Anomaly Detection Improvement in Computer Communication Networks using Machine Learning Techniques

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Abstract

The issue of force misfortune in wireless sensor networks is one of the fundamental points and central defects that should be defeated in building any coordinated computer information trade and communications framework. Where numerous new examinations have given the idea that talk about this point and recommended various techniques and systems of their sorts, proficiency, and intricacy to take care of the issue of energy misfortune in far off sensors in advanced wireless sensor networks. The WSN networks rely upon the sixth-generation innovations by giving a better system than the pace of sending and getting data and giving permitting all over; likewise, the sixth generation crossing points embrace a smart technique for information transmission in WSNs. Sixth generation is the option in contrast to the fifth-generation cellular technique, where 6G frameworks can apply a larger number of frequencies than 5G frameworks and produce a lot higher transmission capacity with lower idleness. In this review, the hardships experienced in terahertz (THz) advances in wireless sensor networks will be demonstrated, including way obstacles that are viewed as the primary test; Additionally, the attention will be on tracking down answers for keep up with the best and least energy misfortune in the WSN networks by proposing machine learning systems that will show exceptional outcomes through effectiveness measures and ideal energy venture.

Keywords: Wireless Sensor Networks (WSNs); Machine Learning Techniques; 6G Frameworks; 5G Frameworks; key word 5; THz Advancements

1. Introduction

The expression "cellular wireless generation" (G) alludes to shifts in speed, framework, recurrence, and innovation between 4G, 5G, and 6G. There are progressed guidelines, abilities, highlights, and various attributes that put every generation aside from the past generation. In numerous metropolitan regions all over the planet, the standardization of 5G has been finished and the course of action has started. Regardless of this, there will be a huge expansion in information traffic because of the developing number of related gadgets, which could arrive at many related gadgets per cubic meter. In addition, novel future applications and purposes, for example, PC created encounters (VR), expanded reality (AR), 4K/8K UHD video, 3D correspondences, independent driving, and different applications and circumstances that are at present in presence [1-3]. The much uninformed rates and inactive necessities of these applications will make it provoking for as of now sent 5G convergences to meet these prerequisites. Issues like these are viewed as a critical factor in the change of correspondence frameworks to the sixth generation of remote networks. Given 5G networks and their predictable turn of events, 6G will offer huge open doors contrasted with more seasoned networks. What should 6G proposition that 5G or its deferred improvement didn't? The key critical enabling advances that will shape 6G, which are expected to be sent by 2030, are right now being recognized, characterized, and assessed by instructive, current, and exploration networks.

The vision of 6G correspondences is a predominant show of the data rate and idleness cutoff points and permit inescapable organization. Likewise, 6G correspondences will embrace a smart technique enabling new

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correspondence experiences against virtual presence and everywhere presence will be instantly open wherever. Furthermore, 6G trades will use famous applications, as holographic calls, flying networks, likewise tele-worked driving [4-6]. In addition, 6G is depended upon to give high steady quality with more noteworthy security, differentiating as well as customary remote networks. Regardless, among each special mechanical review connecting with 6G, THz with fabricated consciousness (artificial intelligence) is the most uplifting. These developments are communicated as moderate advances in the space of remote networks [7, 8]. For such unique advances to be solidified later on networks, an outrageous change is normal in the arrangement guidelines by the business specialists. It is typical that 6G remote networks will notice an outrageous change, making it extensively one of a kind concerning the previous ages and will change the distant progression along "related things" to "related understanding". In addition to that, 6G correspondences will provide organizations that are past versatile Web, but too support unavoidable simulated intelligence organizations from the middle organization including the server ranches along the transmission backhauls and finally to the end devices. With everything taken into account, the change will not be limited to space, but will present a period of interdisciplinary support between information development and distant correspondence. Meanwhile, artificial intelligence will be critical in the arrangement and smoothing out of 6G networks, plans, topography, conventions, and undertakings. To address the reach squash in 4G correspondences, the millimeter wave (mmWave) range was proposed and embraced. Sadly, such current reach information move limit is unequipped to meet the bandwidth need of holographic accounts. Figure 1 shows a schematic diagram of computer communication sensors network [9, 10].

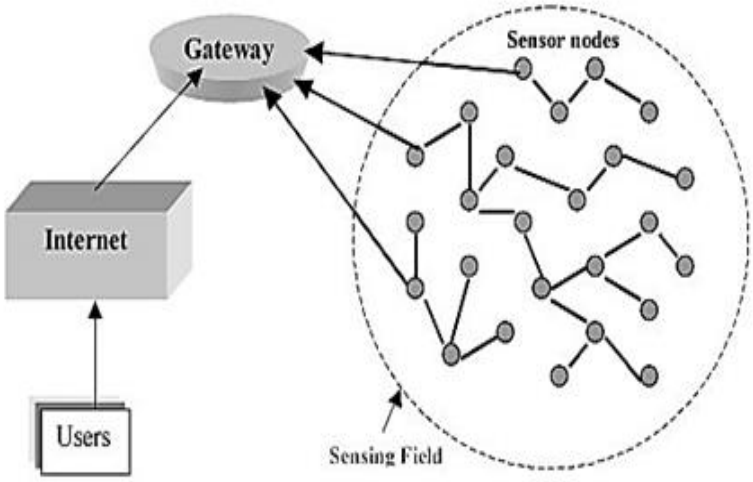

Figure 1. Computer communication sensors network schematic diagram [10].

Figure 1 shows a typical WSN structure for communications using 6G and 5G technologies. Obviously, this presents difficult challenges, such as the spatial efficiency and sensor clusters for data transmission and the necessary redundancy of the network. Thus, a huge transmission capacitance would be needed, which can be found in the T Hz groups, which is defined as the fluctuation amplitude between optical as well as microwave frequencies.

A. Cellular Networks(Mobile Phone Networks)

Electronic gadgets may be associated along significant distances, which is useful. An individual in France, for example, could use a cell to converse with another person in America. Mobile networks could achieve this. The cells give Radios that can be placed together to cover an enormous district. This suggests that an extensive extent of ported trans vectors could talk with one another, fixed handsets, and telephones across the network through base stations, regardless of whether a few transceivers cross farther than a solitary cluster along communication (for instance, cellarers, laptops, or tablets against wideband transceivers, modems). Figure 2 presents a typical construction of the cellular networks against a correlation amidst the information rate using energy utilization against the transmision length for an assortment of Wi-Fi systems and the mobile cellular structures [12-20].

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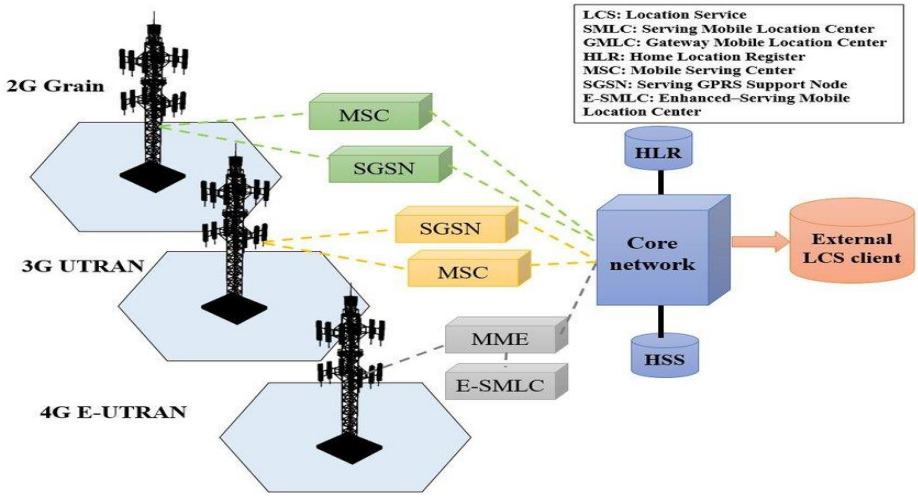

