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Challenges and Issues for Wireless Sensor Networks: A Survey

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Abstract

Wireless sensor networks (WSNs) is one of the significant parts in networking area. Because they are cheap, efficient, and small, they are become more and more important for several applications. However, with the widespread use of applications that rely on wireless sensor networks, they continue to suffer from limitations such as memory and computing. Since, the need for finding effective solutions, especially after the emergence of the Internet of Things, which relies on the efficiency of wireless sensor networks. In this study, a survey was given of the latest research in this field for the years 2018-2020, which was classified into six categories: 1) presented an overview of the applications, management and security of wireless sensor networks. 2) Focused on improving classification algorithms, routing, and energy saving. 3) Review the developed methods of the techniques for information gathering. 4) Focused on coverage, connectivity and positioning techniques. 5) Displayed the studies that dealt with the of Internet of Things (IoTs) technology on wireless sensor networks (WSNs). 6) Illustrates the most important research that has focused on developing algorithms to increase security in wireless sensor networks. The motivation for using WSNs applications within IoTs technologies, and the issues related to application obstruction, challenges and the solutions, development and utilization of WSNs are then surveyed based on the results from the literature. Result of the survey shows that consumption of energy is the greatest fundamental problem in WSN on the other hand, is not detected by the researchers where as it can provide for the enhancement of the energy efficiency. It also elaborates the weaknesses of the existing approaches which make them inappropriate for energy efficient routing in WSN.

Keywords: Wireless Sensor Networks, Coverage, Localization, Data Aggregation, IoT

1. Introduction

In wireless communication a wireless sensor networks (WSNs) are becomes more important. A sensor node resources is unlike from the traditional communication systems since, new operating systems are suggested for WSNs [1]. Wireless sensor networks (WSNs) is described as multi-hop network systems. They are formed through distributed, self-organized, and energy-constrained wireless sensor nodes and actuators that collect data needed for a certain application from the

monitoring area automatically in order to improve the performance of the monitoring systems and decrease the total costs [2]. A wireless sensor network can be described as a composition of tiny sensor nodes that communicate wirelessly with each other to sense some specific actions in an interested field. Each sensor node consists of main components: processing capability, memory, RF transceiver, power source and in some cases equipped with Global Positioning System (GPS). WSNs have deployed in different fields in order to provide online insights into the conditions, demands and performance of the observed infrastructure. WSN can be deployed in different structure of network topology according to applications used in [3].

Wireless sensor networks (WSNs) are cheap, efficient and small. But they have limitations such as limited amount of energy, short communication range, low bandwidth, and limited processing. Wireless sensor Networks are collection of sensors collaborating to arrive at particular decision. Information for such decisions is collected from a large number of centrally located nodes known as base stations (BSs). This is important because many network applications need hundreds or thousands of sensor nodes [4].

The nodes of wireless sensor networks are generally no mobile, and the network topology is not fixed due to the reduced life of the nodes, so the communication network protocols need to self-adapt to the topology changes; the software upgrades are time consuming due to the large number of sensor nodes; data control and forwarding are closely coupled within the network switching equipment, so the network extension and management are costly [5].

This paper is organized as follows. Section 1 introduction of the WSNs. Section 2 research methodology and sources of articles. Section 3 Article search research includes 1) overview of the applications, management and security of wireless sensor networks. 2) Focused on improving classification algorithms, routing, and energy saving. 3) Review the developed methods of the techniques for information gathering. 4) Focused on coverage, connectivity and positioning techniques. 5) Displayed the studies that dealt with the of Internet of Things (IoTs) technology on wireless sensor networks (WSNs). 6) Illustrates the most important research that has focused on developing algorithms to increase security in wireless sensor networks.

2. Methodology

Articles that explored and searched by the keywords Wireless Sensor Networks, WSNs, WSNs survey, WSNs technologies, WSNs security, WSNs toward IoTs, IoT based on WSNs, WSNs applications". Studies on WSNs technologies and WSNs applications were accepted from the search range was controlled to those researches that written in English and they are focused on developing technologies and algorithms to enhance the implementation of WSNs and on the applications of WSNs. The digital databases applied for the articles search included: EEE Explore, a scholarly database that supplies reliable articles in electronic technologies, electrical engineering, and computer science. These databases include large amount of studies on WSNs in large range of subjects. The search was introduce in July 2020. To identify WSNs studies, we used a mix of keywords, including "WSNs", "WSNs technologies", "WSNs applications", We combined these keywords with logical terms such as OR, AND, and NOT for example " WSNs and IoTs" , Wireless Sensor Networks and Internet of Things" or "WSNs and IoT. These studies on the WSNs technologies and its applications were then mapped into a general and coarse-grained taxonomy of

three classes that were derived from a pre-survey of the literature. The exclusion criteria included the following: 1. the article is written in survey for WSNs; 2. Clustering Algorithms, Routing Protocols, and Efficient Energy. 3. Data aggregation, 4. Coverage and Localization. 5. WSNs towards IoT. 6. Security of WSNs.

