:-

T_{silent} - Time in which network goes in to silent mode.

T_{life} - Lifetime of individual sensor node.

T_{period} - Addition of scanning time and silent time.

T_{sleep} - Time in which sensor goes in to sleep state for a short period.

T_{net} - Lifetime of entire network system.

T_{scan} - Time in which scanning wave passes through the body.

l - Length of body section.

w - Working time of sensor.

v - Speed of target

- **Always – Awake Scanning: -** In this technique the system life or network lifetime T_{net} is equal to the T_{life} because sensors work continuously without sleeping.
- **Duty Cycling scanning: -** In Duty Cycling scanning approach the network lifetime T_{net} is the number of periods [T_{life} / w] multiplied by the length of the period T_{period} (the addition of the silent time l/v and the working time w).

$$T_{net} = \left[\frac{Tlife}{w} \right] \left(\frac{l}{v} + w \right) \quad \text{.....(1)}$$

- **Virtual scanning: -** In Virtual Scanning approach the network lifetime T_{net} is the number of $[T_{life} / w]$ multiplied by the length of period T_{period} . T_{period} is the addition of the scan time nw and silent time l/v.

  $$T_{net} = \left[\frac{Tlife}{w} \right](T_{silent} + T_{scan})$$

  $$T_{net} = \left[\frac{Tlife}{w} \right] (\frac{l}{v} + nw) \quad \text{……..(2)}$$

- **Square-Odd scanning: -** In this technique we describe the lifetime of sensor network T_{net} is the number of $[T_{life} / w]$ multiplied by the length of period T_{period}. T_{period} is the addition of the scan time wv(n-1) and silent time l/v.

  $$T_{net} = \left[\frac{Tlife}{w} \right](T_{silent} + T_{scan})$$

  $$T_{net} = \left[\frac{Tlife}{w} \right] (\frac{l}{v} + wv(n-1)) \quad \text{……..(3)}$$

So from above equations 1, 2 & 3 describe the sensor network lifetime. Now we compare all four approaches in tabular form in terms of sleeping time, working time and Network lifetime:-

Table 4.3: Sleep time, working time and network lifetime for four techniques

Approach	**Sleeping (T_{sleep})**	**Working (T_{work})**	**Network Lifetime (T_{net})**
Always-Awake Scanning	0	T_{life}	T_{life}
Duty Cycling Scanning	$\frac{l}{v}$	W	$[\frac{T_{life}}{w}](w+\frac{l}{v})$
Virtual Scanning	$(n-1)w+\frac{l}{v}$	W	$[\frac{T_{life}}{w}](nw+\frac{l}{v})$
Square-Odd Scanning	$(n-2)w+\frac{l}{v}$	W	$[\frac{T_{life}}{w}]\ (wv(n-1)+\frac{l}{v})$

Increase Network Lifetime

There are different types of technique which are use to increase the network lifetime and performance to detect the target. All techniques have totally different sleeping time.

In Always-awake technique, sleeping time is zero. Duty-Cycling scanning has l/v sleeping time. Square-Odd Scanning has the longest sleeping time and hence the longest network lifetime. Square-Odd Scanning has the better network lifetime as compared to other scanning techniques.

For example, we assume that there are 20 sensor nodes with lifetime of 1 hour and the speed of target is 2 meter per second and the length of body segment is 5 meter.

So, n=20 sensors, T_{life} = 1hr.=3600 seconds,

v= 2 meter/second, l = 5 meter.

Now we calculate the network life time T_{net} for different values of w (working time of sensor node).

Table 4.4: Network lifetime Comparison of four approaches

w	Always-Awake	Duty-Cycling	Virtual Scanning	Square-odd
0.1	3600	93600	162000	226800
0.2	3600	48600	117000	181800
0.3	3600	33600	102000	166800
0.4	3600	26100	94500	159300

Square-Odd (SO) scanning method improves the energy efficiency as compare to always-awake, duty cycling and virtual scanning method. This graph is showing network lifetime or energy efficiency for all scanning methods.