Figure 2(a). A typical mobile phone network structure, (a) General plan of mobile cellular networks

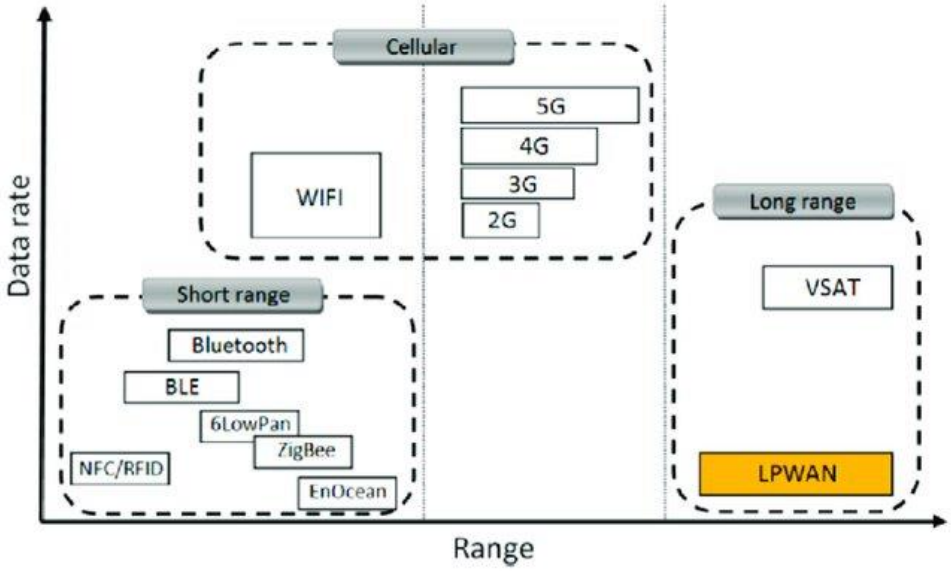

Figure 2(b). Ordinary mobile network architecture, (b) contrasting information rate and power utilization versus communication range for different Wi-Fi and cellular mobile systems [12-20].

Concerning Figure 2, it very well may be seen that the information rates and power utilization values are plotted against the communication range for various kinds of wireless communication sensor network advances. It very well may be seen that inside a scope of 10 meters, Zigbee, WiFi, and Bluetooth innovations convey at information paces of 100 Kbps to 100 Mbps individually. Then again, the geography will contain Low Power Wireless Area Networks (LPWAN), Authorized LPWAN, WiFi HaLow, Cellular 3G, 4G, and 5G networks with information rates going from 1 Kbps to 100 Mbps for a communication scope of 10m to 10km individually.

B. The 5G & 6G Wireless Sensor Networks (WSNs)

In practical approaches or impossible within the confines of cabled or Wi-Fi systems, enterprise mobile networks provide opportunities to improve and rethink business processes. Since it requires industrial users to be able to tailor mobile networks to satisfy the response, coverage, and security demands of maniufacturing-critical implementations, a modern reference to cyber-physical architectures known as Industry 4.0 is essential for industrial users. The strategic necessity of private frameworks is now being factored into the research and development of 6G. Private networks have been a feature added to public cellular systems in previous generations; however, the 5G specification now addresses these requirements directly. Thus, the technology will be able to meet the requirements of potential private network customers and the deployment of corporate 6G networks will

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be accelerated [22]. After years of development, a strong Long Term Rate (LTE) market has emerged, along advancement action in several global segments. Private LTE schemes benefit from the global LTE ecosystem that takes advantage of large scale, standardized technique, also well-established sources which are capable to plan as well as deploy systems. As many industries have already established supply chains and best practices, sector-specific equipment may benefit from the economies of scale and interoperability of global 3GPP technologies. With integrated LTE, one could now purchase sensors, automated guided vehicles (AGVs), security cameras, security devices, and other things [13-22].

A wide range of industrial applications may benefit from LTE. However, LTE is not as suitable for users who have more stringent performance requirements, such as apparatus density, throughput, availability, reliability, latency, and jitter, as 6G is. Because of advancements in the system architecture and radio domain, 6G is superior to satisfy the demands of high-performance practical implementations. For the purpose of response seamless communications for their day-to-day operations, the WSNsindustry places a significant amount of reliance on networks that are dependable, secure, and resilient. Wireless communication companies use sensors, automated vehicles, security cameras, robotic controls, and other devices. A variety of throughput, mobility, latency, density, availability and power requirements are exported through this approach. Additionally, extreme weather conditions like high temperatures and strong winds, in addition to the remoteness and isolation of WSN platforms, emphasize the need for a robust communications system [26]. Despite the fact that 5G LTE technology may be able to satisfy some of these requirements, 5G has the potential to play a significant role in the growth of industrial automation, particularly in light of the extremely dependable low latency communications applications it supports. The examination among 6G and prior ages is displayed in Table 1 beneath [14-22].

Table 1: Clarification Of The Difference Among The Various Generations Techniques Of [14-22].

Characterstics	**5G**	**6G**
Individual data rate	1Gbps	100Gbps
DL data rate	20Gps	>1000Gbps
U- plane latency	0.5ms	<0.1 ms
C- plane latency	10 ms	<1 ms
Mobility	Up to 500 km/h	Up to 1000 km/h
DL spectral efficiency	30 bps/Hz	100 bps/Hz
Operating frequency	3-30 GHz	Up 1000 GHz

The design of sensor nodes in WSNs comprises of four fundamental parts: sensor module, handling unit, handset unit, with enegy unit displayed in Figure 3. It likewise includs extra implementation-subordinate parts like a locating schemes, energy suppliy or battery system, against drifter.

By alluding to Figure 3, one could notice the subtleties units that build the architecture of the sensor hub model. The primary module in Figure 3 is the microprocessor module that achieves all the handling activities necessary to control the sensor hub activity proficiently. Likewise, the handset unit is important to perform the transmission agreements and exercises between the microcontroller system and the outside sensor nodes. Moreover, the detecting module will deliver the occupation of detecting the essential information from the external climate towards the sensor tribute scheme with the other way around through the analog to digital converter (ADC) system. Moreover, an outer memory module is further accessible to save data lastly; the battery system is additionally contained to provide the nevessary stockpile energy. The primary reason for the sensor hub structure is to gauge ecological boundaries as well as transmit the information back to the network passage where it is gathered, stored, and handled [15-24].

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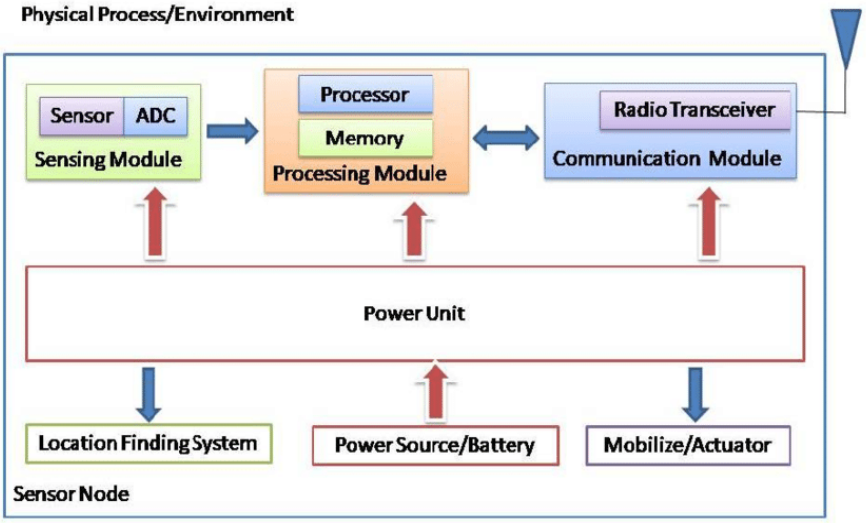

Figure 3. Structure of common sensor node model [15-24].

