Implementation & Enhancement of WSN (Wireless Sensor Network) for Environmental Research using IoT (Internet of Thing) and AI (Artificial Intelligence)

Abstract:-

Enhancement of WSN (wireless Sensor Network) for environmental research using IoT (Internet of Thing) and AI (Artificial Intelligence) is a study of enhancing WSN for monitoring Physical changes and environmental research\condition.

Now a day's IoT (Internet of Thing) and AI (Artificial Technology) are the emerging technologies in the field of computer science and engineering. WSN can be enhanced using these technologies for environmental research.

Wireless Sensor Networks (WSNs) can be defined as a self-configured and infrastructure less wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location or sink where the data can be observed and analyzed

Wireless Sensor Networks appear as a technology, which provides the basis for a broad field of applications, drawing interest in various areas

Now a days Physical and environmental condition have been quite rapid such as temperature, sound vibration, pressure, motion or pollutant and so on. This environmental condition is not only limited to surface only while the apply for different geographical location like ocean\sea or mountain etc.

Environmental challenges—rain and humidity are mostly tolerated through sealed packaging and desiccant inserts. However, some challenges were most unexpected. For example, we learned that one of the hazards for equipment left on the islands of the Eastern Shore of Virginia is that exposed cables are subject to the teeth of small critters.

Applications of sensor networks: Sensor networks have a variety of applications. Examples include environmental monitoring - which involves monitoring air soil and water, condition-based maintenance, habitat monitoring (determining the plant and animal species population and behavior), seismic detection, military surveillance, inventory tracking, smart spaces etc.

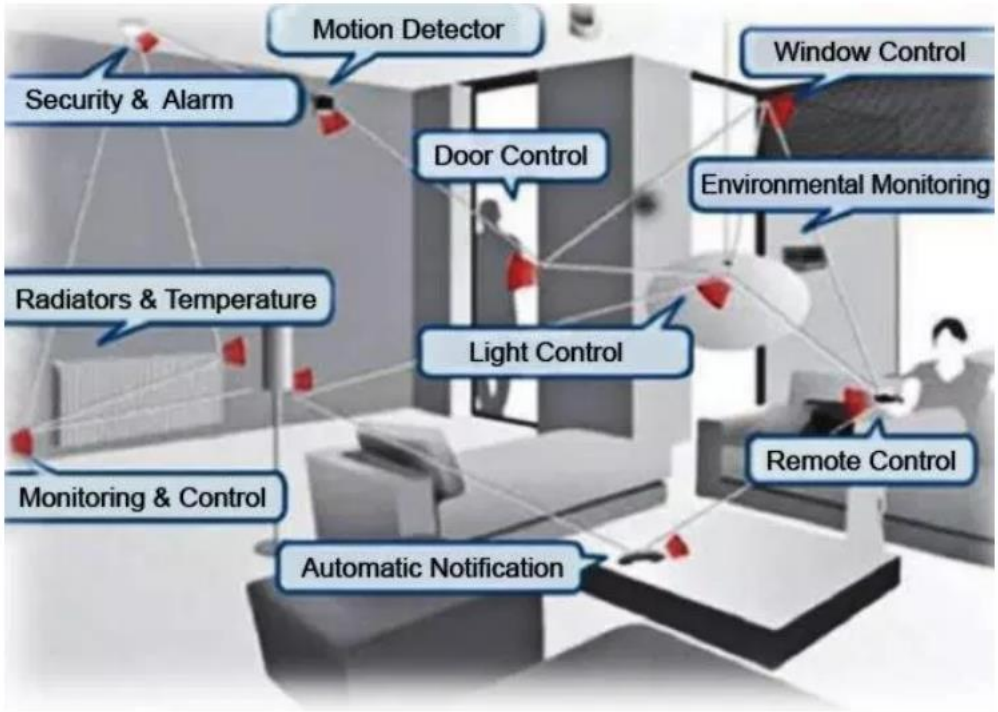
DISASTER RELIEF OPERATION - like in case of fire or similar condition.

