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Wireless Sensors Network Applications In The Behavior Of Environmental Parameters

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ABSTRACT
The Wireless Sensor Network (WSN) has allowed monitoring parameters to improve the production of Precision Agriculture (AP), thus making decision making immediately and improving agricultural production, so this research focuses on the analysis of parameters in a greenhouse located at 3100 m, above sea level.
The analysis of the data, showed that the measurements outside the greenhouse have variation in their measurements, which specifies that the relative humidity goes from 26% to 70%, the temperature is between 12°C to 28°C and the humidity of the soil has variations from the 3 Cb to 35 Cb; the maximum parameters of the temperature at midday is at 25.58°C, while the humidity is 26.2%, these parameters show that they are optimal for production, so in the AP a control on the parameters is necessary environmental conditions with the maximum and minimum values that the plant can support to avoid damage due to dehydration, excess heat or generation of mites or pests.
Regarding the conditions, it presents within the greenhouse, the average humidity measurements are between 60% - 70% and the temperature is between 15°C – 28°C, showing that they are optimal parameters for production.
Keywords - Horticulture; precision farming; data networking; wireless sensor network.

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I. INTRODUCTION

[1][2] They specify that technological advances have been unstoppable in recent years, which has improved communications and generated a process of improvement in the transmission and reception of data, thus achieving an evolution of technological tools, Web applications, the age of information and communication through the Internet.

This evolution has allowed new forms of communication to exist in different types of networks, and therefore, [3] it describes that new wireless networks have been created, such as BAN (Body Area Network) or corporal networks, based on the standardization of the IEEE 802.15.4 and referred to as low speed and low power consumption technologies; [4] refers to another significant network in personal networks, such as PAN (Personal Area Network) or also called Bluetooth networks, which work in free frequencies (2.4 GHz and 5 GHz).

Regarding local wireless communications, there are WLAN networks (Wireless Local Area Network), therefore [5], describes that these networks are based on the 802.11 standard, called as Wi-Fi and work in two modes that are: Presence of a Base station and Absence of a base station.

Also, [6] figure that, the relevant WLAN characteristics for the design of security protocols are: Roaming, Security and Noisy Channel.

It is important to emphasize that the aforementioned networks and technological advances, electronics, wireless communications, among others, have allowed the development of new low power wireless networks called wireless sensor networks (RSI - WSN), which have been miniaturized and they have allowed them to be low-cost wireless networks, [7].

These new technologies will allow data exchange, processing, interoperability, and adaptation; which allows a new evolution in wireless communications and considered as the fundamental principle of Wireless Sensor Networks (WSN).

The WSN's main objective is to optimize different states, so that it can be said that they allow to automate several processes in the area of agriculture, home automation, logistics, security, medicine, among others.

It is important to emphasize that the sensors of the WSN networks are equipped with a radio transceiver and a set of transducers, through which information is acquired wirelessly and when implemented in large quantities, these sensors can be automatically organized and configured to form a multi-hop network, special to communicate with each other and with one or more source of nodes.

Regarding the properties of the WSN are the operation of the equipment without physical attention, adaptability in different climates, functionality in the network, auto configuration of the nodes, reliability in the communication, robustness in the network, etc.

Other important properties are the scalability, reliability and adaptability of the network topology, this is generated by the network allows to implement a large number of sensor nodes, without losing its strength in unexpected events, thus having better responses in the processes and generating the auto configuration of the nodes if necessary, this involves the development of a plug-and-play sensor interface, which should allow the distribution of the network's remote connectivity, [8].

The WSN are technologies that allow communication between different nodes and different communication platforms, so it can be said that the use of this technology is limited only by our imagination and ingenuity, specifying that these networks are a diverse set of applications for networks of sensors that cover different fields such as medicine, agriculture, military applications, inventory monitoring, intrusion detection, movement and monitoring of environmental parameters, machinery malfunctions, among others.

One of the most used fields in European countries and Latin America is in precision agriculture (PA), since they can be used to monitor the climatic conditions of different areas of a large cultivated area and calculate different water needs or products chemical

These WSN networks in the AP, have allowed the implementation of the sensors continuously to report environmental data for short or long periods of time, this allows the human being to take measurements periodically and immediately, achieving greater accessibility to the required data in crops, with fewer errors, lower production costs and thus generating a decision making in reference to the information taken in said WSN network.

II. METHODS

To carry out this research, a WSN network was implemented and different end sensor nodes and a gateway were configured; a database was created that admitted collecting the samples taken in the humidity, temperature and luminosity measurements. This WSN network design allowed analyzing the samples and describing optimal parameters in the production of roses.

