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SUSTAINABLE LOW POWER SENSOR NETWORKS FOR DISASTER MANAGEMENT

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Abstract: The wireless sensor networks that framed using the tiny sensors that are very efficient in monitoring and conveying the information's that are sensed are almost engaged in a wide range of applications with the from environment monitoring to health monitoring. The conventional wireless sensor in spite of its sensing capabilities requires lot of power to operate which in return reduces the life time of the sensors. This paves a way for the low power wireless sensor networks that brings downs the energy consumption, by setting limit on the modes of the device operation. The paper uses the low power wireless devices for the management of a manmade disaster situation such as the air pollution created by the vehicle movement in the cities. The system acts as an early warning for metro cities, with heavy vehicle flow, the industrial outcomes and the other causes that emits the poisonous gas polluting the environment. The proposed system with the low power wireless sensor networks is tested over a busy are to evince the system in terms of the battery lifetime of the system and its monitoring capability.

Keywords: wireless sensor networks**,** disaster management, sustainability, low power wireless sensors, air pollution monitoring

1. INTRODUCTION

The sensor devices are one of the recognized techniques for sensing the physical and environmental changes. They are utilized in multiple of applications such as the industrial monitoring and controlling, in the controlling of electrical systems, in human being health monitoring etc. apart from the above applications the wireless sensors are also used in variety of warning for disasters that are natural and manmade along with the proper management of the disaster occurred. The sensor serves as the key elements of the internet of things in gathering the information's. The wireless sensor network have received a significant consideration in disaster management due to its monitoring and conveying capabilities. As the world today faces a high number of disasters that are caused naturally and man-made causing huge destruction of human lives as well as the materials. So in the researches that were conducted on to find the methods to monitor the disaster lead to the wireless sensor networks that evolved from the DARPA in the year 1960s. The researcher found wireless sensor network to be very cheap and easy to set up as well as appropriate

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alternative to wired networks, when the communication between the wired networks fails due to the infrastructure collapse on the occurrence of the disaster, so the WSNs are preferred more than the other technologies. The wireless sensor despite their monitoring capabilities, the increased power consumption and the very limited battery power reduce the lifetime of the sensors. This is where the low power sensor is required in order to extend the battery life of the wireless sensor network.

The key that increases the lifetime of the WSN is the minimization of the power consumption, hence to bring down the consumed power and heighten the battery life, the wake time/active mode of the microcontrollers the transceivers and the power consumption during the sleep mode are altered. This is done by just modifying the power setting modes of the wireless sensor networks.

There are many low power wireless sensor network that are developed to reduces the power consumption and increases the lifetime of the sensors ,some of them are, wise mac [2] Telos [4], wise net etc.

The paper also concentrates on the usage of the low power sensors in the monitoring of the disaster management caused due to the air pollution in the cities due to the heavy flow of vehicles.

The paper employs the smart mesh embedded wireless sensor network (ultra- low power IEEE802.15.4E) inbuilt with the sensors of the USN4D that provide the perfect surveillance of the air pollution in the cities, that is caused by the huge vehicle flow heavy vehicle flow, the industrial outcomes and the other causes.

The remaining of the paper is planned with the related works in section 2, proposed work in section 3, results and discussion in section .4 and conclusion in section 5

2. RELATED WORKS

The entailment of the low power wireless sensor is to reduce the energy consumption of the sensor and improve its lifetime. In order to have a low power wireless sensor networks the researcher's put forth many ideas as well Min, et al [1], in his paper presented "The over view of the fundamental technologies that makes the low power sensor possible thereby to increase the lifetime of the sensors". Enz, et al [2], The article present the details for the ultra-low power wireless sensor network that incorporates the wise mac which is a low power media access control

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protocol and a complex system on chip along with the dedicated radio that is duty cycled. Polastre et al [3] “the wireless sensor network named as Telos is designed in the paper with the aim of minimizing the power consumption, reducing the difficulties in use along with the robustness for the experimentation and the deployment”

Mahlknecht et al [4] the author puts forth the wireless sensor networks in monitoring the container that act as the vital mode of transportation of the goods. Kim et al [5] the paper is about the review on the “atmospheric energy gleaning technologies such as the solar, thermal, wireless and piezo electric and their applicability in the expansion of the self-sustaining wireless applications. Wan, Z. G., Y. K. Tan, et al [6] presents the. "Review on energy harvesting and energy management for sustainable wireless sensor networks." da Silva, et al [7] presents the efficient disaster management of the wireless sensor networks that are framed with the tiny sensor for the monitoring of the atmospheric changes. coom Torfs, et al [8] the paper “implements a low power network architecture upon the 802.15.4 MAC in a frequency of 900MHz band by utilizing the capacitive MEMS strain , with the acceleration sensors with the 3Dimension monitoring capability and application specific integrated circuit for displaying the information gathered.