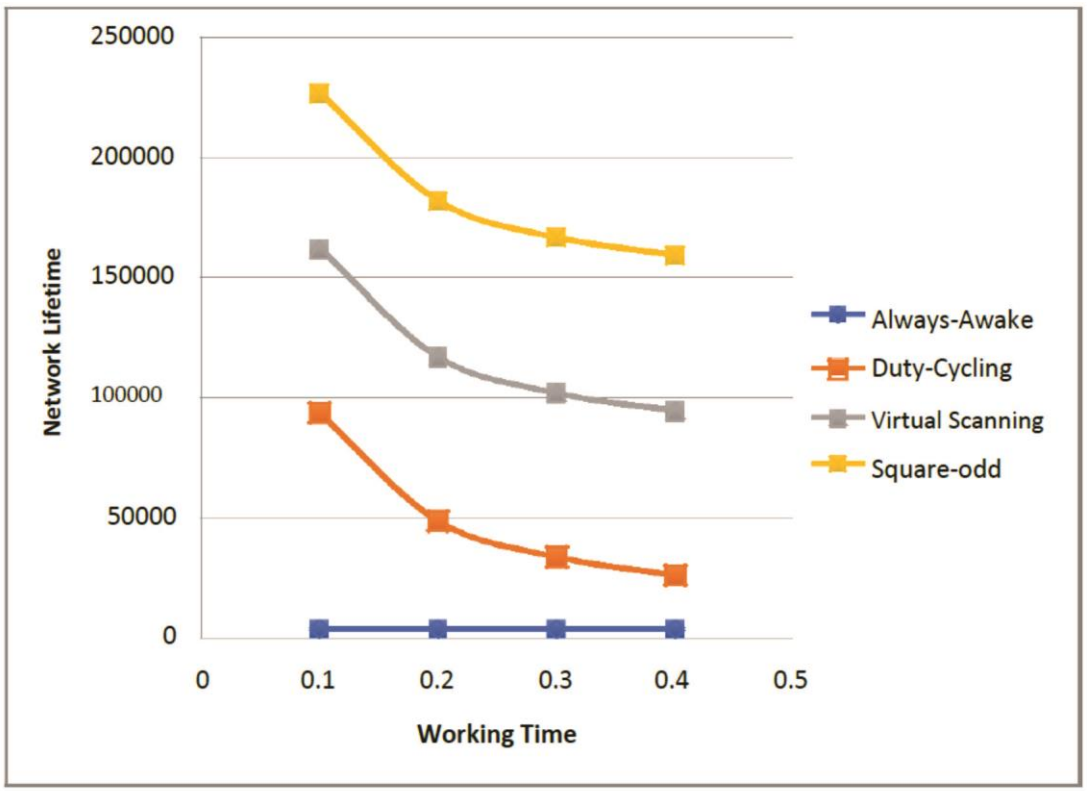


Fig 4.11:- Network lifetime for different scanning techniques

For the value of w=0.1sec, square-odd has the network lifetime of 63 hours, virtual scanning technique has the network lifetime of 45 hours, Duty Cycling 26 hours, Always-awake 1 hour.

For w=0.2sec, square-odd has the network lifetime of 50.5 hours, virtual scanning has the network lifetime of 32.5 hours , Duty Cycling 13.5 hours, Always-awake 1 hour.

Similarly, for w=0.3 sec and w= 0.4 sec, we get the highest network lifetime for Square-Odd scanning technique as compare to other three scanning algorithms. So, according to this performance Square-Odd scanning method is best in terms of network lifetime. This result is shown in figure 4.11.

SOSA gives significantly longer network lifetime than the other techniques, especially when w is 0.1sec as depict in graph 4.11. When w is 0.1 second, SOSA extends network lifetime by 15.5 times as compare with virtual scanning, 33 times compare to Duty Cycling and 63 times, compared with Always-Awake Scanning technique.

4.2.2 Analytical Detection Time comparison

There are several techniques for scanning, Square-Odd scanning, Duty Cycling scanning, Virtual Scanning and Always- Awake scanning can give surety for the detection of targets.

In this section we compare the common detection time once an object entering into a Body segment among the Square-Odd, Always-awake scanning, Duty Cycling scanning and virtual scanning technique. In the sensing area, detection time to be improved in SO scanning method as compare to in virtual scanning method.

- Always –Awake Scanning: - In this approach, we consider the object to cover a body section whose length is *l* and target speed is v. When all sensor nodes wake up at the same time for detection, then the silent time is zero.
- Duty Cycling:- In this, if an object enters in the body segment during the active time of entrance node, then the detection time is zero. While if an object enters in the body segment during the silent time of entrance node, then the detection time is l^2 /(2v(wv+l)).
- Virtual scanning: - When n sensor nodes are deployed on the body section then every node pass through the body segment length of *l*/v in average [80]. However, the object will pass through the body segment either during scan time or silent time. After finding detection time of every node and then combine them to find average expected delay of *l/(*2v). Finally all sensors nodes goes in to sleep state for time period of *l*/v seconds [37][85].
- Square-Odd Scanning:- In square-odd (SO) scanning method, only two sensor nodes are active at a time. Once the sensor nodes are entered in the body segment whose length is *l* and the speed of target is v. The average detection time for each sensor can be achieved by the quantity *l*/(4v). So, Square-Odd (SO) scanning detects the object with a constant delay *l*/(4v) without effecting by the working time w.

We note that the comparison of detection time between the four techniques as shown in table 4.5.