C. Concept of WSNs Energy Efficiency (Harvesting)

Largely, various procedures are accessible to separate energy from the climate, like sunlight based energy, nuclear power, kinetic energy, and vibration energy, additionally the lifetime of the network may be progressed by utilizing energy harvesting systems [12-20]. There is an extraordinary interest in energy harvesting for different wireless sensor applications to work on their feasible lifetime, yet there is likewise a fair need to guarantee execution and effectively use accessible power. The greater part of the examinations in the field of wireless sensors depend on the condition of the leftover battery, while in harvesting frameworks the issue is still to assess the accessibility of natural energy in hubs. Energy the board in energy harvesting frameworks is in a general sense unique in relation to battery-powered frameworks because of the eccentrics of accessible energy. Examination and studies have shown that the accessibility of force fluctuates after some time for different hubs in the network. This presents part of the troubles for the hub at whatever point it requires to compose chances in information light on the excess network energy. Moreover, various hubs might have various energy harvesting open doors, so it is critical to change the responsibility relying upon the energy accessibility of the harvesting hubs. To assess such issues, they proposed a logical design for energy harvesting and execution [16-25]. They recommended a way to deal with balance collect power and burden at a hub. They made sense of the prerequisite for coordinated effort among energy the executive's applications while the harvesting source cannot uphold the degree of hub load consumption. There is an extraordinary interest in energy harvesting for different wireless sensor applications to work on their reasonable lifetime, yet there is likewise a decent prerequisite to guarantee execution and productively use accessible power. The majority of the examinations in wireless sensors depend on the leftover battery state, while in harvesting frameworks the issue is still to appraise natural energy accessibility in hubs. Despite the availability of natural energy, the CEO's provisioning strategy regarding energy access is based on predictable energy assets and cannot be used with eccentric assets. A definitive point behind such a methodology is to deliver power map architecture for a conventional WSN application with fundamental and recognizable power parts and the connections among these boundaries so one could investigate systems to limit the general power consumption of the whole application. Contingent upon such architecture, this approach proposes energy consumption plan for a total application to the extent that logical articulations which empower one to take apart as well as enhance the energy consumption capacity. The architecture fixates on power guts instead of network layers or real things. Most in a general sense, it allows the distinctive evidence of force-consuming component arranging in the WSN execution of the energy things in the structure. One could expect a diligent period some place in the scope of t1 and t2 to deal along the power comsuming amidst the two centers. The energy resting at instant t is characterized by deducting the energy dissipated at t from the basic battery energy at t-Δt. Thus, the power dissipation in Δt will be computed as below [16-25]:

$$\{ E_{residual,i}(t_2) = E_{residual,i}(t_1) - E_{consumed,i}(\Delta t)\ E_{residual,i}(\Delta t) = \frac{\partial E_{residual,i}(t)}{\partial t}\ \Delta t = t_2 - t_1 \quad (1)$$

Also,

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$$\{E_{consumed,i}(\Delta t) = \lambda_1 E_{individual,i}(\Delta t) + \lambda_2 E_{local,i}(\Delta t) + \lambda_3 E_{global,i}(\Delta t) + \lambda_4 E_{battery,i}(\Delta t) + \lambda_5 E_{sink,i}(\Delta t) \; subject\; to: 1. E_{local,i}(\Delta t) > 0 \; 2. E_{global,i}(\Delta t) > 0 \; 3. \lambda_1 E_{individual,i}(\Delta t) + \lambda_2 E_{local,i}(\Delta t) + \lambda_3 E_{global,i}(\Delta t) + \lambda_5 E_{sink,i}(\Delta t) < \lambda_4 E_{battery,i}(\Delta t) \quad (2)$$

Such that, Eindividual, denotes the individual evaluated energy, Elocal, indicates the local energy, Eglobal, represents the global energy, Ebattery, denotes the battery energy, and Esink, indicates the sink energy at the ith sensor hub. Furthermore, λ, is the compensation factor of every power records. Figure 4 displays all restrictions regarding network power-consuming missions.

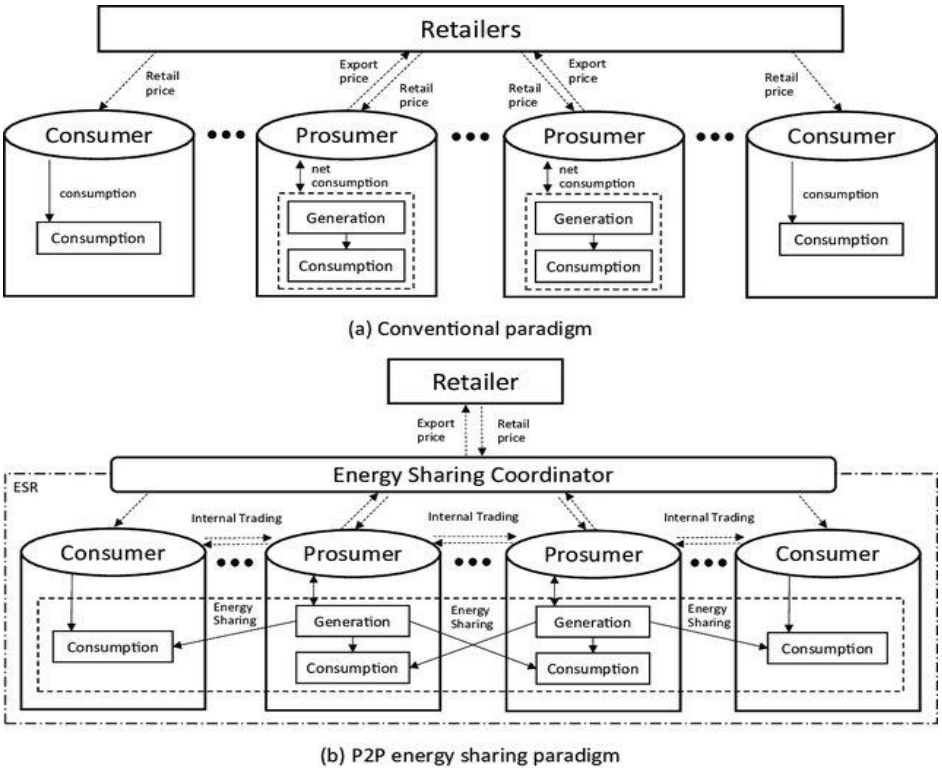

Figure 4. The network limitations correspond of energy-consuming missions [16-25].

By considering Figure 4, one could recognize that the first limitation denotes the requests that collaboration attaches must be established. The next limitation demonstrates the important and sufficient constraint for the hub to be accessible at the network. The third limitation means that the hub must have sufficient power to implement system missions, otherwise, it is inactive also must be eliminated through network accounts. Every factor it is represented corresponding of key components (or parameters). Such essential parameters are outlined on the long needs basis. Hence, the interconnection amidst the energy includs must be considered when calculating the overall power depletion of the overall composition. Thus, the surrounding is sum, for example, might be evaluated by the topology in the general components, which has a direct impact on the power depletion of the local factors [25-32].