3. Articles search results

In this section filtered articles were published from 2018 to 2020. After filtering found 40 papers not related to this work. The reminder of the articles are 105 in different topics on the communication components of WSNs-based technologies. The taxonomy included different categories and subcategories. The first category included 25 articles that representing Survey and Review of WSNs. Second category included 37 articles that representing clustering algorithms, routing protocols and efficient energy. Third category included 7 articles that representing data aggregation techniques. Fourth category included 11 articles that representing Coverage and Localization in WSNs. Fifth category included 8 articles that representing WSNs toward IoTs. Sixth category included 16 articles that representing WSNs security. We observed several patterns from the literature and created a taxonomy as shown in Fig. 1. We distinguished several subcategories although some overlapping areas were observed.

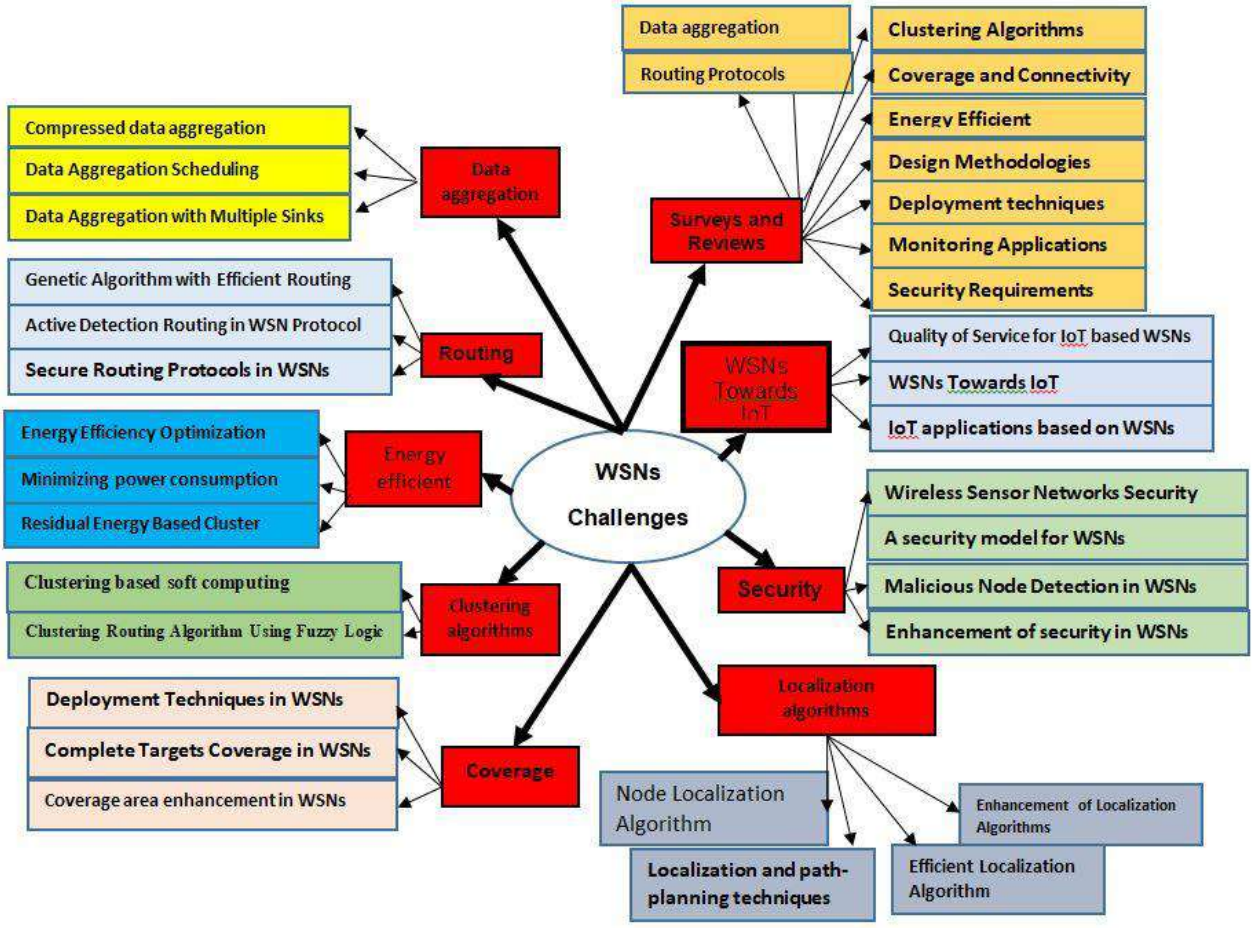

Fig. 1 Taxonomy of literature on WSNs-based technologies

3.1 Survey of WSNs

3.1.1 Applications of WSNs

Surveys and reviews objective to understand the existing thinking and defend the need for future research on areas that have been studied. The articles in this study are divided into six subcategories. [1] In this study, discussed many operating systems employed in IoT hardware for transmission and data transfer. [2] Focus on the multi-agent systems have been applied from simulated approaches like object detection/tracking, healthcare, control/assistant, and security systems to real-world applications, including medical/human-care systems and unmanned aerial vehicles. [3] Presented applications and classification of LWSN. And provide associated works of data collection methods in LWSN. [4] Focus on type's applications of wireless sensor networks can be categorized as 1) Home control applications provide control, conservation, convenience, and safety by facilitating Flexible management of lighting, heating, and cooling systems of sensing applications from anywhere in the home. 2) Medical applications: WSN technology applications are being widely explored in number of hospitals and medical centers. It includes pre-hospital and in-hospital emergency care, disaster response, and stroke patient rehabilitation. 3) Military applications: A number of companies have developed WSNs that include customizable, sensor laden, networked nodes and both mobile and Internet-hosted user interfaces. Wireless distributed micro-sensor networks consist of a collection of communicating nodes. 4) Traffic Control: Ground transportation is one of the most important and complex socioeconomic infrastructure. 5) Agricultural applications: Wireless sensor networks motivated a large number of researchers in an area called agriculture, which is another important application of WSN. In this process, the large farm area is taken into consideration as a homogeneous field. [5] This study described the general architecture and the main features of software defined networks. [6] Focused on structural health monitoring (SHM) that is plays an important role to ensure the functionality of offshore turbines, and wireless sensor networks (WSNs) help to reduce costs compared to the wire-based ones. It review for two of main parameters to deploy WSNs for SHM; data rate and bandwidth which indicate the efficiency of communication for each nodes. [7] Focus for monitoring-oriented applications (e.g., water quality on watersheds, pollution monitoring in cities). [8] Survey of UWSN regarding underwater communication channel, environmental factors, localization, media access control, routing protocols, and effect of packet size on communication is conducted. [9] Reviewed on expected to support a variety of civilian and military applications. Sensed data can only be interpreted meaningfully when referenced to the location of the sensor, making localization an important problem.

