How WSN can be designed to be Efficient

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Abstract—**Communication is the way people can achieve creating awareness in others who need particular information so that they can respond to situations. Sometimes, the need for information can demand that communication should happen within a very short time and in efficient media so that the involved can be able to respond to it. The analysis of the functioning of the Wireless Sensor Networks (WSN) indicates the various issues that affect the communication and how it can be mitigated.**

Keywords—intelligent decision support system, Wireless sensor networks, sensor node, homogeneous, heterogeneous.

I. INTRODUCTION

Through the Wireless Sensor Network *(*WSN) communication system, individuals and groups get information that they can use to make decisions on the way they can respond to an emergency case without failure [1]. WSN is integrated in some response applications that supply real time data in the domain of defense where individuals get to understand their environment within a short time [2]. The system is able to achieve various purposes in collecting and communicating to the public for them to respond to emergency cases. However, in the use of a WSN system, there have been some challenges that have limited its efficiency in communicating information that it ought to present to the public. These limitations have led to a need to identify the problems and devise ways through which people can counter them so that communication through the WSN can be efficient. Even with the limitations that exist in using the WSN, people have continually used it to collect and pass information to the target. However, with research and implementation of the recommendations on the current form of WSN, technicians can improve it to ensure efficiency in delivery of information to the people who need it. The analysis of the strengths and weaknesses of WSN will help to determine how its new design with node-based processing and device-based routing can become more efficient than it is [3].

II. DEFINED PROBLEM OF WSN

An emergency response system needs to be in such a way that it is able to transmit information about a situation within a very short time. The emergency response system also should present proper details of the situation of emergency so that those who respond can be able to use them to make informed decision. When a system is not able to transmit the details about a situation in a place, it is difficult to be efficient and therefore, it would require to be improved so that it can present timely details. This will ensure that a person depending on it will make a good decision to respond to the situation without experiencing failure or confusion because of lack of important details about the emergency case [4].

WSN design of the Intelligent Decision Support System (IDSS) has some notable limitations that may reduce its effectiveness in the process of collecting and transmitting information. This is because transmission of information is dependent on the available bandwidth and the network traffic to have the collected data presented to the target response area. The problem of this design is that it is limited because of congestion that data causes when it is sent from different sensor nodes through the network during the process of its transfer. The sensor nodes of the system collect the information and process it so that it can be ready to transmit it to the relevant locations in the system. One of the constraints has been that although the sensor nodes are able to collect the data in the right time, it is difficult to transmit it immediately because the network used may not have the capability to handle it all [5].

Another problem of the WSN design of IDSS is that it is complicated to synchronize data that come from different locations on which sensor nodes collect and process it. When sensor nodes are not well localized, as in the case of the WSN design, there are possibilities that people will not identify easily the source of the data they receive. This difficulty in determining source of information is likely to delay the decision that people make in a case of a disaster and therefore, subject them to danger that they could have avoided [6].

The WSN has dynamisms that result from the influence of networks and environments controlled by the multi-agents systems that may result to a possible problem of transmitting information and directing it to the right target. The dynamics are likely to result to a possible distortion of communication about an emergency case that may happen in a place. The problems of the WSN design of the IDSS indicate that there are issues that people will need to address so

that the system can be more efficient than it is. For each of the problem identified, there can be a solution to them so that one can identify the issues that will enhance the efficiency of a WSN system [7].

III. SOLUTIONS

In order to ensure that the system of communication through WSN design of IDSS system is reliable, developers need to establish various measures so that they increase transmission of data. Improvement of the WSN design need to focus the problems that the current design has that cause it to fail to perform the required duties with efficiency. The solution should therefore, focus on the positioning of sensor nodes, the issues of traffic and the dynamics of the WSN [8].

The WSN design of IDSS can be improved through a system of separation of capture of environment and that of the context so that it can be able to transmit data through the network. This will mean that the work of transmission of data will become easy because it will get to the network as separate and its receiver will understand it. At the level of the network, the system can transmit the collected and separated data with ease to the target without causing delays or confusion of interpretation [9].