Deak, et al [9] the author puts forth the essentiality and the performance enhancement achieved by using the "IoTs (Internet of Things) and DfPL (Device-free Passive Localisation) in a disaster management scenario." Castillo-Effer et al [10] report the utilization of the proffered system of the wireless senor network in the flooding alerts. Okpare, et al [11] the wireless sensor network designing and implementation for the monitoring of the oil pipeline is proposed in the paper. Adeel, et al [12] the significant role of the wireless sensor networks and the internet of things in the disaster management is survey in the paper. Dhanagopal, R., et al [13] the frame work for a low power, high speed, energy efficient early landslide detection is proposed in the paper for the

3. PROPOSED WORK

The paper puts forth the air pollution monitoring in the cities engaging the low power wireless sensor as the conventional sensors would end up with the decreased battery life due to the more power consumption. So in order to bring down the power consumption the paper puts the smart mesh embedded wireless sensor networks that is built with the USN4D to monitor the air pollution caused by the vehicles with decreased energy consumption and thereby increasing the lifetime of the sensors. The fig. 1 presents the block diagram of the air pollution monitoring employing the embedded low power sensor network.

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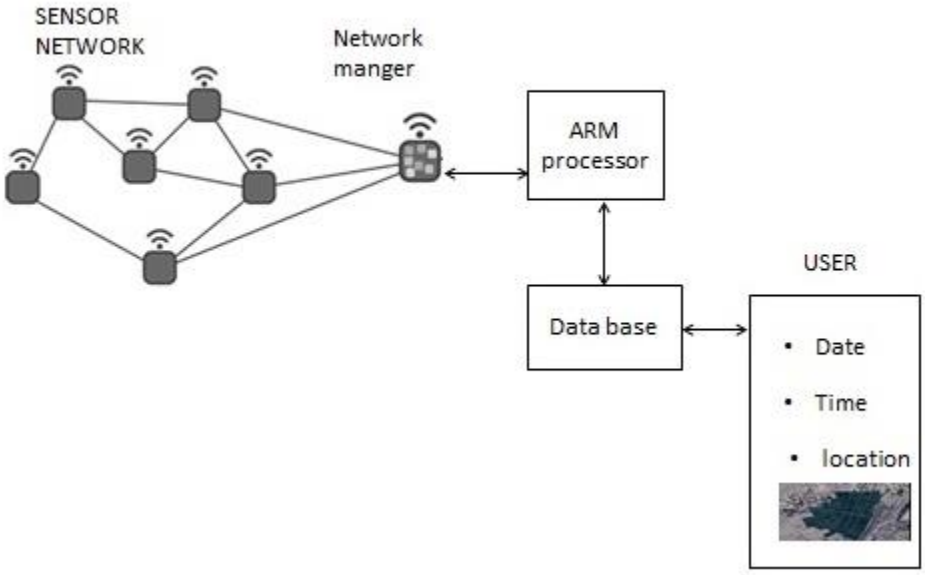

Fig.1 the Block Diagram of Proposed Air pollution Monitoring using ELPWSN

3.1. EMBEDDED LOW POWER WIRELESS SENSOR NETWORK

The Embedded low power WS-network (ELPWSN) is comprised of a self –framing multi-hop network of nodes known as the motes, these motes collects as well as conveys data, the network manager is located in it to monitors and manage the performance of the network, it takes care of the security and also the exchanging of the data with the host application. It conveys the information utilizing the time synchronized channel hopping. The nodes present in the network functions in a coordinated way and the communication in the network takes place in time slots. Allowing a low power packet exchange, channel hopping that is pair-wise allowing complete path diversity.

The network of motes built with the USN4D sensor for the monitoring of the air pollution in the cities is constructed using the data collectors that initiate the sensing of the data engaging dual sensors the Zig bee sensors and the GPRS sensors, the data base that stores the information gathered and an user interface at the end to high light the results using the map services. The USN4D sensors put to gather along with the IEEE802.15.4E network manager, low power radio design and an ARM cortex-M3-32-bit micro-processor to build an embedded low power sensor networks.

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The USN4D utilizes dual (zig bee and the GPRS) sensors as enabling and driving force respectively and the information gathered are stored in its data base. The USN4D are designed with the capability to support eleven different types of gases sensors such as the CO, CO_2, and $C_6H_5CH_3$ etc. And also equips other environmental sensor such as the temperature, atmospheric pressure and the humidity.

The monitoring is initiated twice per second and monitored data that goes above the verge level set reaches the user device along with the data, time and the position.

4. RESULTS AND DISCUSSION

The low power wireless sensor networks utilized in the monitoring air pollution in the cities is coded using the python and evaluated using the MATLAB and tested over a busy area with heavy vehicle flow. The results obtained shows that the proposed system provides a less than cent percentage data reliability , with the battery life less than 10 years along with the reduced cost.