3.1.2 Security of WSNs

[10] Survey the different threats that can attack both IoT and WSNs. [11] Discuss in detail all about Wireless Sensor Networks, its classification, types, topologies, attack models and the nodes and all related issues and complications. [12] Analysis of network layer attacks deployed against the RPL routing protocol, count the impact of attacks on the performance of a network using the Cooja network simulator and discuss new research opportunities in network layer security. [13] Emphasized the importance of security requirements to raise awareness regarding them. In addition, analyzed literature that could be improved by including WSNs security requirements such as Characteristics, constraints, and threats. Analyzed various factors related to

WSNs security based on reviewing the literature and show our contribution, such as a systematic analysis framework and factor mapping compared with traditional studies.

3.1.3 Management of WSNs

[14] The purpose of this study is to enhance the indoor localization Algorithms in wireless sensor. Localization is one of the critical techniques in wireless sensor networks (WSNs). The implementation of localization can be used to determine object's position in the environments that could be applied both indoor and outdoor with several algorithms to estimates distance such as range-based and range-free and discussed the application where the location information is crucial to estimate. [15], [16], [17] Survey of various unequal clustering approaches with their objectives, characteristics etc., is presented and reviewed on cluster based routing protocols in WSNs. [18] categorize various coverage techniques into four major parts: computational geometry-based techniques, force-based techniques, grid-based techniques, and met heuristic-based techniques. To process the extracted data and transmit it to the various location, a large number of nodes must be deployed in a proper way because deployment is one of the major issues in WSNs. [19] surveys the existing various issues for solving the coverage and connectivity problems in WSNs. And discussion sensing models, classification of coverage. [20] Performs SLR for energy efficiency routing with 172 papers at initial stage. Next, 50 papers are shortlisted after filtration based on quality valuation and selection criteria by ensuring relevance with energy efficiency. [21] Address some of the existing energy efficient routing protocols for precision agriculture. [22] Present a survey of existing programming methodologies and model-based approaches for the development of sensor networks and classify existing related WSN development approaches. The main objective is to investigate the feasibility and the application of high-level-based approaches to ease WSN design. [23] The technical issue, challenges & design metric of wireless sensor network have been discussed. [24] Reviewed of the application of different machine learning algorithms in sensor data analytics within the agricultural ecosystem. [25] Survey of more than ten years with complete observation in connection of Reinforcement learning (RL) and WSN to provide better opportunities to perform significant research towards latest WSN challenges. [26] Describes WSNs architecture, topologies and highlights the types of WSN and its applications.