In the analysis of data and sampling of the research, devices were chosen that allow to measure the humidity and temperature of the soil, humidity and environmental temperature, luminosity and atmospheric pressure.

The wireless sensor network (WSN) was implemented through a star type topology, which allowed the monitoring and data collection of the samples of the described parameters. The measurement processes were made inside and outside a greenhouse, thus achieving a contrast of information and analysis of optimal parameters of agricultural production, especially roses.

The processes carried out in the prototype of the WSN network to monitor parameters related to precision agriculture, are based on the following aspects that are visualized in Fig. 1.

The transmission and reception of the information of the sensor nodes (specks), were made through the validation and reading of ports, this information is passed to a database and from there the same ones are visualized.

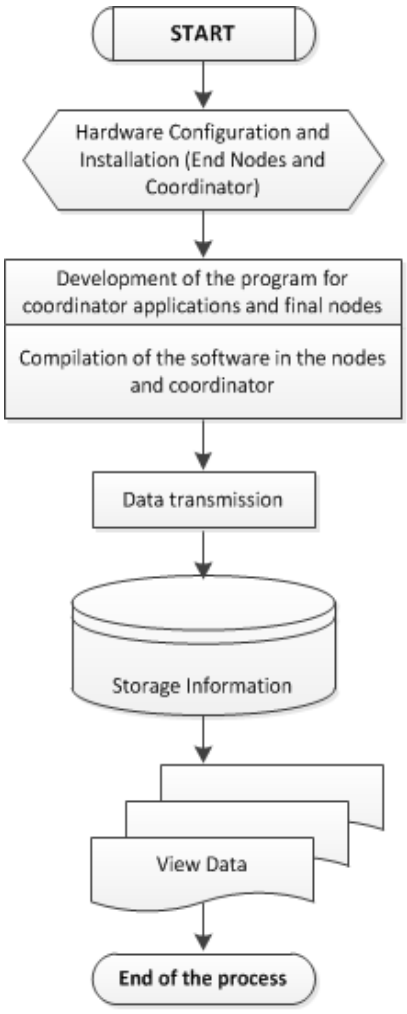

Fig. 1. Prototype WSN block diagram

III. RESULTS

The design and implementation of the WSN network as shown in Fig. 2, was developed in a greenhouse oriented to the cultivation of roses, which is located at 3100 m above sea level.

In the design of the WSN network, a gateway was used to take the samples sent by each final node and be the gateway for the passage of information to the database, two final nodes were also placed which take the samples from the following activities: Node 1: Luminosity, humidity and environmental temperature and Node 2: Humidity and temperature of the soil.

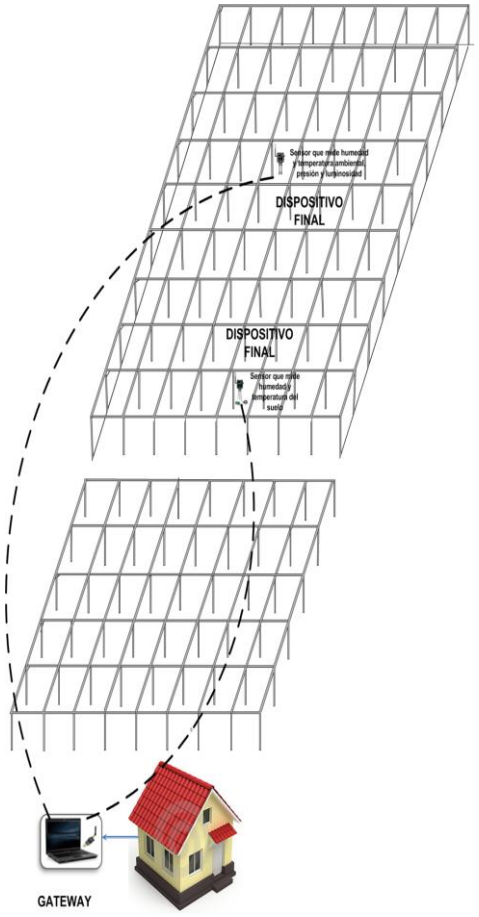

Fig. 2. WSN Network

The data capture processes in the WSN network prototype implementation was carried out in a greenhouse dedicated to Horticulture, with an area of 1440 m2, and for the analysis of the samples taken inside and outside the greenhouse, the equations were applied (1) and (2), which are based on the configuration of the equipment for a period of deep sleep of 1, 5, 10 and 20 minutes in each final sensor.

