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Wireless Sensor Network for Water Table Monitoring in Agriculture

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Abstract – Agriculture is the backbone of the Indian economy [1]. The development of agriculture in terms of area of land under cultivation, use of modern equipment and financial assistance to the farmers is absolutely essential [1][2]. India is to progress economically with all sectors of the population enjoying its agricultural effect [2]. Recent advances in sensing, computing and communication technologies coupled with the need to continuously monitor physical phenomena have led to the development of Wireless Sensor Networks (WSNs)[2][3]. WSN consist of four main components: A radio, a processor, sensors and battery [7]. Sensors are the hopeful device for precision agriculture. By forming wireless sensor network we can make good monitoring system in the paddy crop field area [6].

This paper represents a maximum opportunity of delivery of water level information packets/signals to base station as it also computes a threshold as well as does calculates values based on transmission range [3]. This technology helps us in reducing packets loss [1][3].

***Keywords* – Radio, stationary base station, topology, water, wireless sensor network.**

I. INTRODUCTION

India is country of villages, there are 80% of people earn their bread & butter by agriculture field. Environmental monitoring application plays an important role in agriculture sector and other hand it is related to well define problems, so there are many new technologies comes in focus to solve them in very well format to deployed in the field [5][2]. Water plays a very important role to grow the crop [5]. Limits of groundwater exploitation are reached; farmers are beginning to invest in micro-irrigation technologies to conserve water [5][2]. The cost of these technologies has been declining [5][1]. For example, the cost of trickle (or drip) irrigation equipment is US $0.03 per square meter or US$300 per hectare, easily affordable for those growing high-valued crops, and the equipment can be manufactured locally [5].

Sensors may used to sense the water quantity in wells, tanks, rivers & irrigation and distribution networks [5,1]. Underground exploitation increasing leads to drying ups wells and rivers as well as salitation of soils, also it leads water logging in different areas [5][2]. Excess water is accumulated in root zone of the soil [5,1]. If the land is cultivated this results in reduced growth of yields of growth of crops [5][1]. Commonly it is consider in physical, network, application layers [5]. Thus, the important of calculating water level in farm highlights the increasing need of new advanced technology to help monitoring of water and maintaining water level and quality such as wireless sensor technology (WNS)[5][2]. Hence this paper is focused on monitoring of water level in agriculture using wireless sensor [5].

II. APPLICATION

Water monitoring in Wells:

The main objective of our system is to measure the data from the observation wells and forward it to the central main system for further processing [1][5]. The network is planned to be deployed in a huge area of several hectares [1].We consider 30 observation wells. These wells are controlled by each head nodes [1]. This sequence of observation wells where installed in subsurface drained area for record the fluctuation in the monitoring of water table during the drainage time [1]. We have taken about 40mm PVC pipes each of length 1.5m, there is 5mm, holes for 10cm [1].Where there are 6 bands are taken at the bottom of 50cm in length[1][5]. There is tube at the bottom end for the prevention of soil entry [1][2]. The wells are placed as shown in figure.

Here water levels for observation wells for periodically monitor by obtaining the exact picture of ground water table [1][5]. For particular crop field there are limited number of observation wells easy with human labours but not economical for vast field area[1][3]. So, this technology not for particular crop field is different for crop to crop [1]. Government and nongovernment organization can support farmers for this technology, i.e give 25%subsidies for these technologies. Hence, there is proper monitoring of water can be achieved [1] [5].

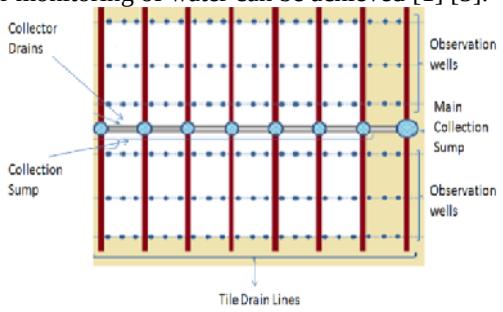

Fig.(a) : Water monitoring in wells via series well layout[1]

There is manual collection of water level data is in unreliable method [1]. So, we deploying automatic sensors in this observation wells for water monitoring [1]. The data collection process can be specified and fetches

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high amount of specific various conditions [1]. The proposed system utilizes wireless sensor for water level detection as well as GSM and SMS technologies [1].this technologies helps for sending message to the farmers as collection is done or not. There is alert alarm notification technique through SMS is used, this technique is really help to farmer for maintaining water table [1][6].

I : Implementation

Implementation point of view sensor nodes are placed in the farm area proposing the tree topology under the control of Wireless Sensor Network [2][3].