D. Concept of Anomaly Detection

Anomaly detection is part of the major challenges to ensuring security in private wireless networks. Specifically, WSNs are vulnerable to various threats, which may cause node damage and provide false readings. In fact, to reduce false alarms, it is necessary to detect such anomalous data. Anomaly detection works by examining specific data points and detecting rare events that appear suspicious because they differ from the established pattern of behavior. [25-33]. Flaw detection is nothing new, but as data increases, manual tracing becomes impractical. Actually, anomalies in WSNs can be identified by monitoring any unusual, abnormal or unexpected behavior or events in the flow of collected sensor data that differ from expected or normal patterns. Anomaly detection is also a relevant problem in data analysis in networked systems, where individual entities interact in pairs. Anomalies are observed when any deviation in the pattern of interactions from patterns considered regular is observed. Figure 5 shows a schematic diagram of the anomaly detection operation with the scope of every anomaly kind in WSNs [30-45].

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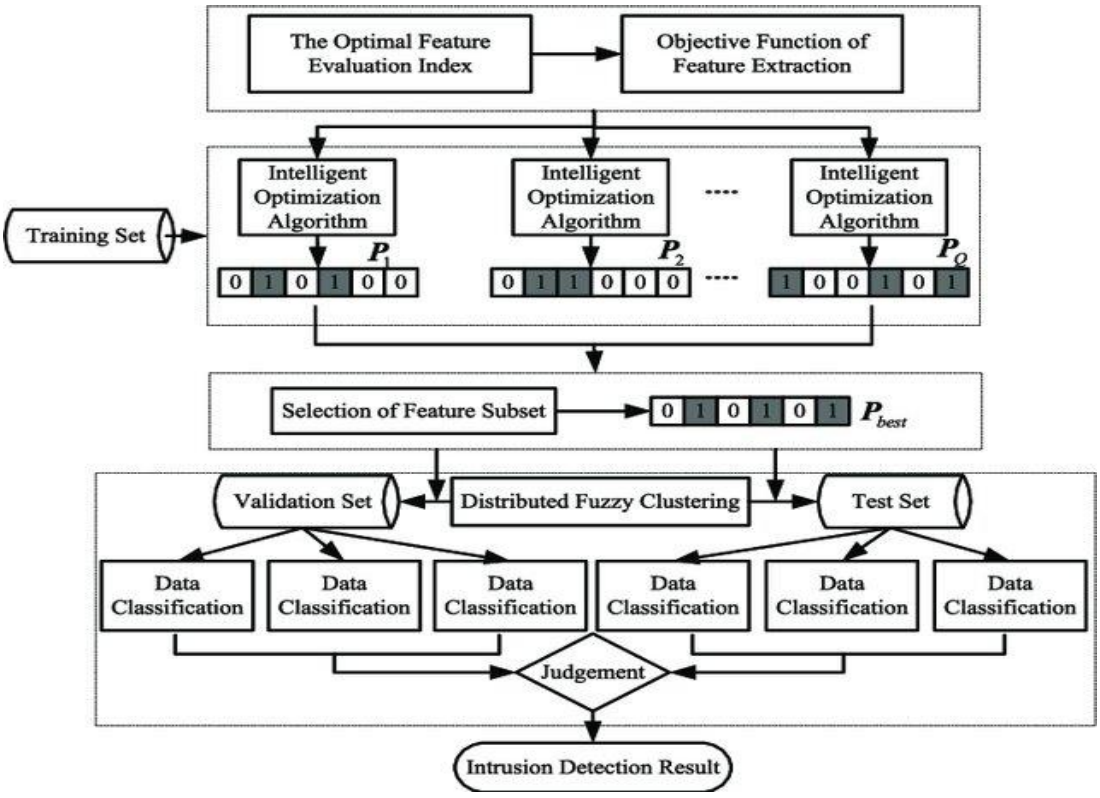

Figure 5. Schematic diagram of the anomaly detection operation [30-45].

By concerning the flow chart presented in Figure 5, one could recognize the operation of the anomaly detection activity flow in the WSNs. Conditions indicating an anomaly related to the client's own policy. For example, the operator specifies the spectrum with time instant required the info to be delivered by the sensor nodes. Such set detection thresholds and recorded anomalies to drivers. So that when the info through the sensor hub is variable according to the predicted program, the driver might be advised. Like that recurrence, importance, with schedules level might also be regarded within a notification definition of the client. Anomaly diagnostics was created in the management of traditional network equipment [12-20], however, it is revisited here along the perspective of WSN to clarify how it does so it might be employed for various kinds of WSN anomalies [30-45].

E. Machine Learning Effect on WSNs

The rapid expansion of information technology will soon affect the entire world. Artificial intelligence (AI) and machine learning (ML) has an important effect on 6G communications. ML is supported by every new technology today, and it is reasonable to anticipate that AI will soon control the planet. In several approaches, the 6G might boost artificial intelligence and ML techniques. Recent research suggests that the wireless industry is pure involved in artificial intelligence, which is leading to machine learning, an advance in cellular, highly intelligent apparatus, also the big data generation. The 6G communications purpose is to enable artificial intelligence in an essential approach and to achieve overall remote as well as automated intercommunication programmed machine learning techniques are composed possible by artificial intelligence at the pivot. Several machine learning concepts and algorithms are the driving force behind automation. In general, artificial intelligence and machine learning power several applications, which run on mobile or smart devices. Theoretical integration, mechanical learning and deep neural networks, extensive communication, saving, with success, and other aspects of 6G all depend on AI. Figure 6 presents a schematic diagram of the effect of ML in 6G WSNs [32-50].

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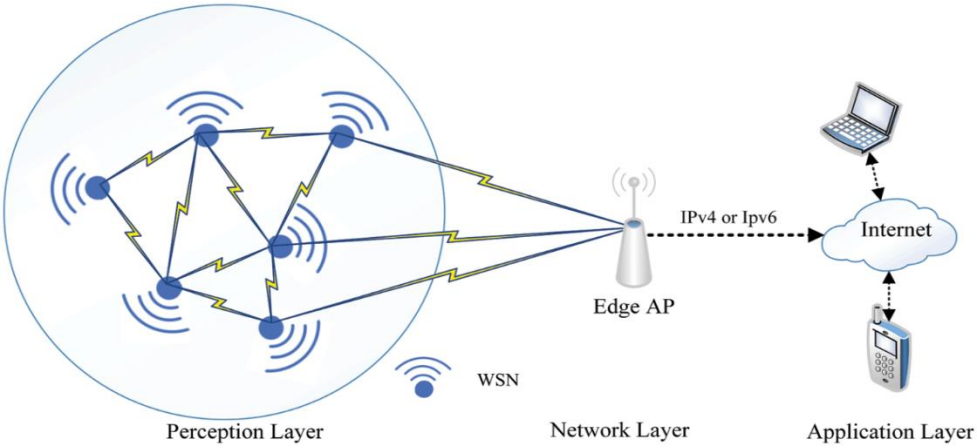

Figure 6. Schematic diagram of the effect of ML in 6G WSNs [32-50].

Furthermore, and because it might form structures that a mathematical equation cannot, Machine Learning (ML) would therefore be critical in 6G wireless networks. In addition, these localized tasks can be optimized by substituting DL tools for heuristic or brute force algorithms. In the meantime, DL has been established to allow for computerized, hands-off control and analysis of 6G networks at any time. In addition, mobile devices may perform additional DL activities or forecasts and report them to the network, making them an integrated compound and assisting with resource management decision making. These data need to be accessed quickly by wireless devices, especially for applications with a lot of potential, like real-instant visual inspection with extended reality (XR). The 6G networks employ ML agents; those are responsible for the radio interface structure, adaptive hopping techniques, connection regulation, with improvisation for a variety of activities [32-50].

