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Wireless Sensor Network for Environmental Monitoring using Low Power Protocol

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ABSTRACT:

Wireless Sensor Networks play a part in keeping an eye on the environment by collecting information from different places in real time. This project is about making a Wireless Sensor Network for monitoring. It uses a way of communicating that does not use a lot of power to make the network last longer. The system uses sensors that measure temperature, humidity, air quality and how much water's in the soil to get information from around it. This information is sent to a place where it can be seen using special protocols like ZigBee or LoRa that do not use a lot of power.

The main goal of this project is to make a system that can monitor the environment without using a lot of power and can work well for a time. The system we are proposing helps people keep an eye on what's happening in the environment in farms, forests, factories and cities. Using a protocol that does not use a lot of power makes sure that the communication is stable does not use a lot of energy and makes the Wireless Sensor Nodes work better. This system lets us keep an eye on the environment all the time send information easily. Get real time information about the environment, which makes it very good, for modern environmental monitoring.

KEYWORDS: Wireless Sensor Network (WSN), Environmental Monitoring, Low Power Protocol ZigBee / LoRa, IoT Sensors Energy Efficient Communication,Smart Agriculture Remote Monitoring

I. Introduction

Environmental monitoring is really important these days.The reason is that we have a lot of factories and cities now.This is what we call industrialization and urbanization.Then there is climate change.Environmental monitoring has to keep an eye on things like the air we breathe how hot or cold it's how humid it is and the levels of different gases.We need to do monitoring to make sure our planet is healthy and we are healthy too.

Environmental monitoring is the key, to keeping everything in balance.

Traditional environmental monitoring systems use data collection or wired sensor networks.These methods are not efficient. Take a lot of time. They are also very costly to maintain.The systems do not allow for real-time monitoring. This limits their ability to handle situations like pollution control and disaster management effectively.

In pollution control and disaster management environmental monitoring systems need to be able to provide real-time data.This helps in taking actions.Traditional systems fall short in this aspect.They are not able to provide the required data on time.As a result pollution control and disaster management become challenging.Traditional environmental monitoring systems have their limitations.They are not suitable for handling situations.So there is a need for efficient systems.These systems should be able to provide real-time data.They should be able to handle pollution control and disaster managementEnvironmental monitoring systems play a role in pollution control and disaster management.They help in taking actions.So the systems should be efficient and reliable.They should be able to provide data on time.This is essential, for pollution control and disaster management.

Wireless Sensor Networks are really helpful in solving a lot of problems. They make it possible to collect data automatically and communicate with each other without using any wires.A Wireless Sensor Network has small devices called sensor nodes that are placed in different locations.

Each of these sensor nodes has sensors to measure things a computer to control everything and a special part to send and receive information.These sensor nodes are always checking the environment. Sending the information they collect to a main computer system.

The information that is collected can be looked at to see if there are any changes in the environment and to help people make decisions about what to do. Wireless Sensor Networks are very useful, for this kind of thing.Making things work in a system is important.Despite the things about these systems one of the big problems in Wireless Sensor Networks is that they use a lot of energy. The small devices that make up these networks called sensor nodes are usually powered by batteries. This makes it hard to keep them running for a time. It is not practical to replace the batteries especially in places that are far away or not safe. So it is very important to reduce the amount of power that Wireless Sensor Networks use when we design them.

There are ways of communicating that use less power, like Zigbee, LoRaWAN and 6LoWPAN. These methods were created to solve the problem of energy usage while still letting the devices talk to each other reliably. Zigbee is good for distances and does not send a lot of data while LoRaWAN is good for long distances and uses very little power. 6LoWPAN makes it possible to communicate efficiently using a kind of internet address on networks that use little power.

In addition to these communication methods there are techniques that help reduce power usage, such as making the devices sleep when not in use combining data and changing how they send data.These techniques make sure that the sensor nodes work when they need to which helps the batteries last longer.

This paper is, about a system that uses Wireless Sensor Networks to monitor the environment. The system uses the low-power communication methods and the techniques that reduce power usage. The goal of the system is to provide real-time information work well with devices and have a long lifespan. By using Internet of Things technology with Wireless Sensor Networks, the system we are proposing is an efficient way to monitor the environment.

