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# Comparative Analysis of Smart Irrigation and Crop Prediction using Wireless Sensor Networks and Machine Learning

Shanthi D.L[1], Mohd. Aiman Jaffer[2], Harshitha Neelakanta[3], M Sowmya, Monisha Dinesh[4]
[1]*Department of Information Science and Engineering, BMS Institute of Technology and Managemnt, Bangalore, India*
[2, 3, 4]*Department of Information Science and Engineering, BMS Institute of Technology and Managemnt, Bangalore, India*

***Abstract:*** ***Agriculture determines the economic growth of nation and is known to be its backbone. Farmers, researchers, and technical manufacturers are joining efforts to find more efficient solutions for solving various different problems in agriculture to improve current production and processes Precision. The proposed framework for precision agriculture employs low cost environmental sensors, an Arduino Uno prototyping board and a pair of wireless transceivers (XBee ZB S2) along with actuating circuit to provide automated irrigation and monitoring of crops. The proposed prototype uses XBee protocol which is based on ZigBee technology .The important characteristics of ZigBee technology favorable for precision agriculture are; low data rate, low power consumption and larger coverage area. Thus, due to aforesaid characteristics, ZigBee technology happens to be the first choice for implementing precision agriculture. The newly emerging technology i.e. Wireless Sensor Networks spread rapidly into many field's like medical, habitat monitoring, bio-technology etc.***

## I. INTRODUCTION

India is agriculture based country where 69% of Indian population has agriculture as their main occupation or side business.Agriculture is mainly based on observing, measuring, and responding to inter and intra field variability in crops.

Agriculture is the art, science or practice for cultivating crops by using different preparation methods. In order to solve different problems occurring in agriculture like poor real time data acquisition, small monitoring coverage area, excessive requirement of manpower, etc. precision agriculture is used. Precision agriculture using WSN is used in soil moisture management, humidity control, temperature sensing, CO2 sensing, pressure sensing etc. Information from these sensors can be communicated to the farmers by some of the ways such as GSM technology, HSCSD phone, HSCSD card phone, GPRS phone, GPRS card phone, Zigbee technology etc.

A wireless sensor network (WSN) is a special class of ad-hoc networks that integrates sensing, processing and communications in small, battery-powered motes. By taking help of WSN, one can transmit the real-time data quickly with in no time. This study will serve as a model for almost all sensor network that one would like to build.

### *A. Wireless Sensor Network Based Low Cost and Energy Efficient Frame Work for Precision Agriculture*

Farming happens to be the key wellspring of employment for pretty much every inhabitant in creating nation counting India. Farming all around decides the monetary development of country and is known to be its spine. It is expected to the populace blast, which brought about lopsidedness of interest/supply proportion for agrarian items.

To fulfill regularly expanding interest for agrarian items, either the horticultural efficiency must be almost multiplied or the strategies utilized as a part of conventional horticulture need to adjusted in a way that would stop the wastage of agrarian assets to almost half.

The proposed system for accuracy agribusiness utilizes low cost environmental sensors, an Arduino Uno prototyping board and a couple wireless transceivers (XBee ZB S2) alongside actuating circuit to give computerized water system and monitoring of yields. The proposed model uses XBee convention which depends on ZigBee innovation furthermore, is worked over IEEE 802.15.4 standard.

The critical qualities of ZigBee innovation ideal for accuracy horticulture are low information rate, low power utilization and bigger scope region. Along these lines, because of previously mentioned qualities, ZigBee innovation happens to be the primary decision for actualizing exactness farming.

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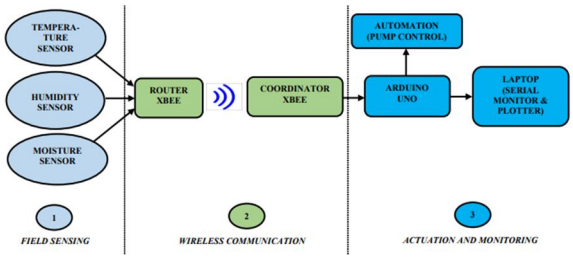


Fig 1: Proposed Framework of Precision Agriculture.