2. Literature Review

In this part, the survey the most famous examinations and pertinent late papers that anyone could hope to find with research articles connected with the subjects of 5G and 6G WSN advancements and power deformity handling mechanisms in WSNs. Significant examinations will sum up the creators' endeavors on this point in a high level logical arrangement. 5G/6G remote communication applications have been acquainted with work on the most impressive conceivable transmission systems to various routes. Procedures used to address energy conservation issues in the field of WSNs are talked about. In 2017, Shafi, M, et. al., [18], talked about the advanced game plan of fifth-age (5G) remote networks which opens one more part in compact correspondences, nudged ahead by the procedure with the push for very trustworthy, low-slack, high information transmission correspondences for applications, for instance, splendid houses, e-prosperity, Web of-Things (IoT), related vehicles, too WSNs. In 2018, Xing, Y, et. al. [19]. This study examines thinking about the 6th and fifth-generation innovation as strategies that help execution and data transmission rapidly forward, as it began in 2018 with remote network associations in significant metropolitan networks, and has now moved to multi-use networks, and as devices to resolve pain points, and establishments for quick remote communications and got to the center network on a lot bigger scope. Mobile phones are at this point being grown, but are in like manner natural to convey in 2019. In 2018, Hilbert, J.L, [20], investigated the terahertz (THz) for 6 GWSN effectively in the composition, empowering an assortment of cutting edge executions containing spectroscopy, distinguishing, and correspondences. There is a wide assortment of distributions focusing in upon the recurrence space generally along 300 GHz reach toward 3 THz, likewise its significant with rising limit as a future development stage. Potential use occasions of distant terahertz correspondence are ultrafast far off neighborhood, intra-chip accessibility, downloads, and server farm accessibility. In 2018, Balteanu, F., [21], He concentrated on the logical challenges in the plan before the furthest down the line innovations could be utilized for far off transmission of signs with frequencies surpassing 0.1 THz. In this overview here, it have restricted it down to three extended parts. In 2019, Segan, S., [22], researched the 6G/5G innovation with the vector network analyzer (VNA) - cleared recurrence methodology, the medium recurrence response is assessed by using a VNA (along against sub-consonant mistakes to work at THz gatherings). The VNA ventures through an extent of discrete, narrowband recurrence frequencies got across the information transmission free from worry too, at each recurrence, measures the channel's significance with stage response prevailed with an opposite discrete Fourier difference in the medium move work that achieves a convoluted CIR. With this technique, very precise medium assessments may be achieved in static circumstances using a VNA with the ideal recurrence goal. In 2018, Sengupta, K., et. al., [23], Past examinations that have upheld exact control of

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information transmission over 6G and 5G networks have explored, for instance, multipath, non-view (NLOS) communications, as well as Doppler impacts, because of control stuffing with flexible courier joins, it is critical to characterize the medium as well as centre the fundamental characteristics of the form as a part of the time so a strong channel design is fabricated and utilized inside the distant correspondence plan test systems/test frameworks. Exploratory data thusly is supposed to decide exact rationale and likelihood outlines for terahertz-far off media. From one viewpoint, the various way with NLOS systems, the possibility of terahertz disseminating is a critical interest. In 2019, Shin, J.Y., et. al., [26] introduced the conspicuous thing in the discussion is such 6G/5G innovation medium stunning in the terahertz is correct now limited by stage synchronism dangers. Such a danger is legitimate for each VNA with SC executions. A few of the recommended medium transmitters do not use synchronism against thusly cannot check through and through delays. Such thing does not completely get rid of their worth. It essentially suggests they can check as it has adjusted relative against the most grounded or first appearance up multipath area. For to some degree short associations, synchronization is all around not an issue since for all time set up relationship among the Tx with Rx are alright. A synchronism interface is used as a stage hotspot for medium stunning procedures so to speak to engage assessments of largely preparation among conveyed and received messages. The actual medium is remote. In various helpful correspondence circumstances, no connection can be used for synchronization. In 2018, Mama, J., et. al., [32], examined the Vector network analyzers, which are regularly utilized in static circumstances considering the long recurrence clear time across an extensive scope of the 6G/5G WSNs, which could surpass the medium levelheadedness time. In like manner, for all time set up affiliations are normal for VNA double port network synchronization which makes it further sensible for short-range with indoor assessments.

The research aims to study the improvement of the detection of anomalies during the operation of computer communications networks, such as problems of delay, data congestion, and service interruptions, using machine-learning techniques.

3. The Materials and Methods

In this section, the details of the suggested model implementation steps and the overall simulation methodology will be demonstrated and discussed in details. First, the dataset loaded from web sites and have been demonstrated in Table 2.

Table 2: The modified data set description from kaggle.com, & github.com web sites.

WSN Nodes										**Energy**
N1	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**	**N9**	**N10**	**(Watts)**
1	1	0	1	0	1	1	0	0	1	60=1
0	1	0	0	1	0	1	0	0	1	40=0
0	1	1	1	1	0	1	1	0	1	70=1
0	1	1	1	1	1	1	0	1	1	80=1
1	0	0	1	1	1	1	0	0	1	60=1
1	0	0	1	1	0	1	0	0	1	50=1
0	0	0	0	0	0	0	1	1	0	20=0
0	1	0	1	0	1	0	1	0	0	40=0
0	0	1	0	0	1	0	1	0	0	30=0
0	0	1	1	1	1	1	1	0	1	70=1
1	0	0	0	1	1	0	1	0	0	40=0
1	1	0	0	0	0	1	1	1	1	60=1
0	1	0	0	0	0	0	1	0	0	20=0
0	0	0	0	1	0	1	1	0	1	40=0
0	1	1	1	1	1	0	1	1	1	80=1
1	1	1	1	1	1	1	0	1	1	90=1
0	1	1	0	1	0	0	1	1	0	50=1
0	1	0	1	1	0	1	0	1	1	60=1
1	1	1	0	1	1	0	1	1	0	70=1
1	1	0	1	1	1	1	0	1	1	80=1
0	0	1	0	1	0	1	1	0	0	40=0
1	1	1	1	1	1	1	1	1	1	100=1

Such that;

1) Low Node Power=0 Watt, High Node Power=10 Watt,

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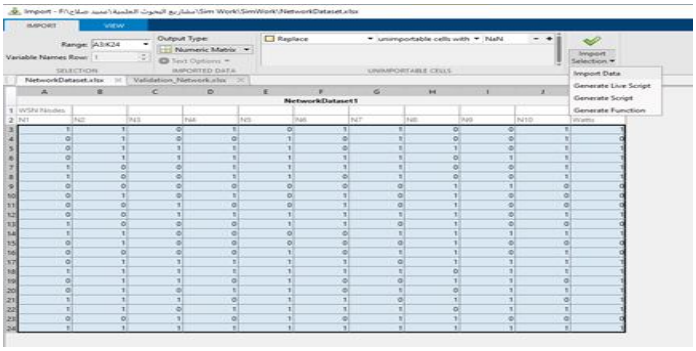
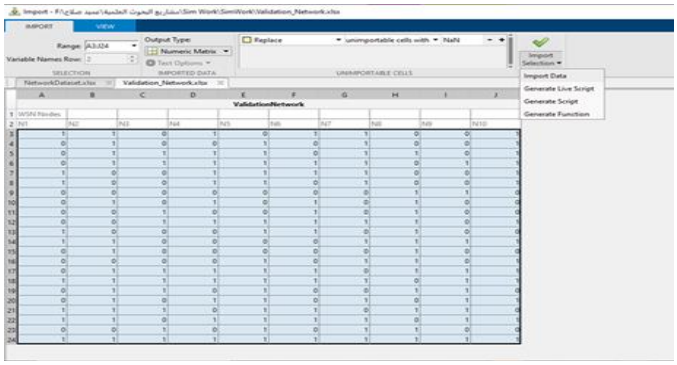
2) If total nodes Power <= 50 then Energy=1, Network transmit data, and

3) If total nodes Power >5 0 then Energy=0, Network OFF data.



(a)



(b)

Figure 7. Illustrates the starting data loading user window to open the classification-learning tool from the application options provided by the MatLab2020b for data loading programming language.