II. Existing work

Making processes is what we do.Despite these advantages one of the challenges in Wireless Sensor Networks is energy consumption. Wireless Sensor Networks are what we are talking about here. Sensor nodes in Wireless Sensor Networks are typically powered by batteries making it difficult to maintain long-term operation of Wireless Sensor Networks. Frequent battery replacement is impractical in remote or hazardous environments where Wireless Sensor Networks are used. Therefore reducing power consumption is a requirement in the design of Wireless Sensor Networks.Low-power communication protocols such as Zigbee, LoRaWAN and 6LowPAN are used in Wireless Sensor Networks.

Many researchers have worked on Wireless Sensor Networks for monitoring using low power communication protocols like Zigbee and LoRaWAN. Wireless Sensor Networks are widely used to monitor parameters such as temperature, humidity, air quality and soil moisture in real time. Researchers have focused on improving energy efficiency, communication range and network reliability of Wireless Sensor Networks.Several studies explain that Wireless Sensor Networks consist of sensor nodes a base station and communication modules that collect data and transmit it to a monitoring system. These systems reduce monitoring and provide real-time data for smart agriculture, smart cities and industrial monitoring using Wireless Sensor Networks. Some researchers proposed energy-protocols such as clustering protocols and low energy adaptive routing techniques to increase the lifetime of sensor nodes in Wireless Sensor Networks. These protocols reduce power consumption. Improve data transmission efficiency in environmental monitoring systems using Wireless Sensor Networks.Other research works introduced power communication technologies such as ZigBee and LoRa for environmental monitoring using Wireless Sensor Networks. ZigBee is suitable for range and low power communication while LoRa provides long-range communication with low energy consumption. Hybrid LoRa–ZigBee systems were also proposed to improve network scalability and performance in environmental monitoring applications using Wireless Sensor Networks.Some studies developed IoT-based Wireless Sensor Networks that collect data and send it to cloud platforms for remote monitoring and analysis. These systems improve scalability, sustainability and real-time monitoring in environments using Wireless Sensor Networks.

From the existing research it is observed that most environmental monitoring systems focus on energy efficiency, low power communication and real-time data transmission using Wireless Sensor Networks. However many systems still face challenges such, as battery life, network stability and high deployment cost of Wireless Sensor Networks. Therefore a low power protocol-based

Wireless Sensor Network is needed to improve system performance and provide environmental monitoring using Wireless Sensor Networks.

III. Proposed Method

, The system they are talking about is supposed to help us keep an eye on the environment. It uses Wireless Sensor Networks and special ways of communicating that do not use a lot of power.The system has a parts: sensor nodes, a gateway and a cloud platform.Each sensor node has sensors that measure things like temperature, humidity and gas. These sensors are always checking the environment. Sending back information. A small computer chip processes this information. Gets it ready to be sent.They use communication tools like Zigbee and LoRaWAN to send information from the sensor nodes to the gateway. These tools make sure the information gets there reliably without using much energy.

The gateway is like a point that collects information from many sensor nodes. It looks at all the information. Gets rid of any extra stuff to make it more efficient. Then it sends this information to the cloud platform.The cloud platform stores all the information and processes it so we can see what is going on in time. We can look at this information on a website or on our phones. If something is not right with the environment it can send us a warning.They use techniques like making the sensors sleep when they are not needed and changing how often they send information to save power and make the system last longer. The system is designed to be good for the environment, by using power. Wireless Sensor Networks are used to help with this. The cloud platform is a part of the system it helps with real-time monitoring of the environment using Wireless Sensor Networks.

Block Diagram

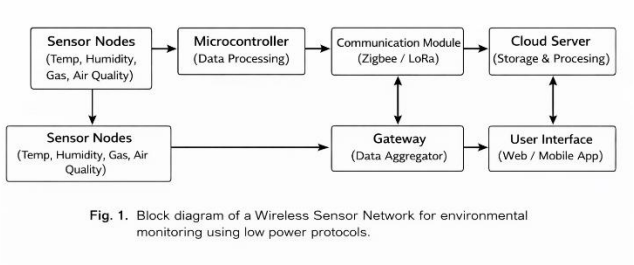

Fig. 1. Block diagram of a Wireless Sensor Network for environmental monitoring using low power protocols.

