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Data acquisition module for the operation of the web system for automatic irrigation in a Greenhouse

Módulo de adquisición de datos para el funcionamiento del sistema web para el riego automático en un Invernadero

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Abstract

The use of technologies in protected agriculture has impacted the way of improving and transforming cultivation processes. Bastida (2004) mentions that protected agriculture is the one that is carried out under production methods that help to aply a certain degree of control on various environmental factors. In the production of crops in greenhouses, these protect different plants from excess cold at certain times of the year, allowing control of temperature, humidity and other environmental factors that favor plant growth. The drip irrigation system is a fundamental element for the production of greenhouse crops. This work describes the operation of the data acquisition module, which its objective its to collect data on humidity and temperature variables through electronic devices such as sensors and the Arduino, and along an interface it is linked to the web system. showing real-time results of automatic irrigation. This project was based on the model in Prototypes

Data acquisition, Irrigation, Greenhouse

Resumen

El uso de las tecnologías en la agricultura protegida ha impactado en la forma de mejorar y transformar los procesos de cultivo, Bastida (2004), menciona que la agricultura protegida es aquella que se realiza bajo métodos de producción que ayudan a ejercer determinado grado de control sobre los diversos factores del medio ambiente. En la producción de cultivos bajo invernadero, estos protegen, las diferentes plantas del exceso de frío en ciertas épocas del año, permite el control de la temperatura, la humedad y otros factores ambientales que favorecen el crecimiento de las plantas. El sistema de riego por goteo es un elemento fundamental para la producción de cultivos del invernadero. El presente trabajo describe el funcionamiento del módulo de adquisición de datos, que tiene como objetivo la toma de datos de las variables de humedad y temperatura a través de dispositivos electrónicos como los sensores y el arduino, y mediante una interfaz se enlaza con el sistema web que muestra los resultados en tiempo real del riego automático. Este proyecto se basó en el modelo en Prototipos

Adquisición de datos, Riego, Invernaderos

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Introduction

Technology has evolved rapidly that has transformed the way of working and controlling different processes. Protected agriculture is one of the areas in which it has impacted the way crops are produced and harvested. For the Secretary of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA, 2015). Protected Agriculture (PA) is that activity that aims to minimize the externality problems that occur in crops grown in the open field. This method has the advantage that crops can be produced out of season and 5 times increase production in relation to open field production, since they have a system that can adapt to the required needs. Water consumption in agriculture represents close to 87% and the global demand for this resource is increasing more and more (FAO, 2003, it is essential that the greenhouse has an irrigation system since the cultivation of plants takes everything a process that needs to be constantly monitored for the proper growth of the plants. The most used technique is drip that supplies water and nutrients to the plant.

This work describes the operation of the data acquisition module, which is supported by the desktop application and is integrated into the web system. For the purposes of this article, mention is made of the desktop application only since it will be addressed in another future work.

This article describes the data acquisition module, the development methodology based on Prototypes, the results, acknowledgments, conclusions and bibliographic references.

Data acquisition module

It is a collection of software and hardware that allows measuring or controlling the physical characteristics of something in the real world such as voltage, temperature, sound level, among others.

For the correctness use of the data acquisition module, the desktop application, the database, the web system and the collection of soil moisture data, data that when obtained serve for decision making by the farmer. Data acquisition refers to the part in charge of taking information from sensors.

Devices for data acquisition module

The following devices were used to design the circuit:

1. LM-393 (Soil Moisture Sensor)
2. Arduino Uno 3
3. Breadboard or Breadboard
4. Relay 5v to 10v
5. Solenoid valve

Sensor

They are electronic devices with which we can interact with the environment, they provide information on certain variables that surround us, in order to process them and generate orders or activate a process. The variables depend on the type of sensor and can be: temperature, distance, acceleration, humidity, pressure, ph. They are used in different areas such as agriculture, mobile telephony, medicine, automotive or in industrial automation processes (Serna at al. 2010). The LM-393 Sensor is a soil humidity sensor. Its function is to measure an electrical signal that calculates the amount of water that is currently in the soil, or in other words, it allows determining the volume of water stored in the soil. the soil after irrigation, so knowing the water consumption by the crop will largely determine the efficiency of the irrigation. see figure 1.