The model created not just gives monitoring of crops in real time by detecting parameters like temperature, dampness and dampness substance of the soil which are basically required for the development of the products yet in addition gives mechanized water system. Farmers are under enormous pressure, even after putting in a lot of effort they are not getting productive outcomes. One approach to overcome this issue is by applying Precision Farming. The specialty of utilizing the cutting edge advancements for constant checking the horticultural field is named as Precision Farming. In 2015, an observing station was produced to sense climate factors to be utilized as a part of precision farming. The parameters observed were temperature, dampness, soil dampness and wind direction. The sensors utilized were aligned with estimating instruments accessible on the observing station. Also, correspondence of checked information was sent to a PC by means of Bluetooth remote module. In spite of the fact that the created framework was less mind boggling than the past frameworks, it utilized Bluetooth innovation which again places restriction regarding range and vitality productivity of sensor hubs. Rather than these advancements, a more up to date control proficient innovation, ZigBee was utilized with various application situations going for decreasing the power utilization at the cost of low information rate.[1]

*B. Machine Learning Approach For Forecasting Crop Yield Based On Climatic Parameters*

With the effect of environmental change in India, greater part of the rural harvests are by and large seriously influenced in terms of their performance over a period of last two decades. Foreseeing the product yield well in front of its reap would help the arrangement farmers for taking suitable measures for storage and marketing. Such expectations will likewise help the related enterprises for arranging the logistics of their business. A few techniques for foreseeing and displaying crop yields have been created in the past with differing rate of achievement, as these don't take into account characteristics of the weather, and are mostly empirical. In this paper, a product apparatus named 'Crop Advisor' has been created as an easy to use web page for foreseeing the impact of climatic parameters on the product yields. C4.5 calculation is used to discover the most affecting climatic parameter on the harvest yields of chose trims in chosen locale of Madhya Pradesh. This product gives a sign of relative impact of various climatic parameters on the harvest yield, other agro-input parameters in charge of product yield are not considered in this instrument, since, utilization of these info parameters differs with singular fields in space and time. The examination was planned to build up a site for discovering the impact of climatic parameters on crop yield in chosen areas of Madhya Pradesh. The yields chosen in the research depends on the prevalent crops in the chosen area. The chosen crops includes: Soybean, Maize, Paddy and Wheat. The yield of these products was monitored for nonstop 20 years by gathering the data from auxiliary sources. Also for the same years, climatic parameters, for example, Rainfall, Maximum and Least temperature, Potential Evapotranspiration, Overcast cover, Wetday recurrence were likewise gathered from the auxiliary sources. The technique received for examination incorporates for values over a particular limit were considered as one kid and the staying as another kid. It likewise handles missing property values. The site is composed as an intuitive programming instrument for foreseeing the impact of climatic parameters on the product yields. This product gives a sign of relative impact of various atmosphere parameters on the harvest yield, other agro-input parameters in charge of harvest yield are most certainly not considered in this instrument. Utilizing the created program, the impact of climatic parameters on crop yield profitability in chose areas of Madhya Pradesh was completed for overwhelming yields. For Soybean trim in all the chosen areas, the most impacting parameter was observed to be overcast cover, for paddy it was found as precipitation, for maize it was greatest temperature and for wheat the base temperature. The electronic programming produced for foreseeing the edit yield from the given contribution of climatological parameters demonstrated a reasonable pattern of each harvest being dominatingly affected by a specific climatic parameter.[2]

*C. Wireless Sensor Network using Xbee on Arduino Platform*

Remote systems comprises of hubs speak with each other remotely. A wireless sensor organize (WSN) is a unique class of specially appointed systems that incorporates detecting, handling and interchanges in little, battery-fueled bits. These sensor hubs regularly work together on a worldwide detecting assignment and convey expected information to at least one centers. This paper presents

