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A centralized solution for water conservation in irrigation using wireless sensor network

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Abstract
India is an agricultural economy. We depends on agriculture one way or the other. Wireless Sensor technology is increasing rapidly in various fields. There has been a great discovery in monitoring the health and environment with help of various sensors involved. In recent few years there has been enormous technological advancements in the field of agriculture and the crop productivity. Agriculture monitoring of crops with help of processing of data collected at different times by different sensors. Once data is collected the task of sensor nodes is complete and its time for actors, here sprinklers, to do their job. The sprinklers would like to minimize the wastage of water used in irrigation depending upon the data collected by the sensor nodes.

Keywords: Zig bee, nodes, wireless sensor network, etc.

Introduction
India is a horticultural nation and agribusiness is the biggest part of the Indian economy. We legitimately and by implication rely upon agribusiness. For the most part we trade numerous agricultural products in different nations these are immediate identified with our farming however some earlier years there is numerous adjustments in our condition. It's immediate impact on our agribusiness and it's circuitous impact on our economy development. We should be cautious from the underlying stage to get most extreme amount and great nature of item and diminish the expense of creation. We upgrade the amount and most recent advancements can help. This innovation can assist ranchers with monitoring crops effectively and to get precise data about their field.

We accept that WSN innovation could assist the ranchers with monitoring various kinds of parameter conveniently and cost successfully. There have been a few investigations of Wireless Sensor Network in horticulture for general parameter checking. A remote sensor arrange (WSN) by and large comprises of countless minimal effort and low-control sensor hubs. In WSN, the hubs interface remotely momentary separations and fit for sorting out themselves in a self-governing multi-bounce work organize. It might identify the earth empowering collaboration between ranchers or PCs and the encompassing condition. The use of WSN in natural conditions has been examined in the writing. Like as, WSN were utilized to assemble woodland temp, information and the measure of precipitation. Remote sensor organize (WSN) must be useful in explicit applications requiring checking of continuous input (information). The remote sensor gadgets can consequently arrange themselves to frame a specially appointed multi jump organize.

Remote sensor systems (WSNs), involved by hundreds or perhaps a great many specially appointed sensor hub gadgets, cooperating to achieve a typical assignment. This structure obliges are connected with the reason and the attributes of the establishment condition. The earth decides the size of the system, the sending technique and the system topology. Assets obliges are forced by little correspondence run, low throughput and diminished stockpiling and processing assets. This examination paper give a survey on remote sensor systems answers for natural observing applications. This system comprises of two sensor hubs and a base station. This ZigBee remote correspondence module, in light of IEEE 802.15.4, is utilized as the remote correspondence unit in the sensor hubs. ZigBee is chosen as it is a minimal effort and low-control than bluetooth and it has been demonstrated to be a numerous suitable innovation for sensor applications gadgets.

These remote modules are anything but difficult to introduce and able for point-to-guide, multipoint and convertible to a work organize. The caught information is made appeared at the ranchers (clients) through a realistic application programming interface (API).

Network Architecture

A wireless sensor network (WSN) can be defined as a network of (possibly low-size and low complex) devices denoted as nodes that can sense the environment and communicate the information gathered from the monitored field (e.g., an area or volume) through wireless links; the data is forwarded, possibly via multiple hops relaying, to a sink (sometimes denoted as controller or monitor) that can use it locally, or is connected to other networks (e.g., the Internet) through a gateway.