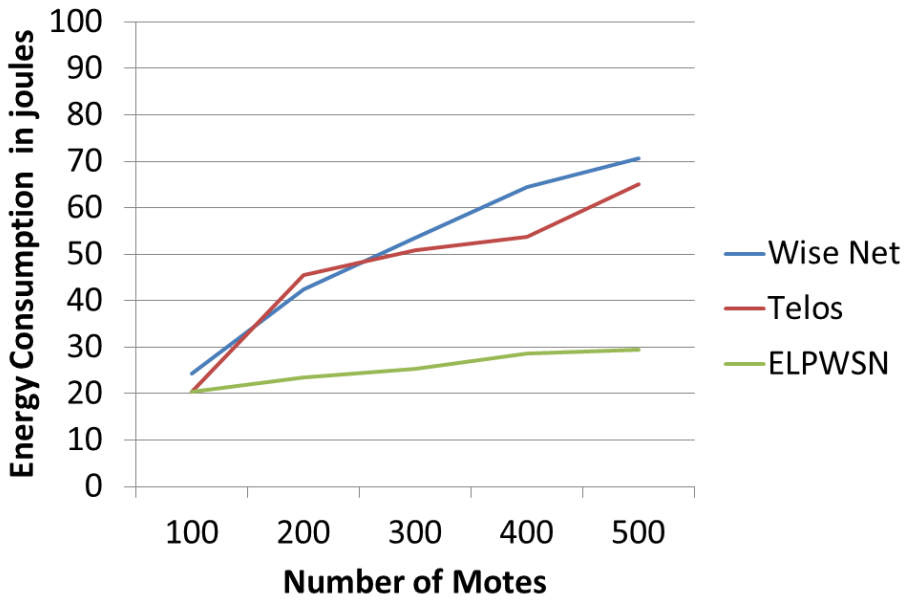

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Fig .2 Energy Consumption

The fig .2 shows the heightened performance of the proposed system of air pollution monitoring employing the embedded low power sensor networks on the grounds of the power consumption. The result also the puts forth the comparison between the ELP WSN with the wise net and the Telos showing the considerable amount of power consumption in the sensors by the ELP WSN.

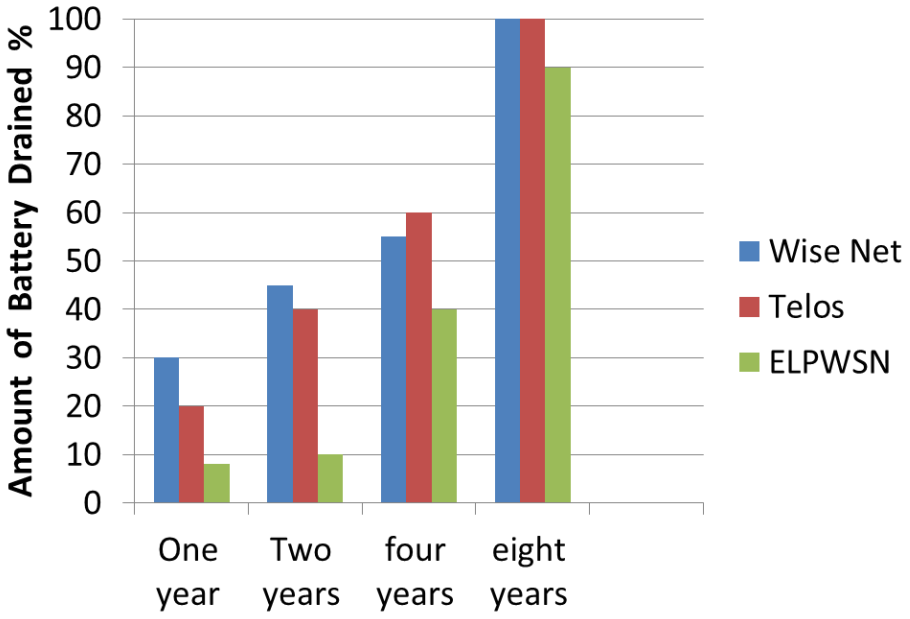

Fig .3 Battery Lifetime

The Fig.3 shows the extension of the in the battery life achieved by the proposed system than the prevailing systems, and the table.1 below provides the details of the comparison of the time duration required for providing the updates for the users along the power consumption and the information of the battery drained for ELPWSN as well as the Wise Net and the Telos.

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Parameters	ELPWSN	WISENET	TELOS
Energy Consumption %	20	60	40
Battery Status %	Less than 10 years	Less than 6 years	Less than 7 years
Time Taken to convey information (s)	.1011	2.5422	1.4538

Table .1 Comparisons of Parameters

5. CONCLUSION

This paper presents the monitoring of the man-made disaster caused to the environment by poisonous gases emitted from the industries, vehicle and the other resources polluting the air. The proposed system for the air pollution monitoring utilizes an embedded low power wireless sensor network comprised of The USN4D sensors put to gather along with the IEEE802.15.4E network manager, low power radio design and an ARM cortex-M3-32-bit micro-processor for monitoring and conveying the information with a low power consumption. The low power consumption in turn increases the battery life time. The evaluation of the ELPWSN with the MATLAB and testing conducted over a real time scenario evince the competence of the ELP WSN over the WISENET and the TELOS on the on the grounds of the power consumption , battery life time and timely updates of the information monitored.

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