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exploratory setup up of making remote sensor organize utilizing Arduino and Xbee module. This study will fill in as a model for all sensor network that one might want to manufacture. This is to make setup which will permit to peruse temperature esteem shape economical temperature sensor set separated at different area that are work arranged to accumulate a surge of info and send to base station. WSN is quick propelling innovation, which is opening number of chances in the field of remote detecting and information observing. Remote sensor organize comprises of number of little sensor remotely found framing a multi-bounce arrange by radio correspondence. Each system comprises of sensor hub base station and sink hub. Base station gathers information from sensor hubs and forward to sink hub. WSN broadly utilized as a part of numerous applications on account of its property of little and modest sensor hub, for example, condition observing, for example, woods fire identification, keen building frameworks, military application, medicinal services application and some more. Late advances in the field of hardware and correspondence prompts improvement of little battery empowered sensor hubs. These sensor hubs are haphazardly conveyed as a remote sensor arranged for detecting conditions. Throughout the years, the most essential issue in remote sensor organize is to build up a directing convention that boost the life time of system. Every hub in a sensor organize winds up futile in the wake of squandering its vitality totally in light of the fact that its energy thoroughly relies upon the implanted battery.

| Xbee | Arduino |
|---|---|
| VCC or 3.3 V | 3.3 V |
| TX or DOUT | RX or 0 |
| RX or DIN | TX or 1 |
| GND | GND |

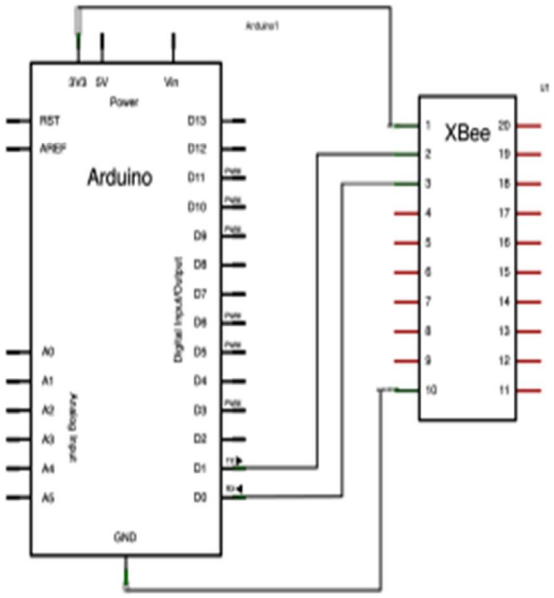



Fig 2: Layout of connection between Arduino and XBee.

In this practical setup they have a router coordinator and two sensor nodes or hubs. Sensor hubs with temperature sensor are placed at spatially disseminated area. Temperature data of every sensor is sent to switch. Switch is associated with facilitator radio, where every one of the information can be accumulated. The sensor hubs depend on Arduino Platform. Arduino is an open-source gadgets prototyping stage with adaptable and simple to-utilize equipment and programming. Wireless sensor network is a communication network wherein sensor hubs conveyed at different area detects the information and send to base station . This paper proposed a down to earth usage of making WSN utilizing Mesh Topology with Coordinator Node, Router and End Devices utilizing Arduino advancement sheets, Xbee Module and Temperature sensors. Xbee connected to Arduino board can detect information and remotely send the information to organizer radio. Utilizing X-CTU and Arduino IDE we can synchronize Xbee and Arduino.[3]

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*D. Designing a Wireless Sensor Network For Precision Agriculture Using Zigbee*

The recently rising innovation i.e. Remote Sensor Networks spread quickly into numerous field resembles restorative, territory observing, bio-innovation and so forth. The pertinence of WSN are enormous. The utility of WSN is for gathering the detected information, putting away or handling the detected information and the transmitting information to the fitting focal station. Farming is one of the field which have as of late turned away their examination to WSN. By taking help of WSN, one can transmit the continuous information rapidly with in a matter of moments. The WSN framework which is created in this paper, is utilized for exactness horticulture. Accuracy agribusiness is only applying right contributions at the correct time to get more development with less power and work. The constant information depends on the few qualities of climate like temperature, dampness and so on. The design of the created WSN framework in this paper appreciate an arrangement of sensors called sensor hub, base station and focal station. Base station sends the detected information to the central station. India is horticulture based nation where 69% of Indian populace has agribusiness as their fundamental occupation or side business. Horticulture is the craftsmanship, science or practice for developing products by utilizing diverse arrangement strategies. India is a farming based nation. Agriculturists develops the yields utilizing different designed strategies, systems and numerous machines. The conventional cultivating hones with a few conditions which are subject to the rainstorm or climatic changes. By following the conventional strategies which does not give effective late, we can go increment the yield by embracing propelled advances they are additionally called as current cultivating. Present day cultivating can be accomplished by including new ideas, for example, such Internet of Things (Iot), Wireless Sensor Networks (WSN) and Precision Agriculture (PA). Exactness horticulture is describing as the condition of workmanship and study of receiving propelled innovation to increase the yield development.