Figure 1 LM393 soil moisture sensor

Arduino

It is considered a development platform based on a free hardware electronic board that incorporates a re-programmable microcontroller and a series of female pins.

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These allow connections to be established between the microcontroller and the different sensors and actuators in a very simple way. One of the most important features of this platform is the possibility of building the board at home since its components can be found in electronic component stores and using a breadboard or a printed circuit that is easy to produce, at low cost. The C++ programming language was used to program the Arduino, see Figure 2.

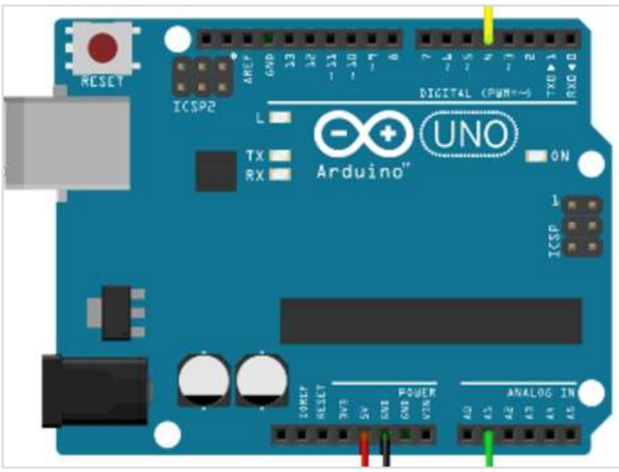

Figure 2 Arduino one

Breadboard

It is a breadboard that allows electronic elements to be interconnected without the need to be weld. Which makes it easier to assemble electronic circuits or systems. It is normally used for testing electronic circuits. If the test is successful, the circuit is designed on a copper plate and weld to avoid the risk of any components becoming disconnected. If the test is not satisfactory, it is easy to change connections and replace components. The breadboard has three easy to identify parts: the center channel, the tracks, and the buses as shown in figure 3.

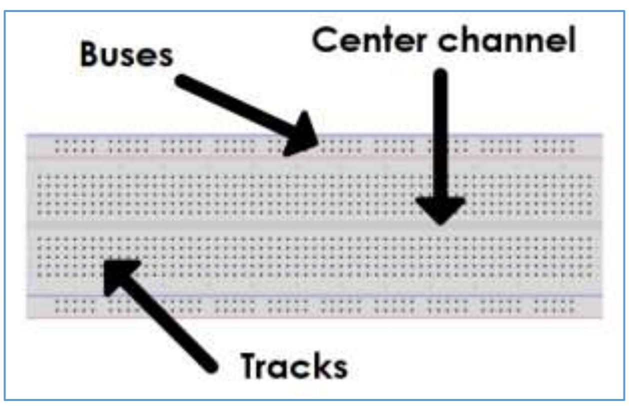

Figure 3 Parts of the Protoboard

Development Methodology

For the development and operation of the two modules, the Prototype model was used. This model aims to directly involve the client in the construction of the required software, and serves as a mechanism to identify and define the software requirements, through an iterative process, (Pressman, 2010, p. 37).

Figure 4 shows the Phases: communication, rapid plan, rapid modeling and design, prototype construction, deployment, delivery and feedback.