The equation used for the sampling is:

Mh= (Th (min))/(Td (min)) (1) Samples / hour

The equation to extract the total samples in each node is:

MT=Mh *H (t)*D (2)

Total samples

For measurement and analysis of data outside the greenhouse, the humidity, temperature, pressure and brightness of the environment were taken as measurement parameters, the deep sleep time of each sensor was 5 minutes and 8640 samples were taken in the sensor No. 1, as shown below.

Mh = 12 Samples / hour.

MT = 8640 Total samples.

The period of time for the measurement with the specks was 6 hours for each curve, this time I take it for node 1 and 2.

The different behaviors of the temperature and humidity curves at different times of year of the final nodes Node 1 (N1) and Node 2 (N2) are presented below, so the measurements inside and outside the sample were taken as a sample. greenhouse for a specific period of time of one year, achieving the following parameters.

Measurement of the soil.

N2 - Outside the greenhouse.

In Fig. 3, the variations of node two are described, therefore, measurements of soil moisture outside the greenhouse describe that there is a decrease since it goes from 19 Cb to 3 Cb, this shows that the humidity parameter increases from 2 pm to 4 pm, achieving at that time approximately 10 Cb, therefore in the lower hours, the soil moisture is not adequate for production, since its optimum parameters are between 10 - 30 Cb, specifying that If the values are lower than described above, the soil needs to be moistened.

As for the temperature of the soil, it can be specified that the values are from 16 to 19 ºC, which shows that in the period of this time does not allow a good production, so the parameters for an optimal production are in 17 - 25 ºC.

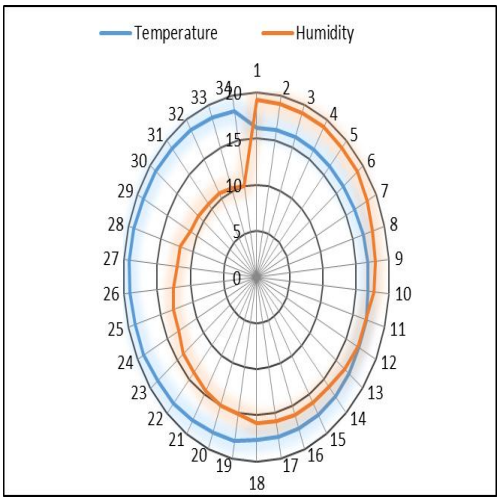

Fig. 3. N2 - Measurement of the soil outside the greenhouse.

N2 - Inside the Greenhouse.

In Fig. 4, it is evident that in the measurements of the soil inside the greenhouse of node 2, the temperature is almost constant since it goes from 15 to 16 °C, having a minimum variation of 1 °C, while the variation of the humidity is between 9 and 12 Cb, which shows that the soil is dry and needs a slight amount of water, so the minimum parameters are 10 Cb for optimal production.

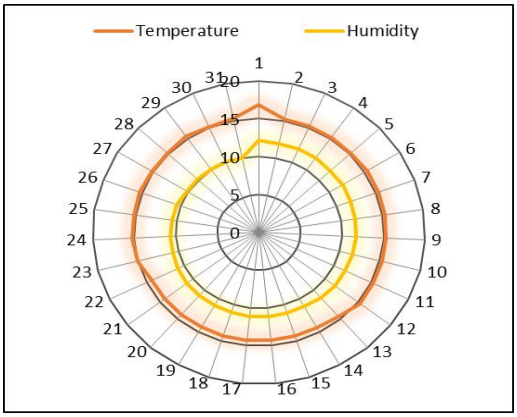

Fig. 4. N2 - Measurement of the soil inside the greenhouse.

Measurement of the environment.

N1 - Outside the Greenhouse.

In Fig. 5 of node one, the samples outside the greenhouse describe that there is a lot of variation in their measurements, since there is no control in the humidity and temperature parameters, so it can be specified that with regard to the parameters of relative humidity the measurements go from 26 to 70%, this could cause that in certain hours the stems and leaves are damaged since the percentage of humidity is not adequate.

It is important to emphasize that percentages lower than 60% damage the plant due to dehydration, for this reason it is stated that the optimum parameters are between 60% and 80% of humidity in the environment.

Regarding the environmental temperature, the measurements taken, describe that outside the greenhouse from 8 am to 16 pm, the temperature is between 12 °C to 28 °C, these temperatures are not optimal in production, since temperatures lower than 15 °C causes damage to the growth of stems and leaves, and on the other hand temperatures higher than 26 °C, are prone to the generation of pests.