Table 4.5: Average detection time for four techniques

Approach	Sleeping (T_{sleep})	Working (T_{work})	Network Lifetime (T_{net})
Always-Awake	0	T_{life}	0
Duty Cycling	$\frac{l}{v}$	W	$\frac{l^2}{(2v(wv+1))}$
Virtual Scanning	(n-1)w+ $\frac{l}{v}$	W	$\frac{l}{2v}$
Randomized scanning	(n-2)w+ $\frac{l}{v}$	W	$\frac{l}{4v}$

Reduce the Detection Time

There are different types of techniques for scanning Square-Odd, Duty cycling, Virtual Scanning and Always- Awake will give surety for the detection of target.

For example, we assume that there are 20 sensor nodes with lifetime of 1 hour and the speed of target is 2 meter per second and the length of body segment is 5 meter.

So, n=20 sensors, T_{life} = 1hr.=3600 seconds,

v= 2 meter/second, l = 5 meter.

Now we compute the average detection time for every scanning technique for different values of w (working time of sensor node).

Table 4.6: Detection Time Comparison of four Approaches

W	Always-Awake	Duty-Cycling	Virtual Scanning	Square-odd
0.1	0	1.20	1.25	0.625
0.2	0	1.15	1.25	0.625
0.3	0	1.11	1.25	0.625
0.4	0	1.07	1.25	0.625

Square-Odd scanning technique gives a constant detection time $l/(4v)$ and Virtual scanning approach having a constant detection time of $l/(2v)$ without affecting of working time w.

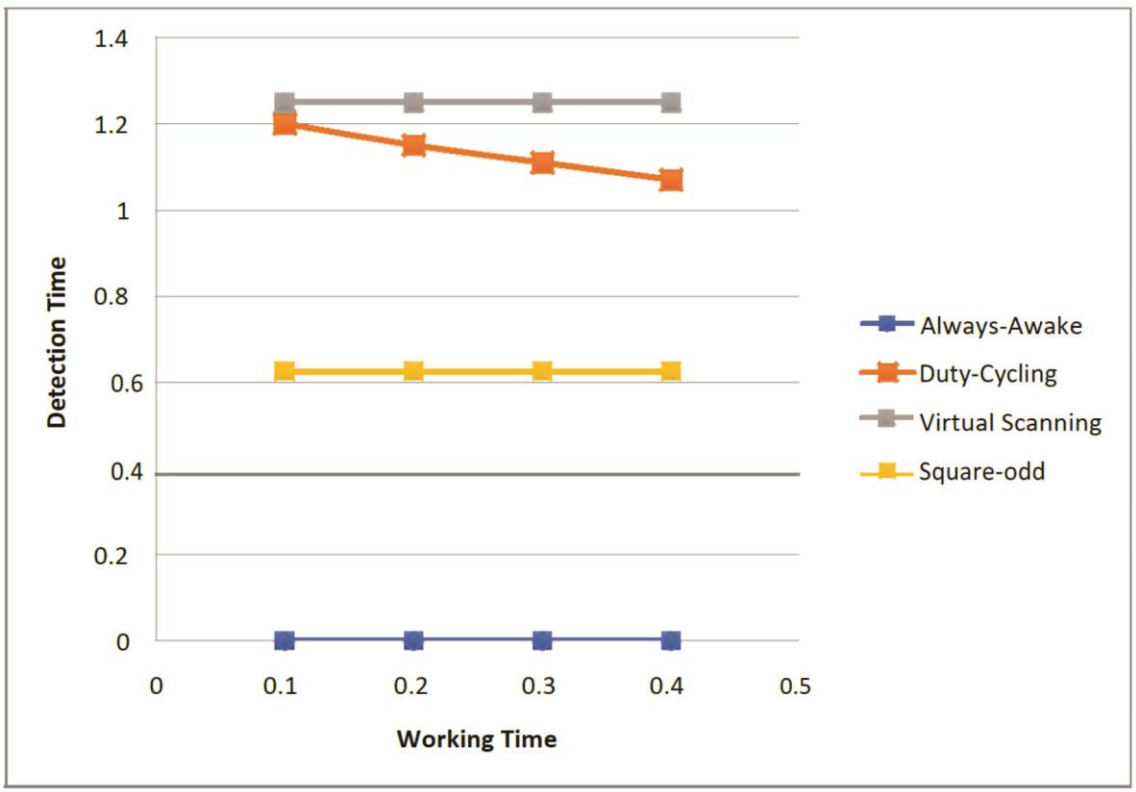


Fig 4.12:- Graph representation for reducing the detection time

For example**,** for working time w=0.1sec, square-odd has the lowest detection time of 0.625 sec, as shown in table 4.4 and figure 4.12, which is better than other three scanning algorithms. Therefore, virtual scanning method has approximate same performance as duty cycling, Virtual Scanning technique can provide 1.25 sec at the expense of two times longer average detection time. Duty Cycling has detection time of 1.20 sec, and the detection time for Always-Awake is zero.