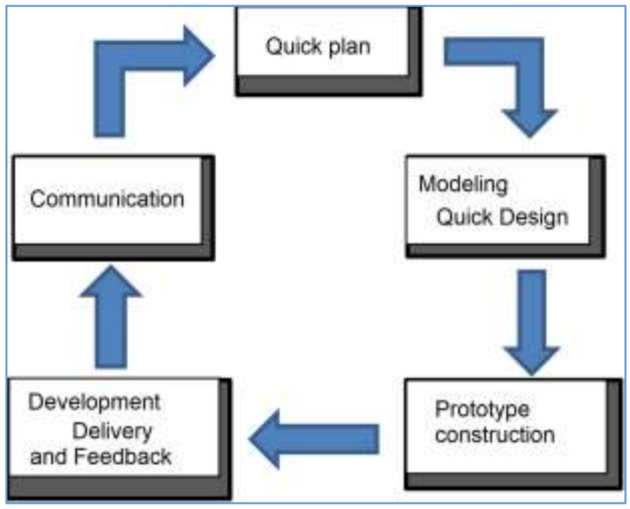

Figure 4 Phases of the model in prototypes
Source: (Pressman, 2010, p. 37)

Description of the phases:

– Communication Phase, in this first phase it is required to obtain soil and moisture data quickly and efficiently. For this, soil moisture sensors will be used, taking into account the requirements for the design of the circuit.

– The Quick Plan Phase. In this phase, the use case technique was used to model the requirements of the data acquisition module. Figure 5 shows a use case for obtaining data from the LM-393 soil sensor.

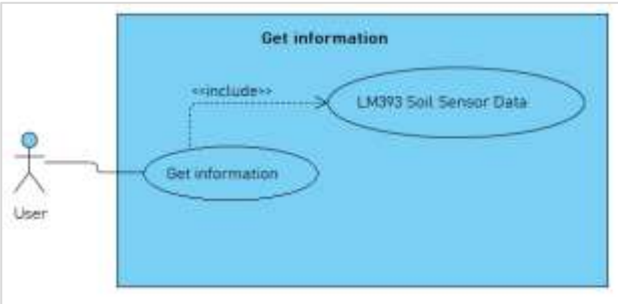

Figure 5 Sensor data collection use case

Table 1, shows a use case to identify the farmer's requirements.

No.	2
Use Case:	LM393 Soil Sensor Data
Actor:	User
Description:	The LabVIEW program displays the values obtained by the sensor on the screen.
Validation	Validation The sensor must be connected

Table 1 Soil moisture sensor use case

– In the Quick Design Modeling phase, the sequence diagrams of the circuit diagram were designed, as an example shown in Figure 6.

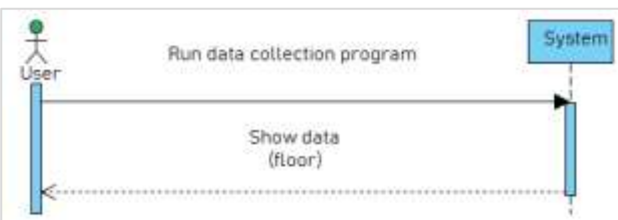

Figure 6 Sequence diagram: data collection

In this phase, the circuit diagram was also designed to obtain data through the LM 393 sensor to obtain soil humidity values, see figure 7.

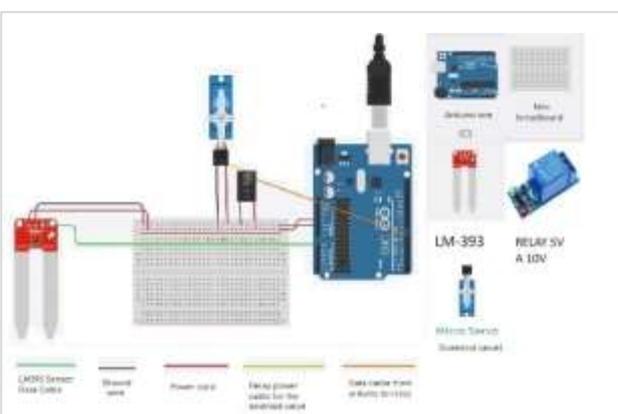

Figure 7 Circuit diagram

– Prototype Construction Phase, the circuit is built, as shown in figure 8.