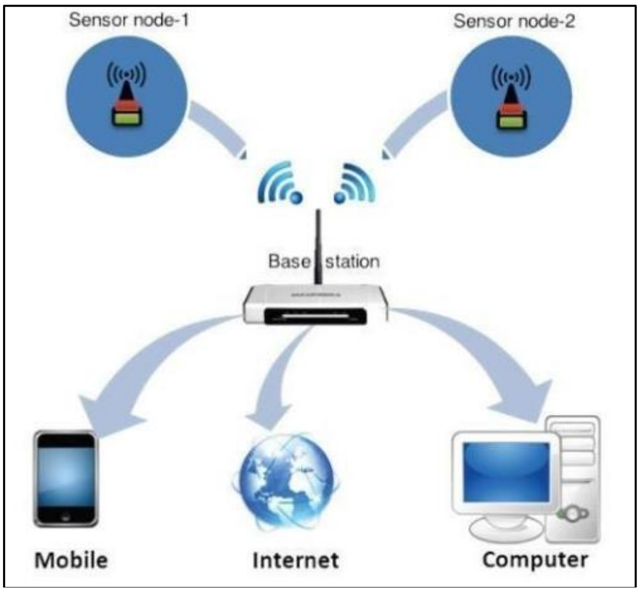

Fig 1: Network Architecture

The WSN (Wireless Sensor Network) was actualized a pound topology in reference point mode. The proposed WSN engineering is appeared in fig. two individual sensor hubs fill in as transmitters have been intended to gather the information, process, and transmit the temperature, and the sensor's area flag progressively. This system works inside a range up to 100meter from the base station to end sensor. It is ideal for observing the grouping of ozone harming substances inside. Remote Sensor Networks is a spatially conveyed to checking physical and natural parameters. Progressively current these sensor systems are use for both side and empowering control of sensor action. This model is the base upon a horticultural idea comprising of no. of control sensors in it. It could be use in a nursery. In this paper five distinct parameters are portrayed alongside the correspondence between two nursery models. The square engineering, circuit outline and other essential graphs are appeared. GPS module idea for getting data from nursery models for looking at their readings for better profitability is likewise done. These five unique kinds of parameters, for example, temperature, dampness, light, water level and soil are estimated in a steady progression and showed on LCD. On the off chance that an end client living far from the homestead field needs to check the readings of various parameters. Notwithstanding information reconciliation and examination, the base station likewise transfers handled information to show gadgets and PDAs. This base station is outfitted with an Arduino Uno Microcontroller for framework coordination, an accepting ZigBee module and a Wi-Fi 33 module for correspondence and information Transmission over the 802.11b/g remote correspondence, which make it conceivable to get to the gathered information by means of the Internet. Moreover, the caught information is embedded into a MySQL database where a website page with a diagramming application programming interface (API) is utilized to show the information.

Colour processing

Colour of an organic material gives vital information about that material.

Colour analysis in this project is based on the RGB Colour Space and HSI colour spaces.

RGB Colour Space

This shading space is usually utilized and human eye can likewise see it. The shade of any item is produced using three essential hues these are Red, Green and Blue. Different hues are produced using essential hues that is, the blend of at least 2 essential shading gives the full shading range. RGB shading space dependent on the essential ghastly parts of red (R), green (G) and blue (B).

HSI Colour Space:

HSI that is shade (H), immersion (S) and force (I) gives the shading portrayal in wording that are functional for human understanding. Shade, Saturation and Intensity of the shading articles are seen and portrayed by human eye. Shade gives the proportion of particular shade of the range, for example, red, green, yellow and so on. Immersion is a proportion of how much unadulterated shading is weakened by white light that is wealth of unadulterated shading. Force is the splendor abstract descriptor and difficult to gauge. The Intensity of HSI model decouples the power part from the shading conveying data (tone and immersion) in a shading picture [19]. HSI is the gives the best outcomes and contrasted with RGB shading framework on the grounds that in RGB shading framework give three separate directions RED, GREEN and BLUE which isn't productive for shading recognition and picture handling than contrasted with HSI mode. While in HIS modular just tint (h) can give the shading observation. Subsequently HIS model is known as the best instrument for creating picture preparing calculations

Henceforth it is demonstrated that HSI is effective in looking at of natural items and other hued objects in light of the fact that

- HIS models can isolate power from the shading data which gives chromatic immaculateness of the hued item
- Hue and Saturation parts are personally identified with the manner by which individual see shading.
- Hue of the shading does not relies on the light power.

Feature extraction and formula used for calculations

Here we are separating the Red, Green and Blue shading from the wheat harvest picture and foreseeing the time of wheat crop. As referenced over the level of green shading in the wheat yield disappears with its age. Right off the bat, we are ascertaining the level of green shading in the picture of wheat crop. In the wake of computing the level of green shading present in the picture in RGB shading framework, we are changing over the RGB shading framework into HSI that is, Hue, and Saturation and Intensity enemy better forecast. RGB information is first changed over into HSI information. With picture portrayal in the HSI area, the shading examination depended on basically the Hue esteem. Tone is a shading quality that depicts an unadulterated shading, while immersion gives a proportion of how much anunadulterated shading is weakened by white light lastly force gives the viability of the shading. The three Dimensional RGB space is decreased to a one-dimensional “H” Space for shading investigation. For a Digitized shading picture, the Hue histogram spoke to the shading parts and the measure of that Hue in the picture. In this paper we are taking three pictures (Image1, Image2, Image3) or wheat crop at various examples of time. The Image1 is taken after 6 frail of planting wheat. Image2 is taken following 14 months of planting and the Image3 is taken after 18months more established. The wheat crop necessity changes with the time and at the age 6, 14 and 18 weeks the yield show most extreme progress in the prerequisite. Along these lines, by realizing this improvement period of wheat crop rancher can develop better yield.