3.2 Refining Network Lifetime of WSNs

3.2.1. Energy Efficiency in WSNs

Energy efficiency is more crucial for WSN. Data transmission in wireless technique requires more power than data processing. When the nodes transmit large amount of data, so this need more battery power and this cause weakened rapidly. So, we must reduce the “data size” and “data merging” for aggregation ways. In energy efficient routing in WSN there are two broad classification of procedures, Clustering approach and Tree based approach. Using energy in sensor nodes to detect the environmental, data gathering and data transmission across wireless links. So, the capacity of battery of wireless sensor is restricted. [45] Explored a type of energy of battery system within a wireless sensor and suggested a centralized energy-aware routing algorithm. [46] Proposed a new idea of control for node. The proposed approach can be used for both homogeneous and heterogeneous networks and focuses on the suitable energy distribution among sensor nodes in order to enhance network lifetime and throughput. [47] Discussed the lifetime of a sensor node and minimize node

redundant data transmissions in both time and space. This thesis showed the energy efficient routing. The thesis presented and discussion for the usage of single-hop sensor networks based on topological, data-centric, hierarchical and location-based is made. [48] Developed a new energy saving WSN node for temperature monitoring in IIoT. Proposed new method of WSN node for temperature monitoring in IIoT and described the designed self-powered WSN node. [49] Reviewing around data aggregation and different techniques for energy-efficient that are used for data collection in WSN. This work proposed "binary based approach" to get best outcome. In this study a hierarchical style of aggregation are organize as the tree. The leaf represent the source nodes and the root is represent the base node. [50] This study is aimed on thermal energy harvesting based on a thermoelectric generator (TEG), enhancement of the energy efficiency. [51] This article, focus on suggested an architecture design of smart agriculture based on SWIPT enabled WSNs. And studied an energy efficiency optimization scheme for SWIPT enabled WSNs to get green communication. [52] Key goal of this thesis is to enhance routing protocols in WSNs to guarantee efficient energy usage and defend against attacks such as "energy draining attacks" directing WSNs. [53] Presented a cooperative system that transmits actuate the getting circuitry based on a swapping ON–OFF probability. Consider a WSN that all sensor nodes can possibly cooperate with each sensor node in the network. [54] Create a new protocol for data distribution in WSNs, depend on Chord protocol. Suggested DHT for best data communication to minimize the energy consumption in communication. [55] This thesis focus to apply a protocol and discussed the performance of the protocol in sensor network. Review the wireless sensor network, features, different types of topology control techniques and challenges of WSNs. [56] Present a "long short term memory recurrent neural network" (LSTM-RNN) way, to predict solar energy in the next three days based on historical solar energy collection data and environmental data and depend on results of energy prediction, selecting scheduling approach to improve the performance of WSNs. [57] The goal of the study develop solutions, which enhance the energy efficiency of wireless sensor networks yet still fulfil the requirements of monitoring applications. [58] Converge the topic of decreasing energy consuming in WSNs by using the Artificial intelligent. [59] In this study focus on mathematical tools to optimization of the energy consumption in nodes of wireless sensor and use stochastic optimization method-genetic algorithm to reduce the energy consumption of WSNs based on the rate the transmitted data. [60] Show RF transmissions by physical layer for "Long Range" interface, and presented some limitations for the Long Range Wide Area Network (LoRa WAN). [61] Presents the implementation of a configurable hardware platform for remote sensing systems based on PSoC and LoRa technology. The suggested hardware design support high performance, providing long-range communication and reconfigurable interfaces in communicating and working with several kinds of sensors. [62] Discussed techniques for Machine Learning which can support in useful and help for Working of WSNs with low cost by decrease the energy and increasing the life span of the WSNs, so machine learning helps in different WSN applications. [63] Focus on use solar energy harvesting system (EHS) for IoT end node devices to Ultra-low power. The solar cell is used as an input source. When sensor nodes failure because the power failure in the IoT and this cause information loss in IoT. So the "solar energy harvesting" is a suitable solution towards efficient energy.