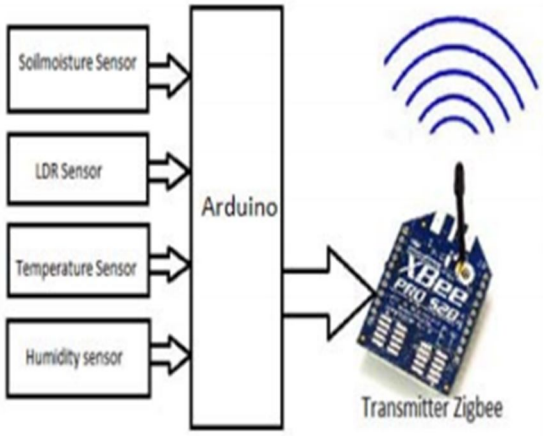



Fig 3: Block diagram of node.

Remote Sensor Network is a rising propelled innovation that helps the improvement of accuracy horticulture. WSN contains sensors, RF modules (radio recurrence modules), microcontrollers to process the information, battery or wellspring of forces, base station to transmit the information. Late patterns and headways in wsn innovation have cut the way for the improvement of less cost. Low utilization of energy and multifunctioning sensor hubs. Sensor hub conveyed at better places detects the diverse ecological parameters at that place and process the information as needs be. The different sensors which is utilized are soil dampness sensor, LDR sensor, thermistor, temperature, rain identifying sensors, stream sensors and so on. There are numerous different sensors like IR sensors, UV sensors, Proximity sensor and so on which are helpful for accuracy farming. As India expends 80% of aggregate accessible water assets for water system reason, we are in a circumstance where water utilization must be diminished utilizing progressed logical methods to maintain a strategic distance from this we can utilize soil dampness sensor as an answer. The fundamental qualities of WSN is self-sorting out and self-mending. Once the hubs are sent and a system is framed at that point, the information will be naturally transmitted with no charge or control. In the event that any gadget in the system breakdown, at that point the system won't be harmed rather it will take another working way and achieves the goal. So any harms or failing of a solitary hub doesn't influence the entire system. he system is planned and seven hubs (6 hubs and one organizer) are composed. Those are designed and steered likewise. The sensors at the hub sense the information and sends to the arduino. The information is gathered and transmitted to the facilitator utilizing Xbee and those information is gotten by the organizer and utilizing arduino those information is arranged per the hub numbers and shows it.

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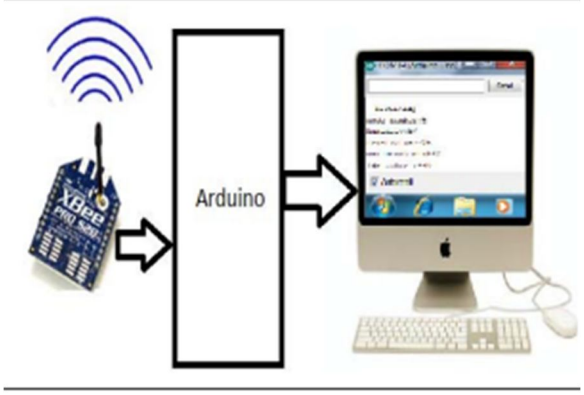



Fig 4: Total setup of receiver.

Here in this work they have utilized a framework just for information accumulation that too sensor information. So they likewise incorporated a camera to watch the wellbeing of the product and also the video spilling. As indicated by the harvest the sensors can be shifted on the grounds that a few yields require light to grow some relies upon the water level. so as indicated by the harvest prerequisites the sensors can be shifted. Indeed, even the system can be extended if required by adding switches to the system. For proficient transmissions of information, the hubs ought to be put appropriately. Some yield needs pH 6 esteem, at that point pH sensor ought to be added to the sensor hub. Indeed, even the power utilization ought to be considered if the system is extended. Indeed, even information mining calculations can be connected to get precise outcomes. Numerous methods can be utilized to yield greatest development.[4]

