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Review on Use of Wireless Sensor Network To Overcome Agricultural Problems of Pakistan

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ABSTRACT

Wireless sensor networks are the communication of small sensing el- ements which collaborate with each other to collect process and communicate over wireless channel information about some physical phenomena. These self- managing, highly robust and energy efficient networks can be excellent means for monitoring underground mining, wildlife and various physical infrastruc- tures such as bridges, pipelines, and buildings. This paper introduces wireless sensor networks to address specific problems in agriculture system of agricul- tural countries like Pakistan and discusses WSN's usefulness to overcome those problems.

Keywords. WSN-Wireless sensor network, I/O: Input Output Devices, pH: Power of hydrogen

1. INTRODUCTION

Developing countries have a multifaceted challenge in utilizing and maintaining re- sources most dear to them.

While the causes of inefficient utilization of resources are complex and their remedies may not be straightforward, we motivate the use of smart micro-electronic devices to deal with those problems which require duly reporting of properties of a certain physical phenomena. The smart devices interface with the physical world creating a profound flexibility for awareness and remote controlling. They are characterized by their little demand for attention from human operators, their capability of self- management; operation in adverse places and near the occurrence of the actual phenomena; great accommodation of node mobility or failure; and effective node cooperation in order to carry out a distributed sensing task.

2. PROBLEMS

There are several problems in agriculture system of Pakistan that exist since ages. The agriculture cycle is similar to any accounting cycle or life cycle of economics that is what you produce should be re-invested as well in order for the cycle to continue.

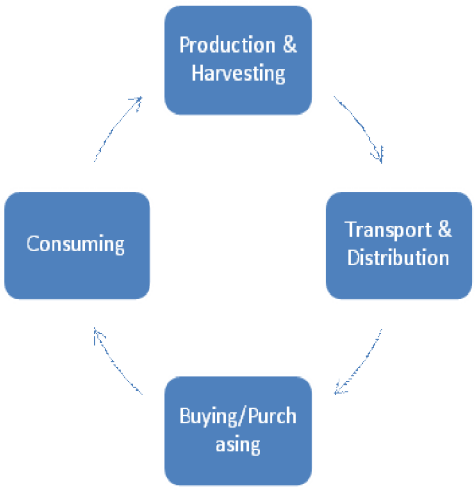


Fig 1: The agriculture cycle

Being a land lord is not an easy business. You need to monitor each and every process carefully and take measures accordingly. Not all but some of them are given below and may give you a clear picture

1. Water is one of the basic necessities of the cultivation process. Too low or too much both may cause harm full effects by which we mean flood- ing and drought.
2. Some farmers may also play a monopolistic approach and make alliance together to take most of your water through political influences as well which is common in Pakistan
3. The mill owners are a nightmare too. They might buy your harvested product for a very price they can and they might get allied to ruin your profit margin. In order to fix this problem the government then has to set a price floor to save the farmer's profit.
4. The government may help you to some extent by providing price ceiling or price floor but even when you do not get the desired profit.
5. Agriculture in Pakistan still follows a Tapedaar system. There is a man- ager who looks after the farmer's land often called a Tapedaar. He coor- dinates with mill owners as well and is incharge of accountability of production and re- investment.
6. Whatever you harvest, some ratio of it belongs to the farmers in addition to their wage.
7. If the Tapedaar makes alliance with the farmers actual profits are not shown.

So if this system is closely monitored by using WSN these problems might be solved.

3. WIRELESS SENSOR NETWORKS

WSN consist of four main components: A radio, a processor, sensors and battery. A WSN is formed by densely deployed sensor nodes in an application area. In most deployments, the sensor nodes have self-organizing capabilities, to form an appropri- ate structure in order to collaboratively perform a particular task. The Sensor Node, which is a basic element of Wireless Sensor Network, is composed of Sensing, Co m- putation and wireless Communication unit. These sensor nodes are hence capable of observing physical phenomenon, process the observed and received information and communicate the observed or processed information to the nearby sensor nodes to form a n