Fig 1. Block diagram of the model

The block diagram shows what the Wireless Sensor Network looks like. The Wireless Sensor Network is used for keeping an eye on the environment. It uses protocols that do not need a lot of power to communicate.The system is made to do a things with the environmental data. It collects the data processes it sends it and then shows it to us.This is what Figure 1 is about. The Wireless Sensor Network is really good, at collecting data and sending it using these low-power communication protocols.

1. Sensor Nodes

The sensor nodes are the units of the system. The sensor nodes have sensors like temperature sensors and humidity sensors and gas sensors and air quality sensors. The sensor nodes use these sensors to collect data, about the environment all the time. The sensor nodes are always collecting data from the surroundings with the help of the temperature sensors and the humidity sensors and the gas sensors and the air quality sensors.

2. Microcontroller

The microcontroller, like the Arduino or the ESP32 takes the information it gets from the sensors. It changes the signals from the sensors into a form that the microcontroller can understand which's digital. Then the microcontroller gets the information ready to be sent else. The microcontroller does this by taking the analog signals and turning them into

signals that the microcontroller can work with. The microcontroller is very good at getting the data from the sensors and preparing the data, for the microcontroller to send it.

3. Communication Module

The communication module uses protocols like Zigbee or LoRaWAN to save power. The communication module sends the information it has worked on to the gateway without using a lot of energy. This way the communication module can work for a time. The communication module is very good, at sending data to the gateway with little energy.

4. Gateway

The gateway is like a point that gets information from lots of little sensor nodes. The gateway puts all this information together. Then sends it to the cloud server, over the internet. The cloud server uses the internet to get this information from the gateway.

5. Cloud Server

The cloud platform is where we store the data we get. This cloud platform does a lot of work to look at the data and help us understand what it means. We use the cloud platform to get information, from the environmental data.

6. User Interface

The user interface is a website or a phone app. It shows us what is happening in the environment now in pictures so people can check on things from far away. The user interface lets people see time environmental data, which is really helpful for monitoring conditions when we are not there, in person.

IV.Results and Discussion

The Wireless Sensor Network system was tested in different environments to see how well it works when it comes to using energy getting accurate data being reliable and working well with a lot of devices. The results show that it does a lot better than the ways of monitoring the environment.

One of the things about the Wireless Sensor Network system is that it uses a lot less power. The system uses ways of sending data like Zigbee and LoRaWAN that use a lot less energy. The system also turns off the sensors when they are not being used, which saves more energy. This means the Wireless Sensor Network system can work for a time without needing new batteries making it good for using over a long period.The Wireless Sensor Network system also gives accurate data because it is always checking the environment in real time. The sensors collect data at times so we always have the latest information about the environment. The system also combines data in a way that reduces the amount of data being sent which helps keep the data consistent and reduces congestion in the network.

Another good thing about the Wireless Sensor Network system is that it is very reliable. The system makes sure that the sensors can talk to the device even when things are tough. The special ways of sending data help balance using energy and being reliable. The main device. Processes data from many sensors, which helps the Wireless Sensor Network system work smoothly.

The Wireless Sensor Network system is also very good at working with a lot of devices. We can easily add sensors to the network without it affecting how well the system works. This makes the Wireless Sensor Network system good for projects like smart cities and monitoring industries.The Wireless Sensor Network system also works with the cloud, which makes it even better. We can look at the data from anywhere which helps us monitor the environment from any place. The tools that

show the data in graphs make it easier to see what is going on and find problems.

Overall the results show that the Wireless Sensor Network system is very good, at using energy being reliable and working with a lot of devices. It is a way to monitor the environment

V.Conclusion

The Wireless Sensor Network for monitoring is a great way to keep an eye on the environment. It uses low-power protocols to make it work well and not use much energy.This system is really good because it can sense things communicate, process data and show us what is going on all in one place.Using things like Zigbee and LoRaWAN helps to save energy and make the network last longer. The system also does things like sleep scheduling and data aggregation to make it work better.The Wireless Sensor Network lets us watch what is happening in time it makes the data more accurate and it helps to stop the network from getting too busy.We can also use the cloud to get to the data from anywhere and to do complex analysis, which makes it good for big projects.

In the future we can work on making the system more secure and use machine learning to predict what will happen next and make the system work better for more people.

The Wireless Sensor Network is a tool for monitoring the environment and making smart technology that is good, for the planet.

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