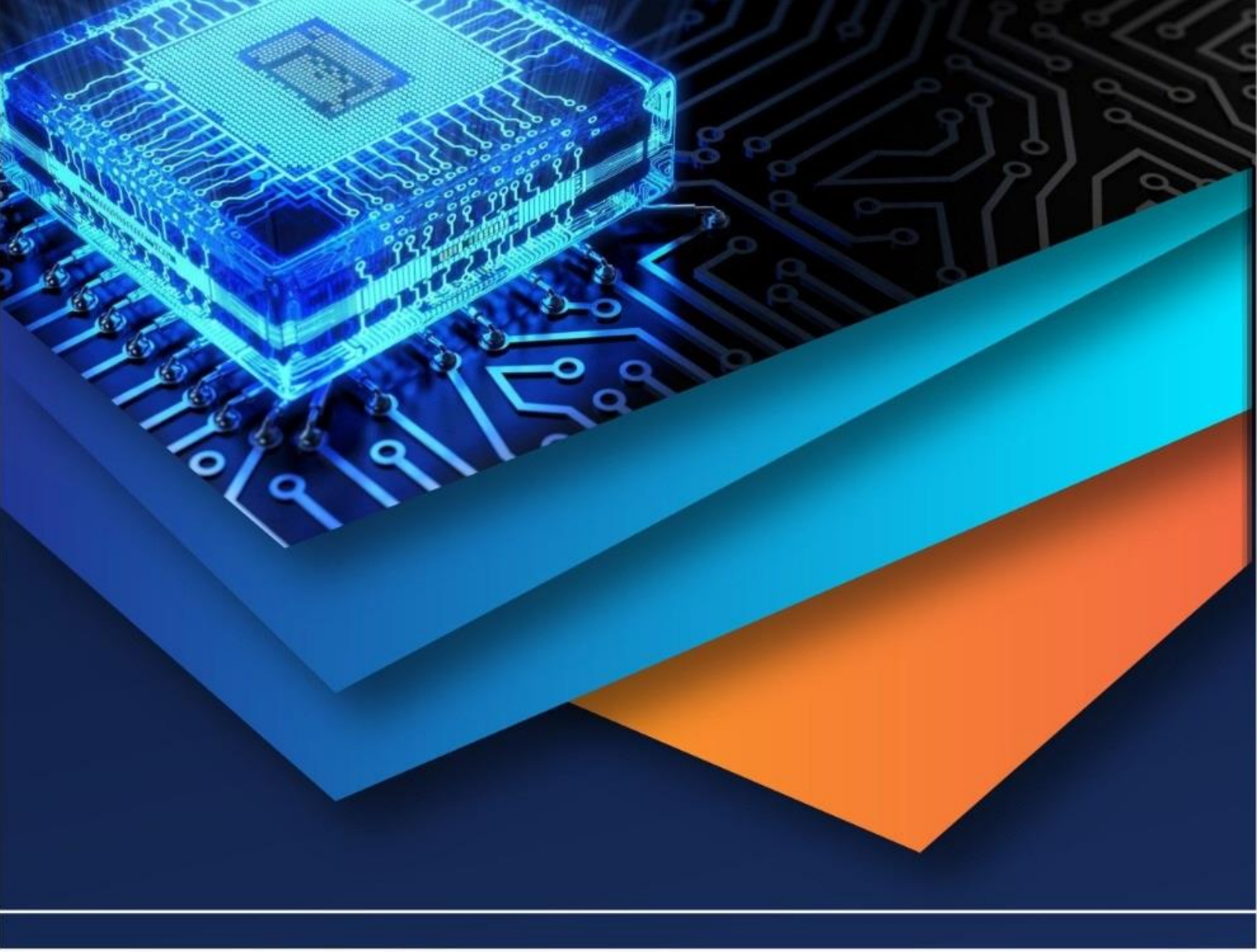
## II. CONCLUSION

This paper illustrates the various precision agriculture techniques using wireless sensor network and also the comparison between them. Wireless sensor network is a communication network wherein sensor nodes deployed at various location senses the data and send to base station . Through this proposed frame work and the prototype, we were able to build a wireless sensor network with peer-peer communication between a router XBee and a coordinator XBee.

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