For w=0.2sec, square-odd has the same detection time of 0.625 seconds, virtual scanning has the detection time of 1.25 sec, Duty Cycling technique has detection time of 1.15 sec, and Always-awake has zero detection time.

Similarly, for w=0.3 sec and w= 0.4 sec, we get the lowest detection time for Square-Odd scanning technique as compare to other three scanning algorithms. For working time w = 0.4 seconds, the virtual scanning technique detects the object within 1.25 seconds in average and the duty cycling technique does within 1.07 seconds.

So, according to this performance Square-Odd scanning method is best in terms of detection time of target. This result is shown in figure 4.12.

Chapter -5

CONCLUSION & FUTURE WORK

In this chapter, the major contributions of the thesis are summarized and some key directions for future work are suggested. Section 5.1 discusses the thesis summary and section 5.2 provides suggestions for future research work related to wireless body area network.

5.1 Conclusion

Recently, with the rapid development in wearable medical sensors and wireless communication, wireless body area networks (WBANs) have emerged as a promising technique that will revolutionalize the way of seeking healthcare which is often termed e-healthcare. Instead of being measured face-to-face, with WBANs patient's health-related parameters can be monitored remotely, continuously, and in real time, and then processed and transferred to medical databases. This medical information is shared among and accessed by various users such as healthcare staff, researchers, government agencies, and insurance companies. In this way healthcare processes, such as clinical diagnosis and emergency medical response, will be facilitated and expedited, thereby greatly increase the efficiency of healthcare. There are some routing algorithms available for wireless sensor networks adapt well for WBANs, but some WBAN specific issues which lead to a requirement for further modification of the routing algorithms. WBAN routing is always from a source sensor to a coordinator. The destination does not change and the number of sensors is also very less. Moreover, movement is more due to postural mobility in WBAN and energy is more difficult to supply. WBAN devices are used to collect life-critical information and operate in hostile conditions.

Therefore low detection time of diseases and long network life time are required to provide best facility and safety of health to the patient. Wireless sensing network uses sensors which have low power backup. So power saving is very significant in such type of network. Suggested algorithm "Square Odd scanning" is used to detect any object efficiently, effectively and it also saves significant power in wireless sensors.

The proposed system provides some amount of intelligence to the sensor nodes. It periodically switches the sensors between sleeping and awake mode where the detection of disease, entering from the entrance point, before they reach one of the protection point. The main limitation was that the system was capable of solely time period monitoring of the patient's standing, not skilled analysis and instruction.

In this work we have review many previous research work of routing protocols, scanning algorithms, WSN and WBAN. In this thesis, analyze the performance of various routing protocols in WSN environment and compare the same in the WBAN environment. The protocols compared are AODV, DSDV, DSR and the AOMDV by using PDR, E2Edelay and the throughput. The AOMDV protocol is found best in terms of the PDR and the throughput as well as delay on all networks. But the comparison clearly shows that the performance of these routing protocols get reduced in the WBAN environment. So, after finding some problems with existing techniques we propose an algorithm Square-odd scanning, with considering two major constraints network lifetime and detection time. Then the proposed approach performance has been compared with the parallel work reviewed.

Experimental and simulation results show that the our proposed algorithm performs better in both fields i.e. increase network lifetime and reduce detection time as compare to other existing techniques. Performance results of Square-odd scanning technique are shown in graphs and tables for different values of sensor's working time. So with Square-odd scanning technique, we can easily scan the sensing area for detecting our object or target with reducing detection time and after reducing detection time, the power consumption is low so, the total network lifetime will be increase.

5.2 Suggestions for future work

A few interesting future research directions are presented here that are either the extension of this research work or are motivated by using the proposed algorithm to improve reliable and efficient communication of the WBAN. Some suggestions are as follows:-

1. This work can be extended in the field of heart beat detection in BAN. When any heart patient on ventilator and at that time it is most required to detect the heart beat position of patient and other dangerous disease at early stage.

2. To detect multiple diseases, we scan sensor network at many times because only one disease can detect at a time. But it takes more power consumption of sensors and increase work load. Currently we have worked with this algorithm to detect only one disease at a time. It can be extended to detect more than one disease or multiple diseases at a time for early recovery of patient.

3. This algorithm can be used to detect gas leakage in gas plants where sensors are applicable to detect the leakage position of gas at early stage.

4. To detect disease in moving body is more complex as compare to static body. This work can be further used in detection of any disease in moving object or in moving body.

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