By regarding to Figure 7, its notice the starting window utilized to collect the data required for machine learning techniques. These data will be loaded from the excel sheets and display on the MATLAB window with saving options to be utilized latterly in the classification ML tool as presented in the above Figures. Next the flow-chart of the suggested "anomaly detection of computer communication networks using machine learning techniques system" model methodology will be illustrated in Figure 8.

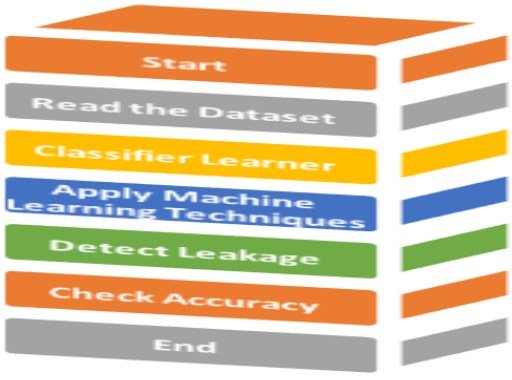


Figure 8. The flow chart of the suggested model methodology.

From Figure 8, the procedure of the suggested model will start the program utilizing by preparing the datasets and read them using the Read the Dataset option utility. Next, the Classifier Learner will be employed that will provide the necessary machine learning programming tools. After that, the Machine Learning Techniques will be applied

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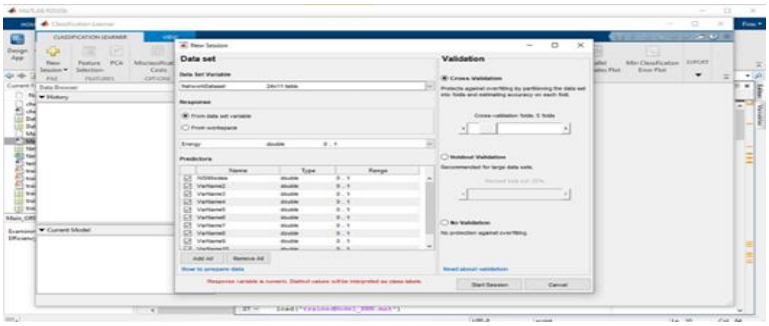
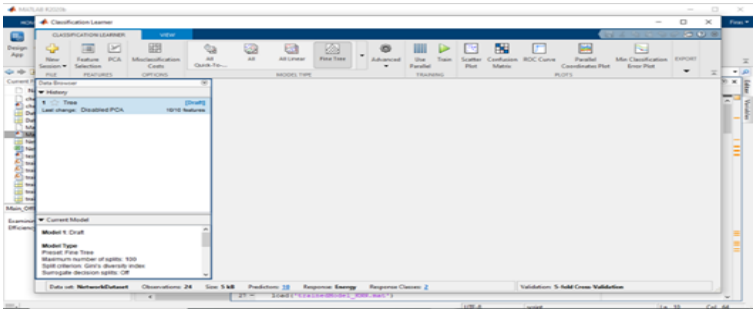
using this classifier learner utility such that the loaded datasets will be trained to find the suitable results. Furthermore, the Detect energy case option will check the points of leakages in the trained datasets, and finally, the accuracy of the leakage detection will be gained from the classification and training results of the machine learning algorithms operation. At last, the will check the overall steps and ends the processing. Moreover, the methodology of opening and adjusting the classification learner tool provided is MatLab2020b Software is displayed in Figure 9.

(a)



(b)



(c)

Figure 9. Demonstration of the Classifier Learner application provided by MatLab2020b Software, (a) Starting interface, (b) Data loading & controlling interface, (c) Classifier Learner Interface window.

By referring to Figure 9, it might observe the methodology of opening and adjusting the classification learner tool provided be MatLab2020b Software. Thus, Figure 9. (a) Shows the starting interface window, which makes the user or the designer capable of access to this application tool. Next, the data loading and monitoring interface wizard will be presented in Figure 9. (b) Which will provide data loading tools as well as control tools to adjust the machine learning properties? Also, Figure 9. (c) Presents the final classifier learner interface wizard that provides all the necessary tools and options to select the specified machine-learning algorithm and examining its performance on the loaded data sets. Next, after employing the suitable training on the loaded WSN datasets, and selecting the best machine learning ML algorithms those satisfying the maximum efficiency values, the classifier learner application will provide utilities to load the chosen ML algorithms as a compact model with the encryption MatLab code scripts. Figure 10 illustrate the export utility in the classifier learner application.

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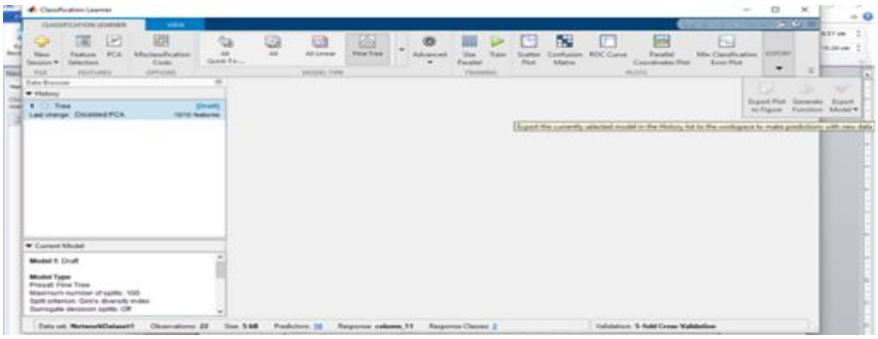

Figure 10. The export utility in the classifier learner application.

Hence, by concerning Figure 10, Its might observe the ability of achieving the tools and functions necessary to implement our proposed WSN model with the best ML algorithm that satisfies the maximum efficiency and detect the best hubs arrangement in the proposed WSN those consuming minimal energy. Hence, and after completing the design of the best ML algorithm that satisfy the maximum energy consumption constraints using the classifier learner application tools, and will complete the design of the suggested WSN model by adjusting the planning framework that defines the network nodes, energy distribution, and data communication process. Table 3 adjust the design specifications of the suggested WSN model.

Table 3: The design specifications of the suggested WSN model.

Round Iterations	Nodes No.	Minimum Energy	Maximum Energy
25	10	10	100
250	10	10	100
2500	10	10	100

According to the design specifications illustrated in Table 3, the proposed WSN model will be employed using the MatLab code, which will be written to simulate the operation of the communicating data through such WSN with the specified hubs, against energy amounts.

4. Results and Discussion

By implementing the suggested "anomaly detection of computer communication networks using machine learning techniques system" model according to the design specifications and requirements presented previously, the results of the classifier learner have been recorded for each type of the examined machine learning technique. The first machine-learning algorithm to be examined according to the entered datasets was the support vector machine (SVM) machine-learning algorithm. The results of the ML training are shown in Figure 11 according to the loaded WSN energy dataset.

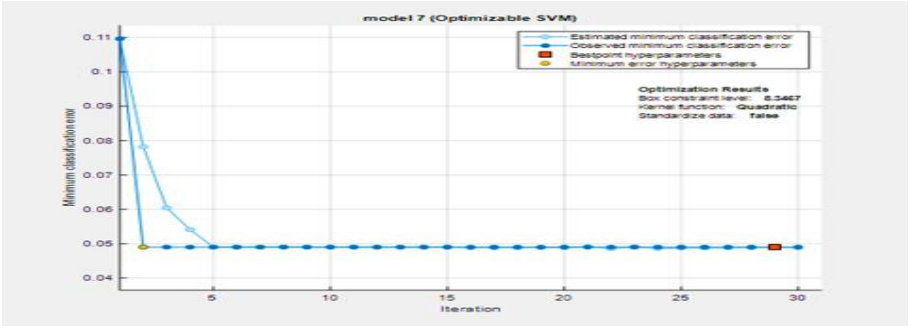

Figure 11. Results of the SVM machine learning training according to the loaded WSN energy dataset.