Fig 2: Image1 (6 Weak older wheat crop)

Figure 2 shows the condition and colour of the crop after the time period of 6 weeks from the date of sowing, when its colour is pure green.

Fig 3: Image2 (14 weak older wheat crop)

Figure 3 shows the condition and colour of the crop after time period of 14 weeks & colour becomes greenish yellow

Fig 4: Image 3(18 weeks older crops)

Figure 2, 3 and 4 depicts about the colour of the crop at any given instant as recorded by the sensor which is then processed by the sensor attached in our network.

Mean of Red, Green and Blue colour components obtained by using Digital image processing in MATLAB. Mean of Red, Mean of Green and Mean of Blue colour components is represented as R, G and B respectively. This computation helps to comprehend the most dominant primary colour of the image.

Percentage of Green colour in RGBmodal

$$g=G*100/R+G+B$$

where, g = percentage of green colour in RGB modal
R = Mean of red colour
G = Mean of green colour
B = Mean of blue colour

RGB colour system is converted to HSI colour system by using following formulas. Given an image in RGB format, the Hue component of each RGB pixel is given by $\tan H=\sqrt{3}/2R+G+B*(G-B)$
where, H= hue component of each RGB pixel

Saturation

$s=1-3/R+G+B[\min(R,B,G)]$
where, s=saturation which is relative bandwidth of the visible output from a light source.

Intensity

$I= 1/3\ (R+G+B)$
Where, I= intensity which is average of all three components.

Various functions are used in matlab for calculating the RGB value from the data collected in form of different parameters by sensors. Further detecting an deficiency among them and take proper action with the help of actor nodes.

Proposed Approach

Consider a rectangular agricultural field with crops sown. In order to perform the required action, the need is to decorate the field with actors and sensors. The sensors are nodes which, for instance, have already taken the information of the amount of water requirement by the respective crop at the given time. The requirement of which differs from crop to crop based on its age and other characteristics. All this is already done, the next thing comes how to effectively, with minimum wastage, irrigate the area with particular requirement. Lets have a look at figure showing the field with sensing nodes and acting nodes. The message is send by the sensing node to the sink node which compiles up the data received, then directs the actor nodes to perform the required action. The sink node is the task manager node.

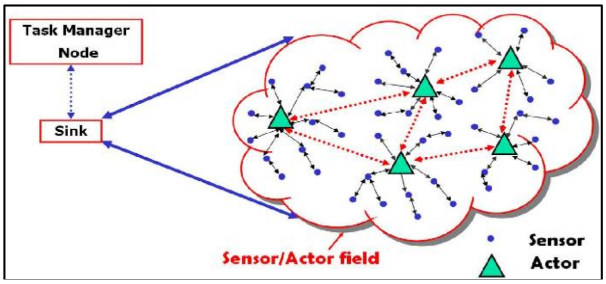

Fig 5: Field with sensor and actor nodes

Different parts of the field will require different quantity of water depending upon the report given by sensors. This is the core idea of this research. To understand the concept lets have a view on a very simple diagramatic representation.

Crop 1 Week 2	Crop 2 Week 2
Crop 1 Week 1	Crop 2 Week 1

Fig 6: Crop Variety in the Field

The crop field shown is divided into 2 types of crop. Now each crop having different age. We have a total of 4 varieties as shown in the figure. The amount of water required by crop 1 which is one week old will be different from the requirement of the same crop which is two week old. Same is the case for crop 2. Thus we have four different water requirements at four different parts of the same field. This requirement is met by the actors which can be sprinklers in this case.

Now the question arises how to place the actors in the field for a favorable outcome. One such criteria for a favourable outcome can be placing the actors in the field such that:

- Minimum number of actor nodes can be installed.
- The actor nodes cover the entire field.
- The area of effectiveness of various nodes is with minimum overlap.
- Minimum wastage of resources.

The coverage of a node can be circular, rectangular or square in shape. One important feature of a node can be the variability of its covering radius. A novel feature can be that the sprinklers can even vary the radius of their coverage. Thus affecting the coverage area.

Sequence of steps to be followed:

1. Calculating the affected area.
2. Identifying all the covering nodes.
3. Choosing the minimum number of nodes to cover the area.
4. Adding the nodes one by one based on their priority of maximum coverage.
5. Repeat step 4 till the entire event area is covered.

We can diagrammatically depict the above steps.Lets take into consideration the area with Crop 1 and age of one week.

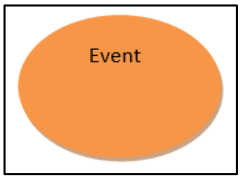

Fig 7: Event area for crop 1.