To avoid the network congestion, WSN design of IDSS can be in such a way that it processes data at the node level, localized at the place of receiving the response. Installation of a sensor node that will process the data at the place of its reception will ensure that it is integrated into the clients' or server's architecture. If possible, data can go to local sensor node that processes it using a mobile agent as opposed to taking it to a central processor that does the work and transmit it to different targets [10]. This will reduce the congestion in trafficking data from the place where an emergency happens to the place where people should receive it and respond to it. In order to reduce congestion of transmitting data, there will need to be a way in which the system avoids redundant messages so that they can reduce the amount of data on traffic and increase the efficiency of transmission [13]. Another way of reducing congestion and enhance faster collection and communication of data is through configuration of the WSN design so that the network can adapt to events in the environment and planning the system through use of intelligent software so that it can respond to emergency action. To ensure that WSN design can achieve its purposes efficiently, implementation of prototype that integrates various technologies so that they can test the efficiency of combining different systems to perform a task is necessary [12].

IV. CASE STUDY

In formulating and implementing a WSN emergency surveillance, there are various things that ought to be fixed in the building in which the system is installed. In such a plan, it will be necessary for installation of sensor nodes at strategic positions in the room that is under the surveillance with a WSN system device. The various points at which surveillance devices are placed are determined by the points of evacuation i.e. the doors and windows, through which individuals in the building can escape to the outside of the building as shown in Fig 1.
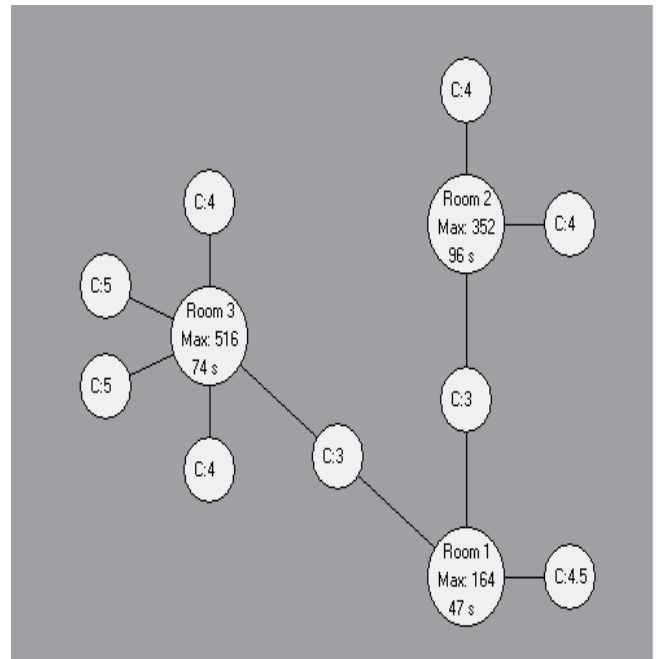

Fig 1: Evacuation decision model

In this respect, the positioning of sensor nodes of specific qualities is done in such a way that they can collect data with ease and transmit it to the homogeneous and the heterogeneous sensor nodes.This linking is done after the sensor nodes have been localized to ensure that they are able to ensure that they collect and communicate emergency data in a specific building [11].

The implementation of localization of sensor nodes happens after the building has been analyzed in terms of the evacuation points and the building is encoded in terms of direction. The sensor nodes of the heterogeneous type are fixed on the center of the ceiling while the homogeneous ones are placed strategically on the walls of the building as shown in Fig 2.