Concerning Figure 11, one might observe that the accuracy of the SVM training reaches to 95.5%. Now, the measuring function of the confusion matrix is obtained as presented in Figure 12.

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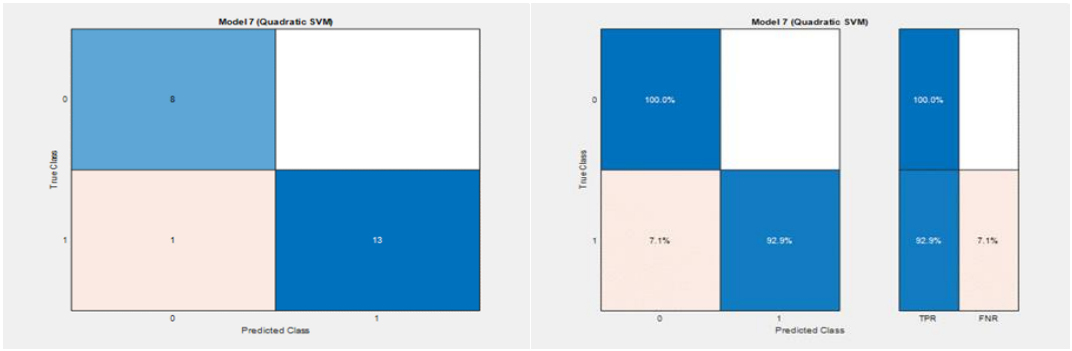
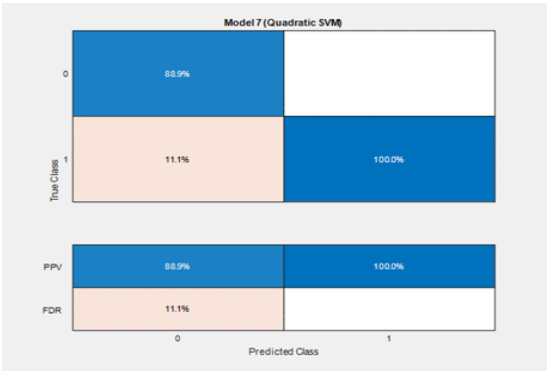


(a) **(b)**



(c)

Figure 12. SVM confusion matrix measuring function, (a) Observations number, (b) True positive rates (TPR) and false negative rates, (c) Positive predictive values (PPV) and false discovery rates (FDR).

By concerning Figure 12, Its might observe the confusion matrix readings measurements which provide indications of how much the SVM machine learning algorithm training has produce a suitable data classification. Since from Figure 12, (a) the confusion matrix indicates that 13 samples for "Energy Access" or symbol "1" are obtained with 1 sample error, while only 8 samples for "No Access" or symbol "0" are achieved between the true and predicted learned data samples. Also the TPR was 92.9% with FNR of only 7.1% between the true and predicted learned data samples as shown in Figure 12, (b). Furthermore, the Positive predictive values (PPV) was 88.9% with false discovery rates (FDR) of only 11.1% in Figure 12, (c). These confusion matrix readings are excellent as indicate a perfect classification for the fine tree ML algorithm. In addition, the receiver observes curve (ROC) measure has been computed for SVM ML algorithm as shown in Figure 13.

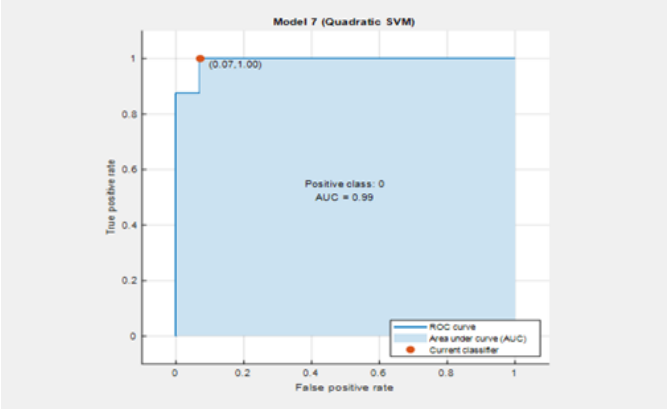


Figure 13. The receiver observes curve (ROC) measure computed for SVM ML algorithm.

From this curve introduced in Figure 13, its might measure how much the True positive rates (TPR) and False negative rates (FNR) are matched for the trained data samples. In this SVM ML algorithm, the ROC reads only

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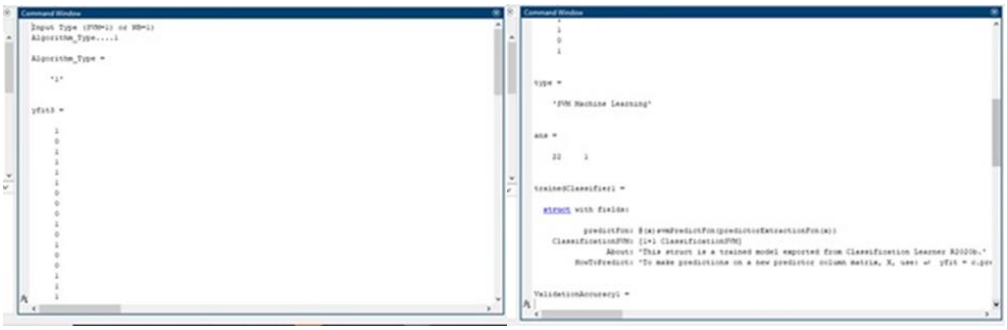
0.99 area under the curve (AUC) which is a perfect indication measurement. The screen shoot of the program implementation for SVM ML algorithm has been shown in Figure 14.

Next, the results of the simulated m. file MatLab2020b program script code written for training the SVM ML algorithm are obtained. The results of the communication WSN energy efficiency improvement detection using fine tree (SVM) ML algorithm are shown in Figure 15.



(a) **(b)**

Figure 14. The screens shoot of the program implementation for SVM ML algorithm.

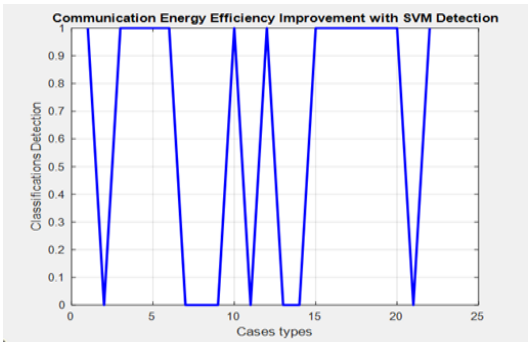


Figure 15. The results of the communication WSN energy efficiency improvement detection using SVM ML algorithm.

Perfect communication WSN energy efficiency improvement detection has been achieved using SVM ML algorithm as found from the results shown in Figure 17. In addition, the outcomes of the simulated m. file MatLab2020b program script code written for training the NB ML algorithm are achieved. Moreover, the results of the communication WSN energy efficiency enhancement detection utilizing Naïve Biase (NB) ML algorithm are displayed in Figure 16.

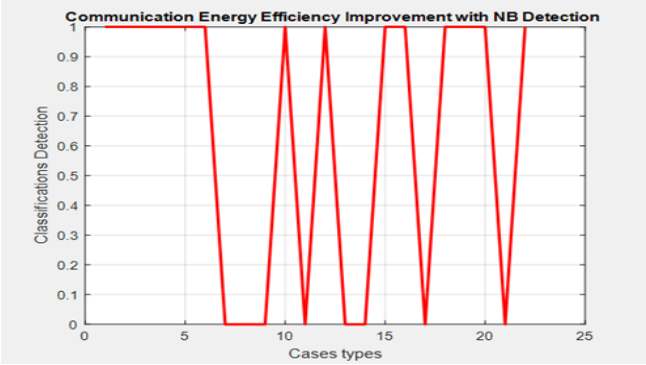


Figure 16. The results of the communication WSN energy efficiency improvement detection using NB ML algorithm.