The base station is stationary and it collects the data from sensor nodes in a farm and process it[2][3][5]. Whereas Nodes in our proposed topology are mobile [3][5]. The data is collected from the node and transfers to base station[3][5]. Further it proceed towards field controller [2][3][5].

For each node, calculate distance from

- Node to node
- Node to sink
- Node to forwarding node[3][5]

Also calculate

- o Angle α
- o Angle β
- o Find minimum angle [3][5]

Step 1:

If connections (i , j) = =1 i.e. there is a link, then calculate minimum threshold

If (min==0) then Find possible node(x, y) [3].

Step 2:

Send the packet information i.e. water level information [3]

Step 3

If connections (i , j) = =1 i.e. there is a link, then calculate minimum threshold

Otherwise connections (i, j) = infinity i.e. no packet information send[3][1]

So values of sensor nodes are stored in sink nodes [3]. Then sink node sends the stored values to base station. Appropriate action will be taken on the basis of values [3][5].

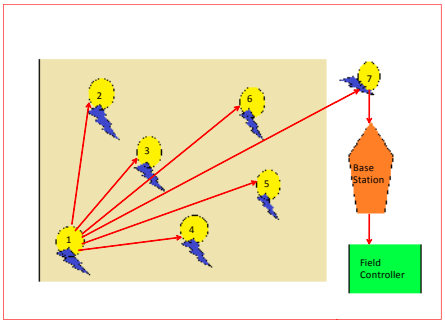

Fig.(b) : Sensor Node Information transfer[3]

From above figure (b). We have a different field area such as tomato field, potato field, rice field & chilli field, but here we have take a rice crop field as farm area. There are 7 nodes for practical purpose. Starting node is called as source node , intermediate node is called as carrier node & last where destinies the connection is called as sink node. Here we give relationship between source node (1), sink node (7), all other nodes are carrier (which provides node to node path) [3]. The function of each node is calculating the distance between that node from other nodes, i.e., one node to another node, node to carrier node, node to sink node with their angles between that node. As shown in figure source node 1 calculate its smallest distance with from other carrier nodes and sink node. With the help of minimum distance and angle we can easily find minimum threshold, if it is null then it is easy to find destination node and send water level information i.e., packet data information[1][3]. Otherwise we have to set connection as infinity so automatically values of sensor node are stored in sink node [7][3][5]. After sink node sends this stored values to base station for further purpose[3]. Base station gives this water level information to field controller. Hence proper action will be taken with the help of basis of values.

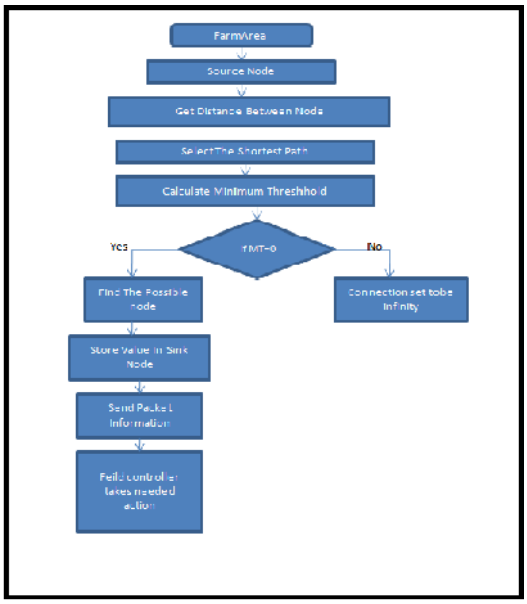

Fig.(c) : Flowchart of implementation

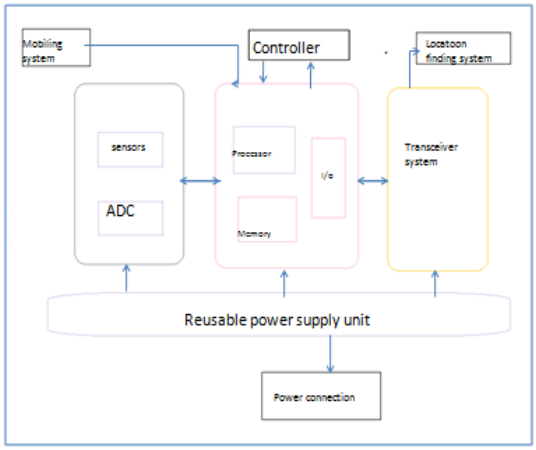

Fig.(d): Architecture of sensor node

III. COMPONENTS

The main components of a sensor node are a microcontroller, transceiver, external memory, power source and one or more sensors.