3.2.2. Clustering Algorithms

Use of energy on nodes with limited energy source is main challenges in WSNs. Data transmission is the main job that decrease lifetime of node, so it is essential to balance the broadcast of data mid the network pathways. Cluster-based architecture in WSNs is the solutions to enhance energy efficiency and long network lifetime. It decreases the amount of messages communicated to the sink or Base Station. This is called Cluster Head nodes (CHs). Clustering is the choice a group of nodes in the network to create good topology. The choice of neighbors can be complete on many standards, such as, density, energy, etc. benefits of clustering is a classified set of nodes named cluster. They are gathering, handling and sending packets from non-cluster. This method gives an effective network organization. [27] Aim of this study is choice the Cluster Leader to improving the life span of the WSN. When selecting a Cluster Leader (CL), see the energy of the rest nodes and select the maximum energy nodes in each cluster and prohibition nodes those with poor energy. [28] introduced a cluster based adaptive duty cycle hybrid MAC protocol AD-MAC, for WSNs. This protocol, cluster heads (CH) are spread in L phases to decrease idle listening time. This will decrease energy consumption from idle listening and collision. [29] Aims on an efficient cluster head selection scheme that switches the cluster head position between the nodes that have greater energy level compared with other. The algorithm counts initial energy, residual energy and an optimum value of cluster heads to select the following set of cluster heads of the network that fits for IoT applications for example, smart cities, environmental monitoring. [30] Presented that Sensor Nodes communicate with each other by different Routing Protocols, and Routing Protocols can be classified into different categories in WSNs. Here, focused on the Hierarchical (cluster-based) routing protocols and analyzing their performance by simulate these protocols in Mat lab simulator to display the growth of each protocol that shows increasing the rate of extending lifetime of the network. This study focused on the routing protocols that classified based on the network structure particularly those named chain based routing protocols that the hierarchal routing protocols is one of these kinds. Within hierarchal routing protocols all nodes doing together but in dissimilar situations by spread the nodes into sets called cluster heads and each set perform its jobs. [31] Presented the key task is how to select cluster heads and route data through energy-efficient paths to destination. Proposed R-MUCH a clustering routing algorithm. It is a multi-hop version of MUCH algorithm (Multi-Criteria Cluster Head Delegation Based on Fuzzy Logic). Head nodes (CHs) send data to the sink by selecting the path with little energy consumption. R-MUCH select its next-hop. It uses fuzzy logic and relies on three factors: the distance, the node's remaining energy and the number of times the node has served as next hop. [32] Present a survey of soft computing based clustering for enhancing lifespan of WSNs. greatest soft computing based clustering ways are heuristic, stability concerns in nature. [33] Present a new method for clustering based on quantum genetic computing to ensure their balanced distribution in network. The new protocol is to ensure a proper and balanced distribution of CHs in network by avoiding the random selection of initial CHs using Quantum Genetic Algorithm (QGA) operators. [34] Proposed Hybrid Multi-hop Partition-Based Clustering routing protocol (HMPBC) which is appropriate exact environment, suitable the needs, balance network the network lifetime. HMPBC used to reduce number of forwarding via picking cluster-heads in the procedure of data communication, and to decrease energy consumption. [35]

Proposed clustering scheme based on distributed method, multi-hop transmission and displays the proposed system get improved performance of energy consumption.

3.2.3 Routing Protocols

Routing is a method for route between a source and a destination nodes. The key objective of routing protocols is determine the shortest path that bring efficient energy consumption, less delay, best quality of service to get expand the network lifetime via saving the sensors node alive more time as possible. So, WSN routing protocols can be categorized based on network structure into three major sets [30]: Flat routing protocols, Hierarchal (cluster-based) routing protocols and Location-based protocols. [36] Discussed the use of secure routing protocol to enhance security of network. Most routing protocols are work with some failures with in network and may be have insecurity. In this study suggest secure routing technique with using multi data flow topologies (MDT) scheme to protect from threats and suggest optimization methods to decrease the energy cost. [37] Discussed that an effective routing solving is distinguished via the enables the increase lifetime of the network, improve efficiency, and guarantee the best quality of service. [38] Study the energy efficient routing method with many mobile sinks and split the entire network to some clusters and analysis the effect of mobile sink number on network lifetime. Simulation outcomes display that network has top execution when mobile sink number is around 3. [39] Gives taxonomy of hierarchical routing protocols and examine the hybrid hierarchical routing protocol that is distinguish with intelligent routing protocols. Proposed usage swarm intelligence in cluster creation and their hierarchical routing to improve the scalability and robust of hierarchical routing protocols. [40] Describes a routing protocol, named "Delay and energy efficient proactive" for WSNs (DEEP) which is a hierarchical kind for shortest path and a clustering method to do aggregation. The protocol targets to provide trade-off between delay and energy consumption. [41] Discussed all routing protocols applied in WSNs. [42] Proposed a Genetic Algorithm (GA) to optimize and determine the routes among the nodes to/from the sink, decrease the energy costs. [43] Classifies the protocols for network structure and node mobility and analyzes the design necessities for routing protocols. [44] Discussion that routing protocols are playing important role to efficient communication between source and destination nodes. Selection best routing protocol provides good performance, service and reliability of a network.