MILITARY APPLICATIONS - As the WSNs can be deployed rapidly and are self-organized therefore they are very useful in military operations for sensing and monitoring friendly or hostile motions. The battlefield surveillance can be done through the sensor nodes to keep a check on everything in case more equipment, forces or ammunitions are needed in the battlefield. The chemical, nuclear and biological attacks can also be detected through the sensor nodes.

ENVIRONMENTAL APPLICATIONS - These sensor networks have a huge number of applications in the environment. They can be used to track movement of animals, birds and record them. Monitoring of earth, soil, atmosphere context, irrigation and precision agriculture can be done through these sensors. They can also used for the detection of fire, flood, earthquakes, and chemical/biological outbreak etc.

MEDICAL APPLICATIONS - In health applications, the integrated monitoring of a patient can be done by using WSNs.

HOME APPLICATIONS: Below picture depicts in brief:



Enhancement Area and focus:

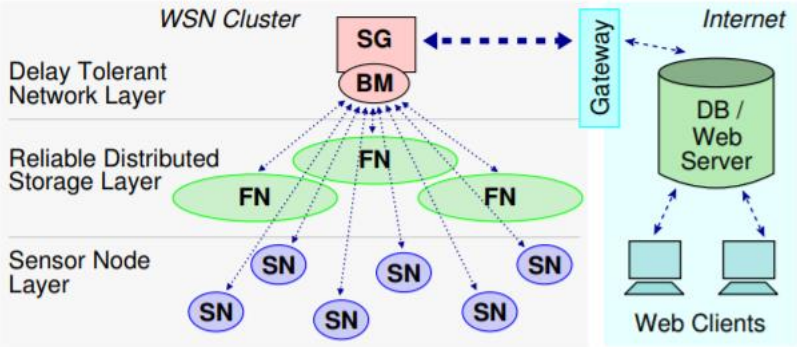
- ➔ Energy Efficiency
- ➔ Localization
- ➔ Routing

Energy Efficiency: Energy efficiency is a dominant consideration no matter what the problem is. This is because sensor nodes only have a small and finite source of energy. Many solutions, both hardware and software related, have been proposed to optimize energy usage.

Localization: In most of the cases, sensor nodes are deployed in an ad hoc manner. It is up to the nodes to identify themselves in some spatial co-ordinate system. This problem is referred to as localization.

Routing: Communication costs play a great role in deciding the routing technique to be used. Traditional routing schemes are no longer useful since energy considerations demand that only essential minimal routing be done.

LUSTER's hierarchical architecture.



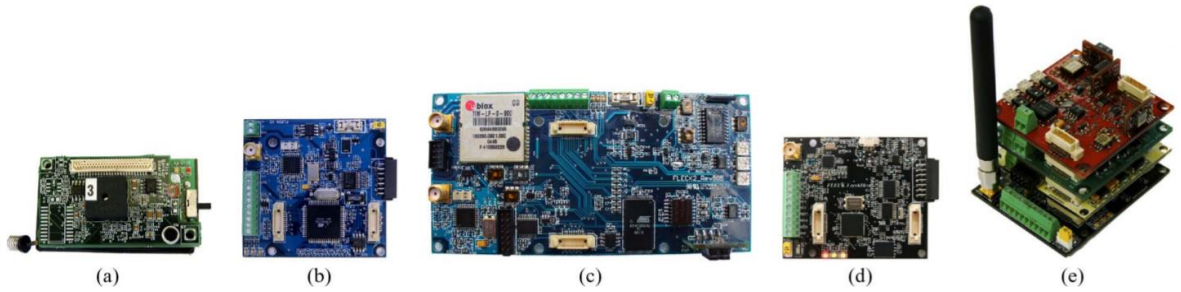
Sensor Queries and Data Extraction

LUSTER requires time-synchronized periodic sampling of the environmental sensors deployed, for which a number of data management protocols are available. To support deployment validation using the SeeDTV, however, we additionally require the capability of issuing queries from devices inside the network.

Major Sensor Network Deployments.