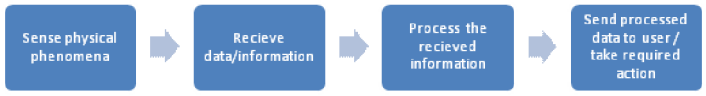


Fig 2: General Process flow of a sensor

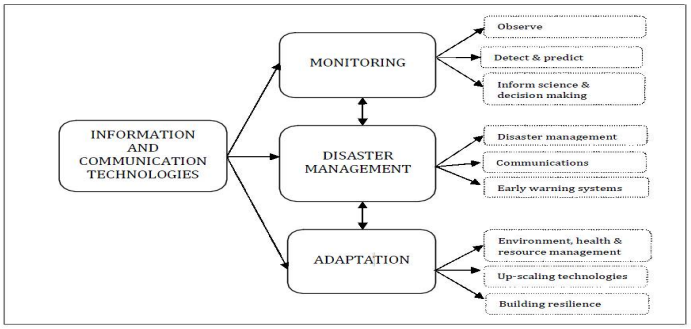


Fig 3: Applications of WSN

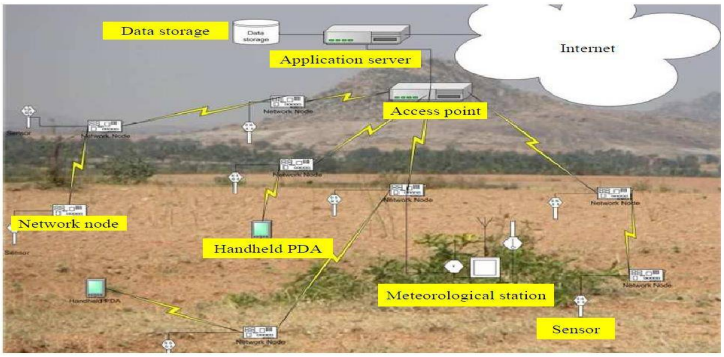


Fig 4: Generic Model of WSN

A WSN typically consists of large collections of nodes performing local processing,

Communicating wirelessly to form networks. Individually, each node is autonomous and has a short range~ collectively, they are cooperative and effective over a large area. The typical elements are:

- **Sensors:** Sensors with harvested or stored power sources for collecting and transmitting information about the surrounding environment
- **Access Network:** Sink nodes collecting information from a group of sensors and facilitating communication with a control centre or external entities
- **Middleware:** Software for the collection and processing of the data
- **Applications Platform:** A technology platform for effective use of a WSN
  for a particular application

One of the main advantages of WSNs is that they can be deployed in almost any kind of terrain where it might be impossible to use traditional wired networks, require little

human interaction, are scalable and offer many advantages over long range remote sensing technologies. Developing countries have been identified as major beneficiar- ies of WSNs in the field of environmental monitoring as they are most at risk from climate change

4. USEFUL FUNCTIONS OF WSN

Following are some useful applications of WSN in agriculture

a) Rainfall and Landslide Monitoring
b) Fire Monitoring
c) Flood Monitoring
d) Monitoring Impacts on Agriculture
e) Participatory Monitoring

5. PROPOSED NETWORK ON ZIGBEE

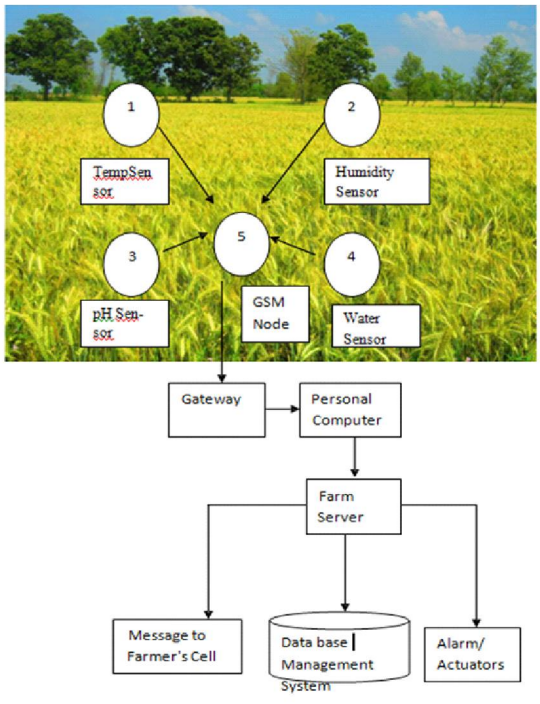


Fig 5: The proposed Zigbee Network

We have taken an example of a generic agricultural process where four entities are closely monitored in order to produce a healthy crop that is optimum amount of water, humidity, pH level and temperature.

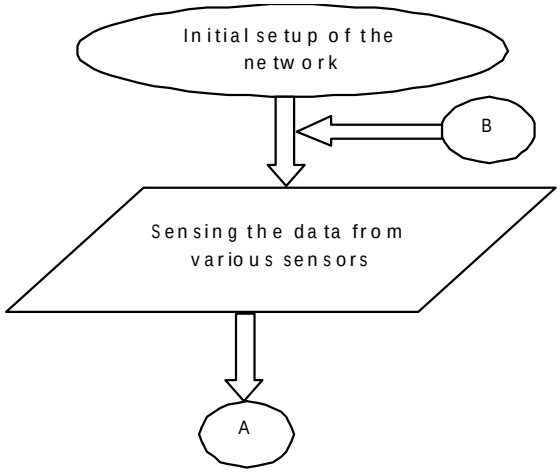
Irrigation needs water depending on type of soil and especially ups and downs of land tell where water is needed. In our proposed network we made a zigbee wireless sensor network for monitoring the crop field by deploying water sensors in the land and de- tect places where water level is low.