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Good communication WSN energy efficiency improvement détection has been achieved using NB ML algorithm as observé through the results illustrated in Figure 16. At least, the WSN communication energy efficiency improvement detection accuracy results for both SVM and NB algorithm are comparing as shown in Figure 17.

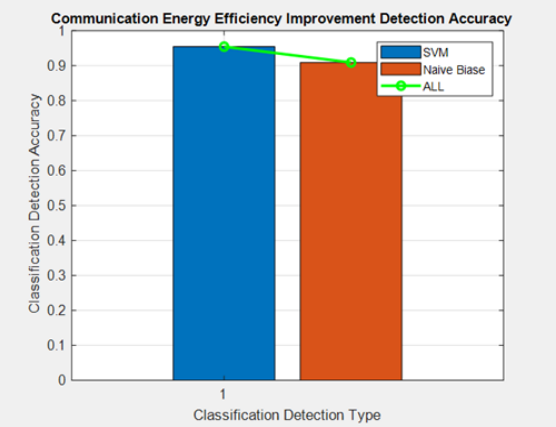


Figure 17. Comparison between the SVM, and NB algorithms for the obtained WSN communication energy efficiency improvement detection accuracy results.

Moreover, the screen shoot of the implementation program showing the final accuracy results is presented in Figure 18.

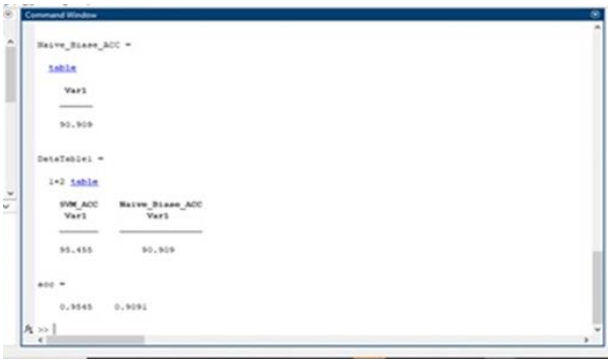
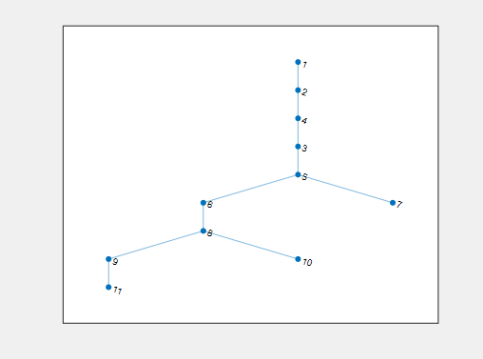


Figure 18. The screens shoot of the implementation program showing the final accuracy results.

Concerning the results shown in Figure 17, and 18, its might conclude that, the SVM algorithm has produced the best detection accuracy of 100% than that of the NB algorithm for our suggested WSN communication energy efficiency improvement model. Moreover, the WSN connections topologies have been obtained according to the energy values as displayed in Figure 19.



(a)

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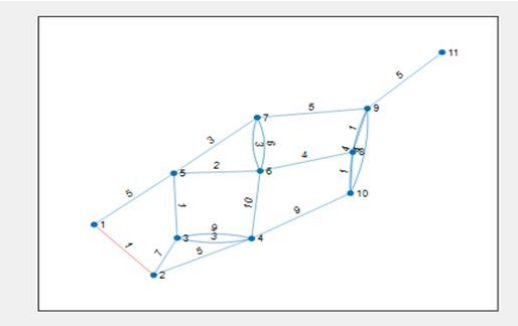
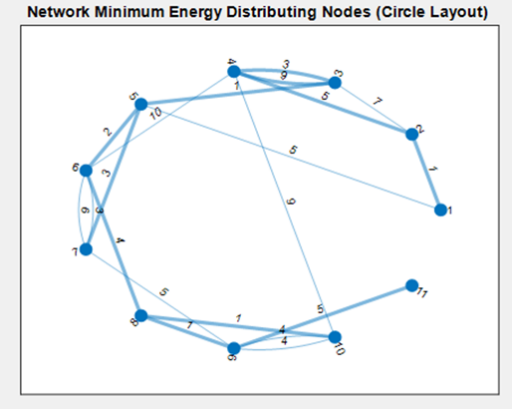


(b)



(c)

Figure 19. The obtained WSN connections topologies according to the energy values, a) Edge Label', (b) 'Layout', (c) 'Layout'.

Its notice from Figure 19, that, the WSN of the suggested model has been implemented with 10 nodes for examining the performance of the energy detection nodes those operating efficiently with high accuracy, and avoiding nodes having low level or anomaly detected energy values. Moreover, the path of the transmitted nodes with maximum energy consuming values has been computed as shown in Figure 20.

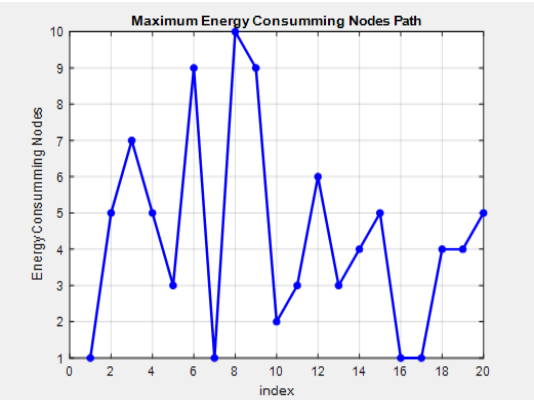


Figure 20. The computed path of the transmitted nodes with maximum energy consuming.

By referring to Figure 20, it could observe the path of the transmission through nodes having maximum energy consuming values in our proposed WSN model with 20 examination rounds. By other words, may could see that the WSN will communicate with maximum energy consumption starting at node 1, and then passing through nodes, remaining shown nodes. As à final comparison, the energy consumption results have been calculated for every case of the suggested WSN, which is with the anomaly WSN, and against the optimized one as presented in Table 4.

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Table 4: The final evaluation of the energy consumption curves computed for each case of the suggested WSN, the anomaly WSN, and the optimized one.

WSN Energy Evaluation (Watt)	**Samples Rounds**			
	0	500	1000	2000
Anomally	100	100	100	80
Optimized (Proposed Model)	5	4.5	4	2
Difference	95	94.5	96	72

By regarding the outcomes introduced in Table 4, one might conclude that, the optimized WSN has provide energy consumption of 95% than the anomaly one with 2500 examination rounds.

5. Conclusion

In this study, the recommended "anomaly identification of computer communication networks utilizing machine learning procedures framework" model has been effectively executed using the MatLab2020b reenactment program with the help of utilization utilities. In this review, the consequences of the machine learning algorithms used to identify the best matching among WSN hubs have been accomplished by the prepared informational indexes likewise, they have been talked about with examination among different machine learning methods execution. The info information to the proposed program model were the adjusted datasets of the potential hubs utilized to move the information as per the hub's energy, while the outcomes were the chance of the hubs accessing information or not by the dataset data's readings of energy along the WSN structure. Moreover, the accomplished accuracy of the utilized machine learning (ML) algorithms has been viewed as a program result. It has been found that the SVM ML strategy created 95.5% accuracy against 91% for the NB ML method as per the analyzed WSN informational indexes. Additionally, the proposed WSN model has created an energy utilization of 96% for optimized hubs than the anomaly hubs by applying the SVM ML algorithm.

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Conflicts of Interest: “The authors declare no conflict of interest.”

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