1. Controller

The controller performs tasks, processes data and controls the functionality of other components in the sensor node[7][20]. While the most common controller is a microcontroller, other alternatives that can be used as a controller are: a general purpose desktop microprocessor, digital signal processors, FPGAs and and ASICs[7]. A microcontroller is often used in many embedded systems such as sensor nodes because of its low cost, flexibility to connect to other devices, ease of programming, and low power consumption [7]. A general purpose microprocessor generally has a higher power consumption than a microcontroller, therefore it is often not considered a suitable choice for a sensor node [7][2]. Digital Signal Processors may be chosen for broadband wireless communication applications, but in Wireless Sensor Networks the wireless communication is often modest: i.e., simpler, easier to process modulation and the signal processing tasks of actual sensing of data is less complicated[7]. Therefore the advantages of DSPs are not usually of much importance to wireless sensor nodes[7][3]. FPGAs can be reprogrammed and reconfigured according to requirements, but this takes more time and energy than desired [7].

2. Transceiver

Sensor nodes often make use of ISM band which gives free radio, spectrum allocation and global availability. The possible choices of wireless transmission media are Radio frequency (RF), Optical communication (Laser) and Infrared. Lasers required less energy , but need line of sight for communication and are sensitive to atmospheric conditions[7][16]. Infrared, like lasers, needs no antenna but it is limited in its broadcasting capacity [7]. Radio frequency based communication is the most relevant that fits most of the WSN applications [7][6]. WSNs tend to use license-free communication frequencies: 173, 433, 868, and 915 MHz; and 2.4 GHz [7]. The functionality of both transmitter and receiver are combined into a single device known as transceivers,it often lack unique identifiers[7][3].The operational states are transmitting, receive, idle, and sleep[7]. Current generation transceivers have built-in state machines that perform some operations automatically[7].

Most transceivers operating in idle mode have a power consumption almost equal to the power consumed in receive mode[7][6]. Thus, it is better to completely shutdown the transceiver rather than leave it in the idle mode when it is not transmitting or receiving[7][3]. A significant amount of power is consumed when switching from sleep mode to transmit mode in order to transmit a packet. [7]

3. Sensors

Sensors are hardware devices that produce a measurable response to a change in a physical condition like temperature or pressure[7][22]. Sensors measure physical data of the parameter to be monitored[7]. The continual analog signal produced by the sensors is digitized by an analog-to-digital converter and sent to controllers for further processing[7][1]. A sensor node should be small in size, consume extremely low energy, operate in high volumetric densities, be autonomous and operate unattended, and be adaptive to the environment[7]. As wireless sensor nodes are typically very small electronic devices, they can only be equipped with a limited power source of less than 0.5-2 ampere-hour and 1.2-3.7 volts. [7].

Sensors are classified into three categories: passive, Omni-directional sensors; passive, narrow-beam sensors; and active sensors [7][3]. Passive sensors sense the data without actually manipulating the environment by active probing [7][6]. They are self powered; that is, energy is needed only to amplify their analog signal [7]. Active sensors actively probe the environment, for example, a sonar or radar sensor, and they require continuous energy from a power source [7][3]. Narrow-beam sensors have a well-defined notion of direction of measurement, similar to a camera [7]. Omni-directional sensors have no notion of direction involved in their measurements [7].

The overall theoretical work on WSNs works with passive, Omni-directional sensors [7][3]. Each sensor node has a certain area of coverage for which it can reliably and accurately report the particular quantity that it is observing [7]. Several sources of power consumption in sensors are: signal sampling and conversion of physical signals to electrical ones, signal conditioning, and analog-to-digital conversion [7][21]. Spatial density of sensor nodes in the field may be as high as 20 nodes per cubic meter [7].

4. External memory

From an energy perspective, the most relevant kinds of memory are the on-chip memory of a microcontroller and Flash memory—off-chip RAM is rarely, if ever, used. Flash memories are used due to their cost and storage capacity [7][3]. Memory requirements are very much application dependent [7]. Two categories of memory based on the purpose of storage are: user memory used for storing application related or personal data, and program memory used for programming the device[7][5]. Program memory also contains identification data of the device if present [7].

IV. Conclusion

This paper presents the design a day to day life water level monitoring technique using wireless sensor network (WSN)[1]. In typical Indian farming method the farmers are not idea about usage of new technologies like a deploying wireless sensors network with alarm notification for water level indication and save the water[1][7]. Because our network technology although dependent upon the distances of wireless information from source node to sink node(base station) as well as minimum angles between source and destination nodes with their minimum threshold are also considered as one of the main reason for crop field[3][4]. This paper offers a maximum opportunity of it.[1][5]

V. References

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