In localization of sensor nodes, an individual can use either the hexagonal or the square geometric patterns so that they are able to collect data and communicate it without failure or leaving any part of a building uncovered [11].
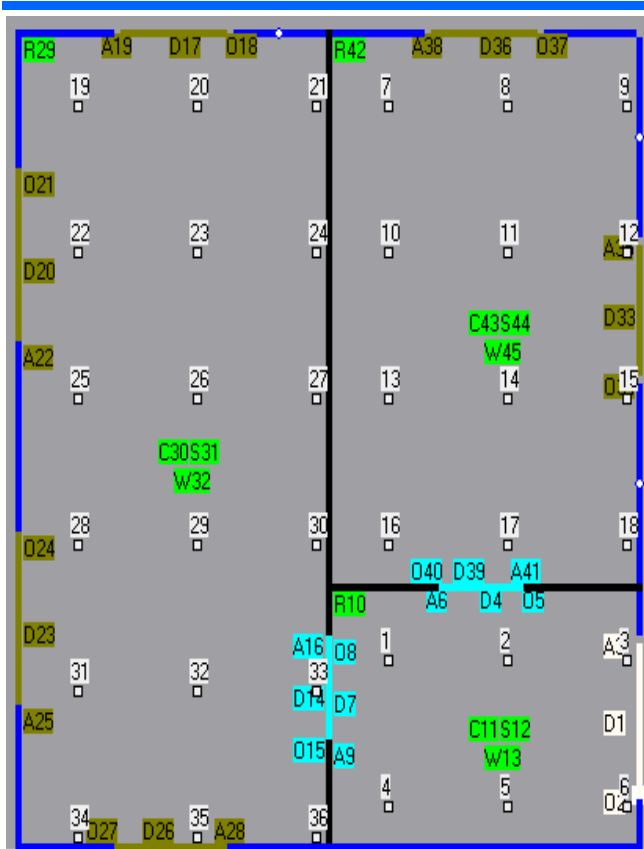
Fig 2: Building Layout and Node Location Distribution Patterns.

The incorporated sensors in the intelligent fire detector can have different spacing distances. When these differences are substantial, the sensors grouping in the same sensor node will necessarily result in sensing overlapping and also in using a greater number of sensors as can be seen from Table 1.

Table 1: Relation between spacing distance and number of sensor nodes

NLDP	Hexagon			Square		
Sp dist (m)	3	4	5	3	4	5
Number of Sensor nodes	37	30	18	36	20	18
Difference	7	12	---	16	2	---
Ratio	23.33	66.67	---	80.00	11.11	---

The increase of the number of sensor nodes when the spacing distance is reduced poses the problem of how optimal can the grouping of sensors in the sensor node be organized. Table 1 show for example, for the building layout and node location distribution patterns considered in this study shown in Figure F2, those 7 extra nodes (23.33%) will be required when sensors having a spacing distance of 4m are grouped in a sensor node with sensors having a spacing distance of 3m.

Increasing the number of sensor nodes and reducing the distance between them poses the concern of the optimization of grouping of sensors in a building so that they can achieve the required purpose. In this respect, it is important to segment a building so that it can be easy to determine the position at which sensor nodes can be placed so that they achieve the goals they are intended to. In the process of fixing the sensor nodes, the technician doing it needs to have the understanding of the overlapping of various sensors so that they can implement proper localization. The type of sensors that a person fixes in a building will determine the kind of data one will expect at any time, there can be a combination of all time active, and duty cycled sensors or each used singly. When sensors nodes are fully fixed, they are connected to the router nodes and to the network so that collection and communication of data can be achieved easily [11].

V. SUMMARY

People use various methods in communication to create public awareness of an environmental situation or an occurrence in a place so that it can trigger a specific response to them. Many systems of communication, which use different technologies, exist and each of them has a level of efficiency that informs the choice of individuals or groups who want to communicate. WSN system is one of the mostly used systems in the sector of communication of emergency cases but over time, technicians have identified some problems with it that make it inefficient in the process of communication of the appropriate data to the target. Researchers have ventured to explore the sources of the problems and they have made various recommendations on the way the system can be improved to achieve the goals it ought to. Some people have also advocated for new designs of the WSN systems so that to avoid the issues that affect and the analysis of the processes of installation has been considered as one of the issues that can improve efficiency in the use the system. The analysis of the various ways of localizing senor nodes and linking them to the routing nodes will enhance the communication. The types of sensor nodes that people use in their buildings also determines the reliability of the information they receive from the system because some of them are set to be active at particular times. The understanding of the issues of sensor overlapping and the issues related to the patterns of fixing the sensors is important in the establishing a good system that will ensure reliability and efficiency of communication of data.

VI. CONCLUSION

In communication of emergency data, the consideration of the factor of time is important to ensure efficiency in transmission. The WSN design of IDSS is one way of collecting emergency data through sensor nodes, and communicating it through networks

that has been used by many people regardless of its limitations. However, proper considerations of the causes of the inefficiency help to determine the measures that technicians can take to ensure efficient communication so that individuals involved by emergency cases can make on time decision on the best way to avoid the area of danger. The most important way of increasing the efficiency of WSN system is by reducing congestion of data in the process of communication through the relevant networks that it uses.

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