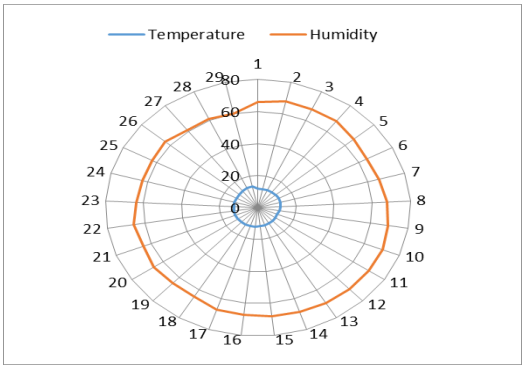

Fig. 5. N1 - Environmental measurement outside the greenhouse.

N1 - Inside the Greenhouse.

In Fig. 6, it is described that the humidity measurements inside the greenhouse from 18 pm to 6 am, are between 14 - 25%, which shows that great care must be taken in the irrigation processes, since percentages lower than 60% relative humidity are optimal for the development of powdery mildew, these low humidity parameters are frequent in summer, and the planting of flowers to be inside a greenhouse causes higher environmental temperatures, so it is a specific control of the parameters of relative humidity and soil irrigation is necessary.

The temperature taken from 6 a.m. to 6 p.m. is between 15 °C - 33 °C, describing that 15 °C is a minimum but acceptable parameter for production, and as for the maximum value, it is evident that it is on the optimal assertions of production, since the maximum should be 26 °C, and there is an excessive temperature of 7 °C, which could help the generation of dust mites, mildew and mildew that reproduce at temperatures higher than 25 °C.

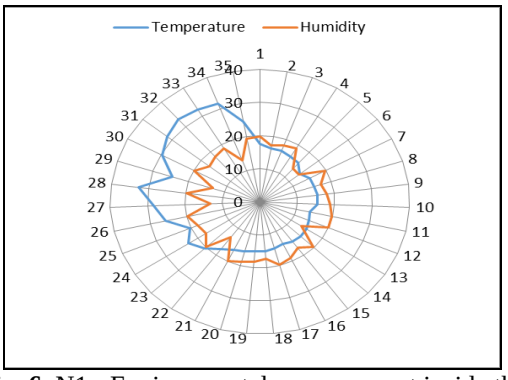

Fig. 6. N1 - Environmental measurement inside the greenhouse

IV. CONCLUSIONS

It must be taken into account that the measurements outside the greenhouse do not have a control, therefore they can increase or decrease uncontrollably, showing that the production outside

the greenhouse does not have a control on the humidity, temperature, luminosity and pressure of the environment, As well as in soil moisture and temperature, which is why it would cause damage to plant growth and production, it is for this reason that samples outside the greenhouse describe that there is a lot of variation in their measurements since there is no a control in the parameters of humidity and temperature, this is evidenced in the relative humidity that goes from 26% to 70%, causing that in certain hours the stems and leaves are damaged; while the temperature is between 12 °C to 28 °C, specifying that these temperatures are not optimal in production which cause damage to the growth of stems and leaves, and therefore are prone to the generation of pests.

The humidity of the soil outside the greenhouse has constant changes due to not having a control of this parameter, therefore it is described that there is a decrease ranging from 35 Cb to 3 Cb, evidenced thus, that the soil moisture is not adequate for the production since values lower than 10 Cb produce deficiency in the growth of the plant because the soil is too dry, and if it is above 30 Cb it would mean that the soil is too humid and the plant would die.

Regarding the conditions that it presents within the greenhouse, it can be specified that there is a viable control in the production, so that the measurement parameters of the environmental and soil part are maintained and do not generate abrupt changes, which is why they do not have steep climbs of humidity and environmental temperature, as well as the earth does not dry immediately, achieving stability in the production parameters, this is evidenced by the average humidity measurements within the greenhouse are between 60% - 70%, which shows that they are optimal parameters for production.

The average temperature inside the greenhouse is between 15 °C - 28 °C, describing that the 15 °C are minimum but acceptable parameters for production, and as for the maximum value it is evident that it is on the optimal production assertions. It is important to describe that the optimum parameter for a good production is 26 °C, thus having an excessive temperature of 2 °C and to control this excessive value the windows of the greenhouse are opened, thereby controlling the environmental parameters, thus avoiding excessive temperatures generate mites, powdery mildew and ash.

The maximum measurement parameters outside the greenhouse at midday show that they are optimal for production, so that the temperature is at 25.58 °C, while in humidity 26.2%, it shows that it is important to generate a control in the environmental parameters with the maximum and minimum values that the plant can support to avoid damages due to dehydration, excess heat or generation of mites or pests.

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