Humidity sensor detects the weather conditions so that farmer may know if rainfall is expected water is not irrigated then that saves water and power.

pH sensor tells about the acid level in soil and indicates where fertilizer is needed.

Temperature sensor indicates the temperature and hence tells when more water is needed.

6. FLOWCHART OF THE PROPOSED NETWORK



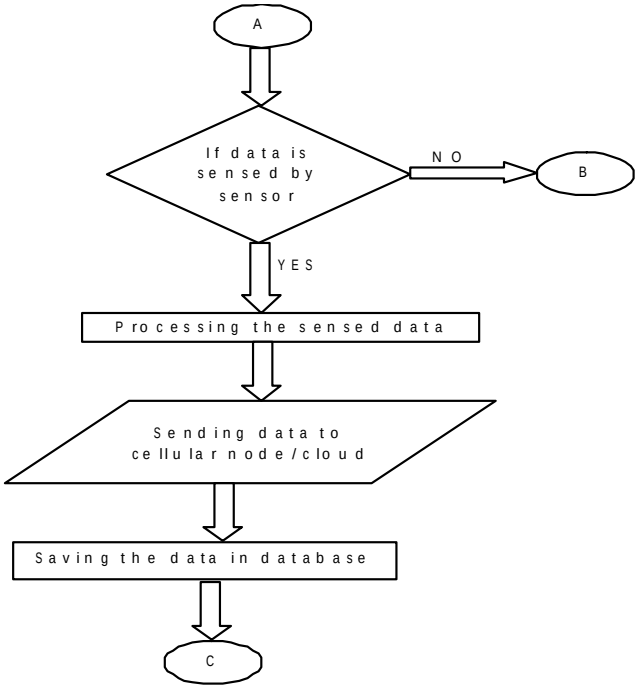
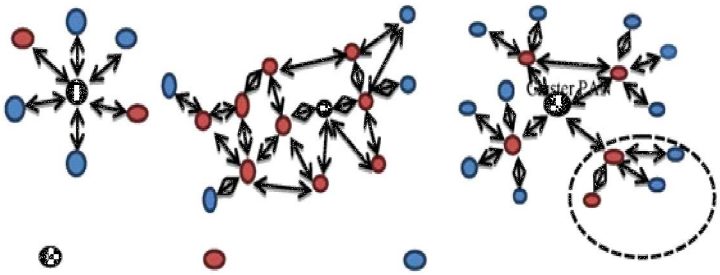


Fig 6: Flowchart of the proposed network

The system would be initially setup for sensing parameters like water level of the land, humidity & temperature of the environment and pH value of the soil. As the sensors start sensing and sending data; the data would be checked for its validity and reliability. The procedure of sensing the data would be repeated if the data is found erroneous. Further the data is processed and sent to a cellular node or cloud. Once the data is received on a cellular node or cloud, the data is stored for future reference and the conditions of all sensing parameters are checked. If the conditions are normal; no changes are required. An alarm is activated and the farmer is informed about the con- ditions if the conditions are not normal like the water level is running low or pH value is high etc.

There are three types of ZigBee standards for nodes, coordinator, end Device and router. A coordinator is a device that works as the main unit in a network. PAN coordinator initializes the network, stores information from nodes and manages the network. It handles the routing of data to all nodes and recommends what routing techniques to use to transfer the data to different nodes. There can be only one PAN coordinator. It can work in all-star, mesh and cluster tree topologies. A router supports the data routing functionality, including acting as an intermediate device to connect all components of the network. A router can communicate with other routers and end devices. Routers can be connected to main power supply or run on batteries. In a Star topology, these functions are handled by the Co-coordinator and, therefore, a Star network does not need Routers. In Tree and Mesh topology routers are normally located in network positions that allow messages to be passed up and down the tree. In a Mesh topology, a Router can be located anywhere that a message passing node is required. An end device is the dead end of the network. The main tasks of an End Device at the network level are sending and receiving messages. It cannot relay messages and cannot allow other nodes to connect to the network through them.. On the basis of these nodes types, IEEE 802.15.4/ZigBee supports mainly three types of topology. Star topology, Peer to Peer topology and the Mesh topology. In the star topology a coordinator is responsible for the network. All other devices are end devices and communicate directly with the coordinator. This topology is suitable for networks with a centralized device and for time critical applications. In a peer-to-peer topology each device can communicate directly with any other device if the devices are placed close enough together to establish a successful communication link. All the three ZigBee Topology are shown in the figure 1 below



Coordinator Full Functional Devices Reduced Functional Devices
Fig 7: (a) Star Topology (b) Peer to Peer Topology (c) Cluster –Tree Topology [10]

8. CONCLUSION

This paper discussed the agricultural problems and usage of WSN network as a solu- tion. Zigbee technology was used to propose a network having various sensors. It is proposed to install small nodes of zigbee along with the sensors. The main advantage of Zigbee is that it consumes less power. In future, we would be working on real time deployment of the proposed network and checking its feasibility.

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