3.2.4 Data Aggregation Techniques

"Data aggregation" is a gathering and aggregating the needed information. It is essential handling way for saving the energy. The key purpose of data aggregation process in WSNs is aggregate data and to keep energy in best method to network span time. "Data aggregation" reduce energy used with high efficiency. There are two kinds of aggregations. First: data collected from different sources. The second approach mixes the data from different sources in the single header forward the BS [49]. [64] Suggesting an effective data aggregation tree depend on the different clustering structure for communication and routing by applying fuzzy logic approach, Density of Node and Load cluster heads. Using routing algorithm to balance energy consumption among heads of cluster. And applied data compression techniques to decrease energy consumption. [65] In Wireless Sensor Networks (WSNs) data transmitted has great redundancy and small rank. By using the compression rate of cluster-head node to enhance data rebuilding accuracy of sink node in the domain of data collecting

in WSNs. [66] Explain data aggregation challenge in WSNs and suggest two algorithms for data aggregation with many sinks to reduce number packet through data collection: "Minimum Spanning Tree algorithm" and "Shortest Path Tree algorithm". [67-68]Discussed that a Data aggregation scheduling is a critical issue in wireless sensor networks (WSNs). This study present the less delay of "Data Aggregation scheduling" challenge using "multi-Channel Duty-cycled" WSNs, that goals to achieve data aggregation with minimum delay. [69] Suggested "differentiated data aggregation routing scheme" is to decrease energy consumption. [70] Proposed data gathering algorithm that aims to extend the network lifetime in WSNs. This algorithm initially separations the n nodes of sensor within k sets then allocates each "mobile sink" as local mobile sink and group data by sensors. Then choose best set of data group and creates a individual path forwarding via each group.

3.2.5 Sensor Deployment

Two key challenges in WSNs employed: "discovery coverage" and "network connectivity". Coverage reflects the capability of sensor network in the interest area. A connectivity reflects the reliability that collected of the information by the sensor nodes and communicated to the processing station. Sensing coverage of Field of Interest (FoI) is significant task of the "sensor nodes" in linked WSNs. FoI is covered if every place in the FoI is monitored through one sensor node at least [19]. Coverage defined as how the sensors detect activities in the area that sensors deployed. Coverage is defined as how extent each point of network is with the care of a sensor node. The aim of coverage challenge defined as: how well monitoring the objective area by sensors". Area coverage includes total area fitting to application needs. Two kinds of area coverage: full or partial coverage. Full coverage is necessary for applications that need a high degree of exactness for example "battlefield monitoring" that need full coverage but particular applications do not require full coverage it need partial coverage. Connectivity- is significant topic for WSNs. WSN is connected if each node pair can directly or indirectly connect with other. Coverage can be considered as a measure of QoS. [71] Studied this challenge to determine whether each point in part of sensor network is covered. The objective of this study is to guarantee that each slice can be monitored via at least one of the sensors. This paper studied the solutions for two types of the coverage challenge, called: k-UC and k-NC, in WSNs. [72] this study focused on the coverage and connectivity challenges, besides expanding the lifetime of the network. And categorize various coverage methods in WSNs in three kinds: coverage depend on deployment methods, coverage depend on heuristic methods, and coverage depend on scheduling methods. [73] Defines a novel coverage challenge in WSNs that goals to achieve increasing quality of coverage. [74] Focus increasing coverage area. And discovery the space in coverage area into monitoring area, that is not cover via any sensor. [75] Focus the challenge of WSN connectivity and coverage and analyze and recognition the influence on coverage. And suggest models that best solution for monitoring application. [76] Survey the advantages of energy transfer to the all goals coverage challenge and suggests a new model is Mixed Integer Linear Program (MILP). [77] The objective of this study is to discover best deployment for sensors to enhance the quality of the sensing with reduced transmission range and lifetime constraint for a specific network. This study develop essential conditions for best sensor distribution in homogeneous and heterogeneous for mobile wireless sensor network (MWSNs). Suggested algorithms are important for area coverage. It is feasible to calculate the sink location and

routing challenge simply, if deployed and locations of sensors area become known.

3.2.6 Localization scheme

WSNs is emerging technique including hybrid wireless exchange and sensing technique, and it is become essential for military, medicine, etc. Localization system must guarantee that maximum nodes in the network must localized. In some applications, just when known the location of the node, so, the node can be done the monitoring function more affective. With an unknown environment, how can get the localization of the node with best permanence. Realize the localization of the nodes in WSNs become basic challenge of WSNs. Today, a numeral of methods appeared for node localization that can be realized using "artificial Positioning" or "Global Positioning System (GPS)" that found within sensor itself. For large scale of WSNs, become the localization of the node need more effort and require more cost. In [78] this study focus on the "mobile robot-node" to create best work of WSNs by using the mobile robot's dynamic. In several IoT schemes, "sensor localization" is essential task since using physical sensing in a sensor network. [79] Suggest system for sensor localization using WLAN and APs as anchor nodes. This study developed AP signal detection technique with AP identification using a technique called "cross-technology signal detection". This develop allows us to reduce the distribution of new anchors with indoor sensor localization system. [80] Suggested new localization system of nodes depend on iterative centroid estimation. [81] Displayed key challenges of mobile anchors presented the dissimilarities among the algorithms.