Now all the event related actor nodes are taken(shown in figure 8) and each is assigned to the event one by one in the order of their priority, as depicted in figure 9 to figure 10. The node which covers the maximum event is of highest priority.

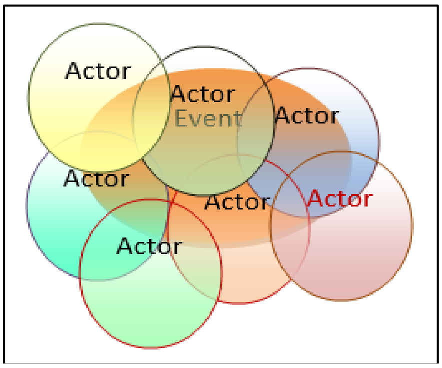

Fig 8: All the actors(sprinklers) which covers the event

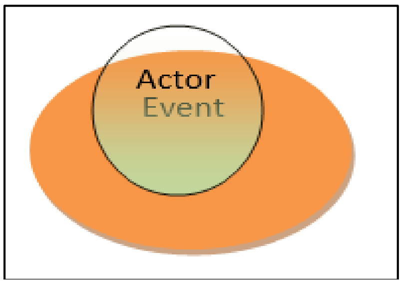

Fig 9: The actor with maximum overlap will be added first

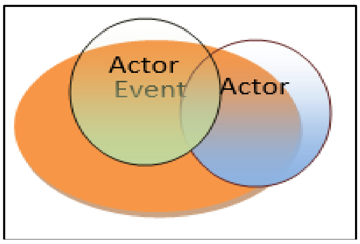

Fig 10: The actor with second maximum overlap will be added next

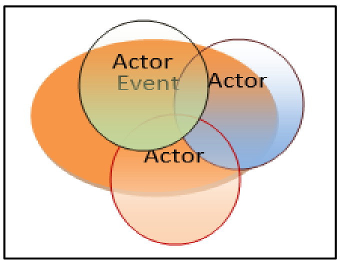

Fig 11: The actor with third highest overlap will be added next

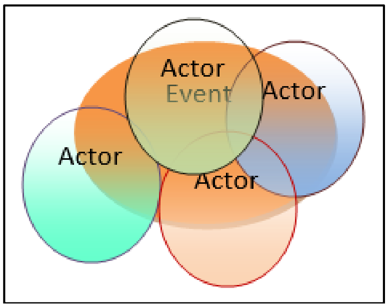

Fig 12: The actor with next highest overlap added

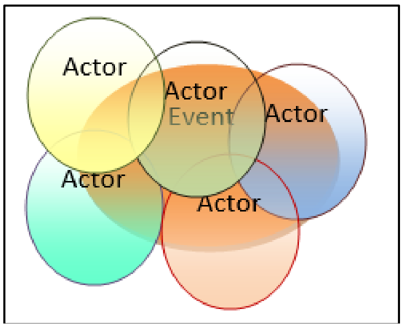

Fig 13: The actor which can cover the remaining event added

Comparing figure 8 and figure 13, we can see that several unwanted nodes are not used in the final scenario. This is done because the entire area is already covered. Moreover, the resources can be best utilized in this way.

Result and Discussion

The level of green shading is diminishing from first picture to the third picture that is, Image1 have greatest green shading and Image3 have least green shading. Above level of green shading can be utilized in maturing the wheat crop. So the Image1 crop is younger then the Images2 and Images3 crop. Also, their sustenance prerequisites can be chosen by their requirements for better yield.

HIS parts for the 3 pictures are additionally determined and each of the three pictures give unmistakable qualities tint (H), saturation(S) and force (I). Shade is greatest for the Images1 and it diminishes as the harvest ages comparatively immersion level additionally diminishes with the period of yield. Yet, the power is most extreme in Image1 and diminished with time of harvest.

Using the data above the central node will direct the actor nodes to use the required level of irrigation at the required area. Thus the precious resource can be well utilized and sustained for future use.

Great yield of a harvest animal categories is needy upon basic development arranges so the plant can benefit from positive climate periods during the developing season. A comprehension of how harvests react to natural worries at various phases of development can aid the evaluation of yield condition and generation potential all through the developing season. In this paper we have taken three diverse picture of wheat crop during various interims. Positively pictures were taken when the yield's sustenance request changes that is, Demand of manure and different supplements changes with development of harvest. Supply of composts and supplements based on harvest age can lead higher yield. Utilizing Color handling of Digital picture preparing the period of wheat yield is found and fundamental move can be made by time of harvest. Passing judgment on the development of wheat yield should be possible.

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