ID	Application	Unique Challenges	Lessons	Deployment	Year	Hardware	Software	Size	Network Protocols
A	Micro-climate	Proof-of-concept		Lab outdoors (Stage 1)	2005–2007	Fleck1C	TOS 1.x	25	ZTDMA
B*	Cattle monitoring	Static/mobile nodes	Flooding not scalable, network management difficult	Farm (Stage 1)	2005–2006	Fleck1C	TOS 1.x	28	ZTDMA
C*	Ground water quality	Long range low-power wireless communications (>1km)	Link layer retransmissions beneficial	Burdekin	2006–2007	Fleck3	TOS 1.x	9	MintRoute
D	Testbed	Self-maintained operating system	Link quality based communication benefits	Lab outdoors (Stage 2)	2006–2009	Fleck3, Fleck3B	FOS	45	Diffusion, LQ
E*	Virtual fencing	Localisation and actuation, static and mobile sensor network integration	Threaded OS more productive, trade-off between hardware features and range	Farm (Stage 2)	2007–2009	Fleck 3, Fleck Nano	FOS	80	Diffusion
F*	Rain forest micro-climate	Non-line-of-sight low-power communication, low energy harvest	Solar energy limitations, radio transmission in dense foliage	Springbrook (Stage 1)	2008–2009	Fleck3	FOS	8	LQ, LPL
G*	Water quality at different depths	WSN - robot integration, low-power wireless communication over water	Challenges of wireless communications on floating nodes	Wivenhoe (floating)	2008–2009	Fleck3	FOS	50	LQ, LPL
H	Environmental impacts monitoring	Solar power base-station		Wivehoe (catchment)	2009	Fleck3B	FOS	55	LQ, LPL
I	Biodiversity monitoring	System energy		Springbrook (stage 2)	2010	Fleck3B, multimedia nodes	FOS, Visual DSP++	55	LQ, LPL

Environmental Wireless Sensor Networks



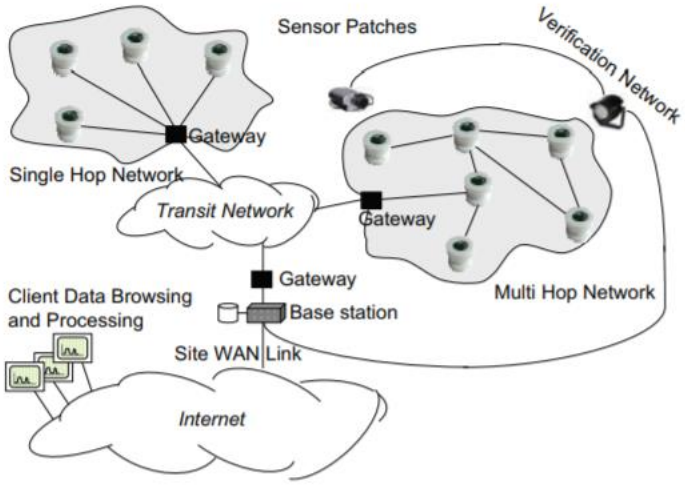
Evolution of CSIRO WSN mote platforms. (a) Mica Mote. (b) Fleck 1c. (c) Fleck 2. (d) Fleck 3. (e) Fleck 3b stack.

Lake Water Quality Monitoring

The purpose of this deployment was to measure vertical temperature profile at multiple points on a large water storage that provides most of the drinking water for the city.

Lake deployment. Robotic boat in the foreground and a floating node in the background.

System architecture of Wireless Sensor Network deployed on Island:



System architecture of the Wireless Sensor Network deployed on Island

WIRELESS SENSOR NETWORKS (WSN) TOPOLOGIES

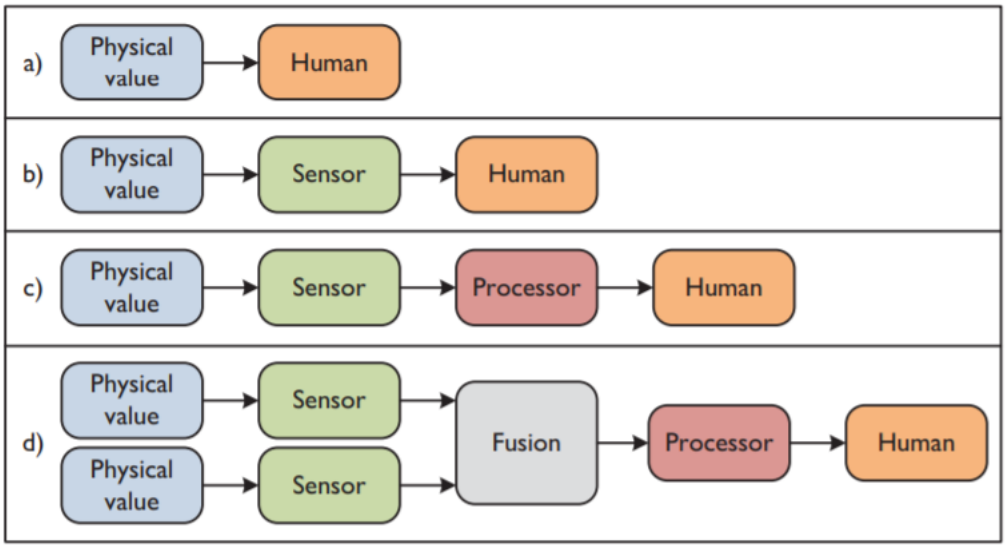
- Point to point network
- Star network
- Tree network
- Mesh network

END-TO-END SOFTWARE SOLUTION

Our end-to-end WSN software solution has evolved to conveniently present data to the end user (the ultimate purpose of a WSN) and to automate recurring tasks that are common to all deployments. It is the culmination of our numerous real-world deployment experiences, mainly outdoor solar-powered deployments, and substantial software development effort.

Ongoing Technical Challenges The field of sensor networks has become very popular in many ways due to the breadth and depth of its technical challenges. In moving to an environment free of fixed communications infrastructure, and introducing significant constraints around energy and computational resources, much of the standard thinking around communications, networking, operating systems, hardware platforms, and sensing has had the opportunity to be rethought from first principles

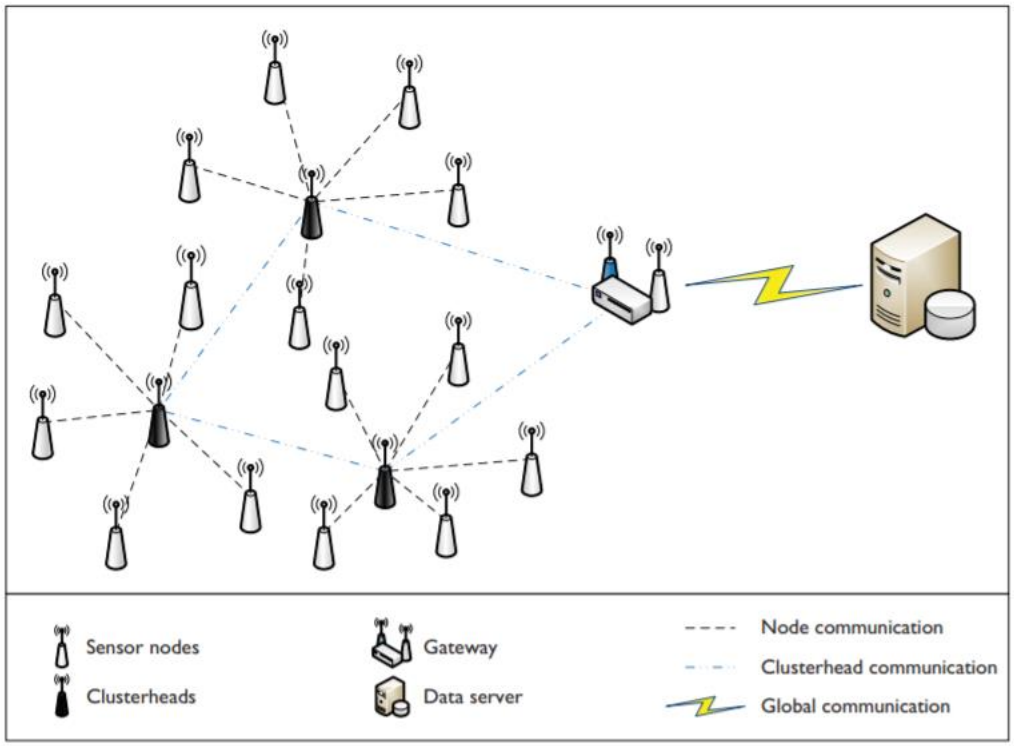
The rapid development, enhancement miniaturization of sensor devices, and the recent advances in wireless communication and networking technologies, are allowing scientists and engineers to develop networks of small or medium sensors that can be used to continuously monitor the health and stability of the environment we live in.