3.3 WSNs towards IoT

Today a human life become more and more needs and depending on smart devices. WSNs IoT are becoming most significance now day. So, the challenges increase too and the needs to enhancement becomes more essential. [82] Display a review for employ machine learning in WSNs and IoT. [83] Suggest a new structure for running Internet of Things (IoT)-based next-generation wireless sensor networks. By using 3- layers transmission method to efficient energy communication among the nodes. [84] This thesis focus on four challenges that affected on the performance of IoT based on WSNs: High node density, node mobility, traffic heterogeneity, and integration WSNs and cloud computing based IoTs. [85] This dissertation give study of integrating WSN with Internet and provides vision for the service that different including heterogeneous traffic in the IoT-based WSNs. [86] Explain that WSN a key part that is used with IoT platforms. Main challenging task in WSNs is sensor deployment that required to be addressed. This study focused on the applications of WSN that require low delay for communicating information that sensed by WSNs. [87] Presented the integration of WSNs into IoT and the integrating WSNs into the Internet. [88] This article display five fields of applications that used Radio Frequency Identification (RFI) and Wireless Sensor Networks (WSNs) technologies in the IoT. [89] This article display IoT method for checking temperature to create maintenance in hospitals and objective is to combine and integrate minimal cost and smart sensors within large areas. This study give a complete vision for the technologies that organize the IoT architecture: the node layer, management layer and cloud-based layer for allowing remote monitoring.

3.4 Security

Additional important subject is a security of sensor nodes for data and network. Usually, security must be protection system more and stronger as possible.

Security levels must be greater than threats. If security strategies are very high, that affect the execution of the scheme. If a system applies stronger method of security that can be affect to the performance of the device which has restricted resources. So when using security techniques with WSNs we must done by selecting the appropriate level of security. Security Version is aimed does not require high security for node sensors encrypt. Developing strong security techniques to ensuring confidentiality, integrity and authentication for WSNs applications becomes more and more necessary. [52] Major goal of this dissertation is to enhance the security against attacks specially "energy draining attacks" directing WSNs. [90] This study gives solutions for limited resource to WSNs and used ARSy Framework for security. [91] Presented the using Cryptography in WSNs by RSA and Elliptic Curve and evaluation the encryption time and energy consumption as evaluation criteria. This study shows the performance of the "RSA and Elliptic" in the environment of WSNs. [92] Presented Over-The-Air Programming (OTAP) and the suggested security techniques uses asymmetric cryptography. [93] This article discussed the different security risks on routing protocols of WSNs and list several protect methods. [94] Displayed a "low power cyber-security mechanism" for WSNs monitoring applications. Proposed method can discover and separate different attacks for example "denial of sleep". [95] Developed structure for use three-tier wireless sensor networks of physical layer security. Sensing data are collected by sinks from the remote sensors helping access points. And suggested new the random geometry method to perfect the random locations and densities of the ("sensors, access points, sinks, and eavesdroppers"). This study focus on a secure transmission using two states: "Active sensors transmit" to sensing data to APs, and "active APs forward data" to the sinks. [96] Discussed WSNs are vulnerable to large scale of security attacks such as sinkhole attack. This article suggested detection method anti sinkhole attack by using "Swarm Intelligence (SI) optimization algorithm". [97] Explains WSNs design that uses multi-layered methods to provide the security. [98] Focus that a Machine Learning methods suggested to make WSNs can be capable to provide different services which can support to effective employed of WSNs in low cost , reduce energy and life span of the WSNs. [99] Suggested model of security on WSNs. The case study is for water quality monitoring in WSNs. This model can be useful when employing and maintaining WSNs. The security framework proposed to process significant subjects of security in WSNs. [100] Focus on secret and private information and security problems. The restrictions in memory, energy, and computing power of WSNs consider the key challenges of the security in WSNs. This article presents a novel security encryption for wireless sensor network. Applying this framework will give good security for sensor nodes. [101] distinguished that security playing a key function in most applications of the IoTs. This study Suggest structure for the finding and stopping attacks in the "Internet-integrated" "Constrained Application Protocol" (CoAP) environments. Main objective is detecting "Denial of Service" attacks and detecting attacks against the "6LoWPAN" and CoAP communication protocols. [102] Suggested a Channel-aware called detection threshold (CRS-A) to find "selective forwarding attacks" in WSNs to estimates the information sending performances of sensor nodes, and examined packet loss. [103] defines security topics, objectives and threats in WSNs since WSNs are vulnerable. [104] suggests authentication system that allows a remote client to best authentication processes at a time. This authentication system is fit for the WSN architecture.

[105] focus on the IoTs, and consider the detecting sensor data is significant goal of secure communication and power consumption.

4. Discussion

The key aim of this paper is to provide a latest idea of the structure of WSNs, challenges of WSNs, applications of WSNs. This study analyzes WSNs by surveying previous studies on this topic. We provide a taxonomy of these articles to support future researchers explore this area. The suggested taxonomy present several advantages. For example, the taxonomy organized the publications to some levels. A number of researchers concerned in IoT-based WSNs technologies that much research lacks an impaired organization, which leads to: inappropriate research activities. A number of research has been conducted on wireless networking of networks from a primary perspective, while other research has focused on developing WSNs capabilities. The suggested taxonomy it gives a clear research framework and management capacity, so this provides researchers with important research ideas related to the most important problems and solutions in this field. The taxonomy gives students and academics various directions for choosing a topic related to WSNs technologies. This study categorizes WSNs based on their applications and limitations that interest of researchers also to motivate customers and users to attention on this area. This classification can help researchers discover gaps and weaknesses in the literature. Fig. 2 lists distribute the papers for most significant directions in WSNs limitations, solutions and applications.

Topics	Number
Survey and Review of Applications of WSNs	**9**
Survey and Review of Security of WSNs	**4**
Survey and Review of Management of WSNs	**12**
Survey and review of WSNs towards IoTs	**7**
Improve Clustering mechanisms	**8**
Improve Routing Protocols in WSNs	**9**
Improve Energy consumption in WSNs	**18**
Improve Data Aggregation Techniques	**7**
Improve Coverage and Connectivity in WSNs	**7**
Improve localization schemes in WSNs	**4**
Improve the security in WSNs	**16**

Fig.2 various topics related to WSNs

5. Motivations

The components of communication for WSNs-based technologies have become a promising study field. This part surveys a group of 1related study that show the advantages of the topology, structure, coverage, Connectivity, localization, routing, clustering, energy efficiency, security, integration WSNs with the Internet and integration WSNs with cloud computing being used in IoTs. So the main motivation for this study is give much attention for the following requirements [57]: energy, bandwidth efficiency, quality of service, scalability, throughput, mobility, reliability.

6. Challenges and related Recommendations

In this section, we analyze the limitations of WSNs-based applications and provide some recommendations to improve the performance of the sensor networks. There are several challenges about utilizing the applications of WSNs. This part, we present the limitations of the WSNs; also we give several recommendations to improve the performance of such systems. Although WSNs-based technologies have several advantages, but may be not give the top solution for connecting WSNs to the Internet or to IoTs components. Academics or researchers face a lot of problems or limitations when employing the WSNs technologies for different applications in order to monitoring environment and with the IoTs.

We explain some main challenges for Energy efficient [45-63] to reduce energy consumption due it is more necessary to span battery life. They are defined following:

- The first challenge for all applications of the WSNs is security. For example, the data of "Personal health" and information of the business of the organizations should not be in public. So, it is necessary to keep them private and secure though transmitting above the WSNs. There are some security methods that focus to make WSNs secure, but all these mechanisms, such as authentication, encryption are not enough. The security of the data should be maintained because new security challenges grow with design new technologies, for instance, the mixing of IoTs with WSNs. Privacy: Protection of personal and confidential information has become an important customer requirement [90-105].

- Despite recent developments in the field of wireless sensor networks, WSNs still need high power from energy constrained batteries for data processing and sending.
- The wireless sensor nodes have limited memory and computational capabilities. In addition, the WSNs have been applied in harsh and inaccessible environments for a long time. Thus, the resource limitation of the wireless sensor nodes is another challenge for WSNs-based applications.
- Coverage and Connectivity: means the ability of applications to connect with the sensors, people and cloud [71-77].
- Data aggregation techniques [64-70].
- Sensor Deployment methods.
- Clustering algorithms [27-35].
- Localization approaches [ ].
- Routing protocols [36-44].

Due to these challenges, and to reduce energy consumption we present some recommendations for enhancing the performance of the WSNs:

- Using different algorithms to give privacy and security for applications of WSNs.
- Applying specific techniques to reduce the consumption of resource for the nodes of WSNs, such as, develop algorithms or techniques to get optimization.
- Using the effective computing and communication methods for the different applications of the WSNs that needs different QoS, for instance, time restriction.
- Improve Sensor deployment.
- Improve Data Aggregation Techniques.
- Improve Clustering mechanisms.
- Improve Routing Protocols.
- Improve localization schemes.

7. Conclusions

With increasing the technology speedly, WSNs is becoms more important and the sensors are nowday employ in many environment. The limited with WSNs are becomes very complex to be capable to utilize. The outcomes for these limitations are becomes essential goals for researches. This study is done on the exiting aricles in order to survey for imporant fiels in WSNs area to displaying the main problems and the solutios that are suggetion to deal with these problems. Also present the key challenges that face WSNs technologies. The main gaol for this study is to provide more clear and understand for researchres and to attract the attention of researchers and specialists in this field to many aspects and fields and a number of weaknesses and strengths. As well as reviewing the benefits of this type of network to encourage the user and try to raise the customer's confidence by adopting applications that depend on wireless sensor network technologies.

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