Evolution of sensing

Evolution of sensing:

Typical network architecture of environmental monitoring application under scope



Typical network architecture of environmental monitoring applications under scope

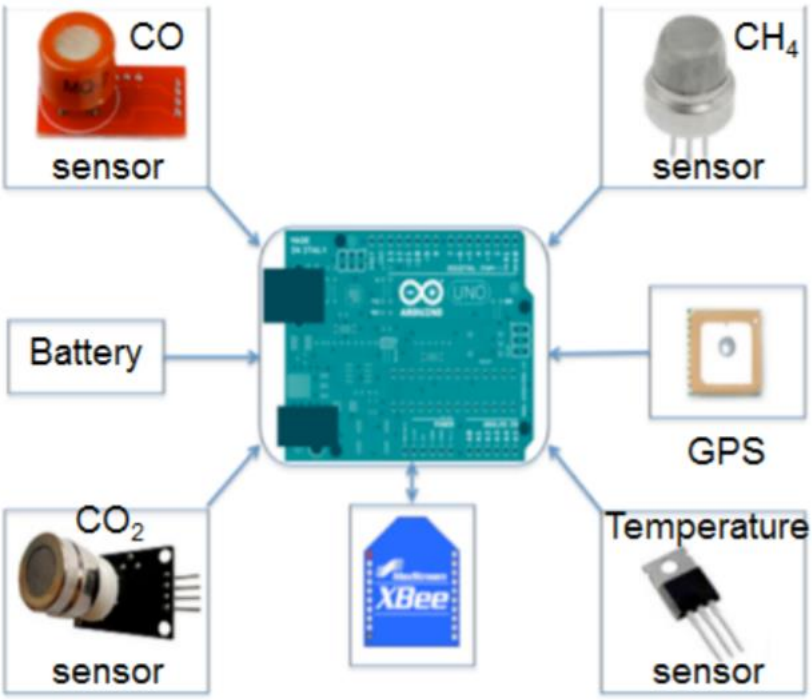
The application of WSN for environmental monitoring has been studied in the literature. For example, WSNs were used to gather forest temperature data and the amount of rainfall. A multimodal environmental monitoring system built for microclimate and pest monitoring in olive groves, was introduced. In this paper, we present the implementation and testing of a real time environmental monitoring system using wireless sensor networks, capable of measuring temperature and environment gas concentration levels including CO, CO2 and CH4 levels. The network consists of two nodes and a base station however we can consider the further enhancement and development and advancement gradually as we proceed further.

WSN Network Architecture:

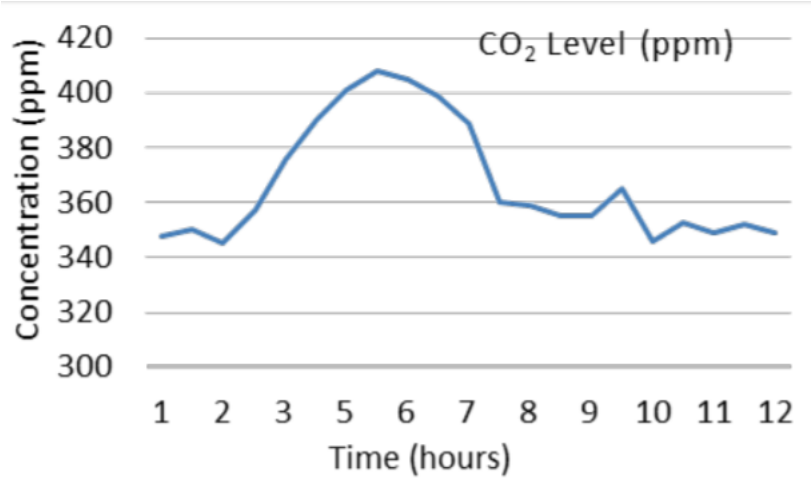
Transmitter Node:

To achieve a power efficient and robust network, open source and low-power consumption hardware were used to implement the transmitter. The structure and design of the transmitting nodes can vary as per the suitability.

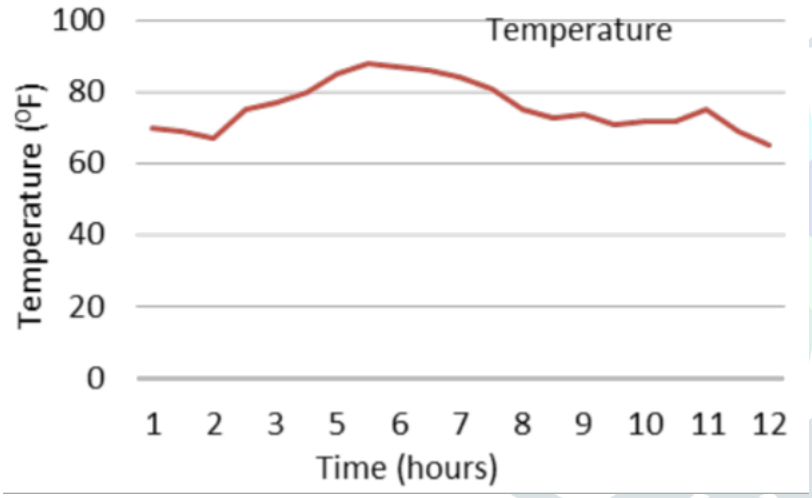
The Below diagram show the structure of structure of transmitter node:



Monitoring concentration of CO2 level (PPM)



Monitoring temperature and its variation (F)



4. Research Objectives

The objective of this research is to enhance WSN and remove various shortfalls and flaw which can lead to monitor physical and environmental changes in better and in an efficient way. Abrupt environmental change leads into the negative direction which not only harms our geographical environment while it impacts negatively on the respective habitats as well.

To study develop\enhance and design a WSN to monitor this environmental change.

To design a robust solution and low cost high effective WSN solution to monitor the environmental condition.

To study about the behavior of habitats and surround environmental changes using low cost high efficient WSN.

5. Scope of Work.

In the research scope I have brought a robust and efficient design WSN using the emerging technologies like IoT (Internet of Thing) and AI (Artificial Intelligence).

6. Research Questions

Research Question 1: What is the level of awareness of IT system and management in business managers required to meet the present-day challenges?

Research Question 2: To what extent different standards in management practices are used?

Research Question 3: What are the approaches taken for people learning through ICT?

Research Question 4: What are the methods of rewarding best performance in a research organization?

7. Original contribution by the thesis

Original contribution has been made by many research scholar and have been taken the next steps from there to accomplish this existing thesis.

8. Methodology of Research, Results / Comparisons

This survey-based study was conducted in a particular geographical environment for various age, time and duration and it has been found changes and frequencies occurred as given in very rapid manner.

9. Specific demographic information of the sample

Specific demographic information of the sample is given as in below table:

Environment Age	Frequency	Precentage
0 to 10 years	99	25.6
11 to 20 years	150	38.9
21 to 30 years	72	18.7
31 to 40 years	42	10.9
Above 40 years	23	6
Total	**386**	**100**

10. Achievements with respect to objectives

The implemented idea has been getting implemented in real life successfully with expected result which has led to reduce the fraud online transactions.

11. Conclusion

So, research shows that using the idea provided \implemented is efficient and robust in order to monitor physical or environmental condition.

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