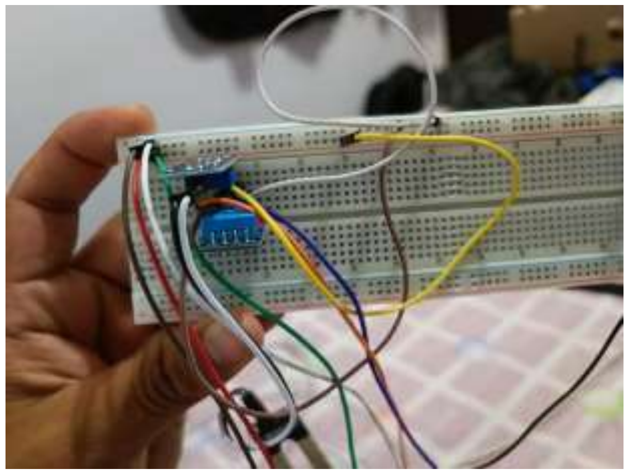

Figure 8 Circuit Construction

Deployment, delivery and feedback phase

Figure 9 shows the final design of the data acquisition module. In this phase, a mock-up was built where the tests of the web system, the desktop application and the operation of the data acquisition module were carried out since due to restrictions Due to the pandemic, at that time they could not be carried out physically in the Greenhouse.

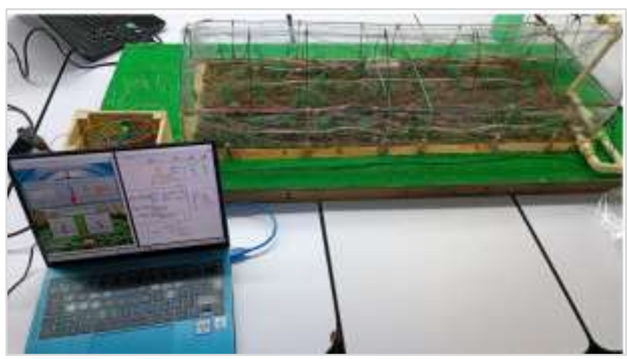

Figure 9 Final design of the data acquisition module

Results

Below are the results obtained from the Data Acquisition module using the web system with the help of the desktop application.

To start, the user must log in to the system with the username and password. See Figure 10.

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Figure 10 System Access Screen

Main screen of the web system

Figure 11 shows the main view of the web system, the options menu, the current system data obtained from the data acquisition module with the values of temperature, humidity and soil moisture, as well as the Water button.

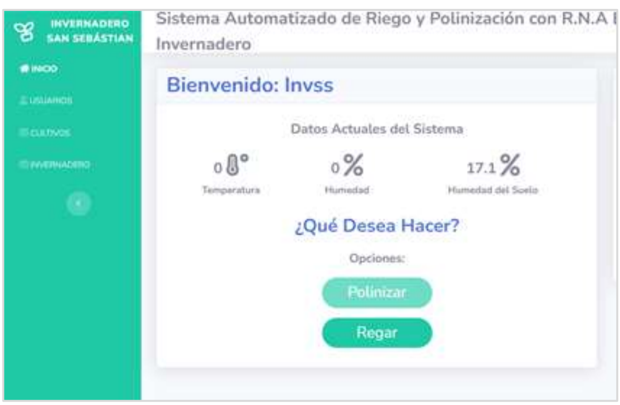

Figure 11 System Access Screen

One of the main functions of the web system is irrigation, and this is where the data acquisition module takes the values sent by the soil moisture sensor to automatically start irrigation.

The process is the following:

– The soil moisture sensor sends the signal to the arduino

– The Arduino is directly linked to LabVIEW in the desktop application part which makes insertions to the database every 5 minutes, indicating the percentage of soil moisture, once it marks that the humidity, if it is very dry a message is sent to the user (user notification) to activate irrigation

– Irrigation is activated from the website once the Irrigation button is clicked, an Update is performed on the status of the insertion that was made in the previous step.

– This change is detected by LABVIEW and sends data to the Arduino.

– The Arduino detects that a signal was sent to digital port 7 of the output and sends a signal to the Relay which changes its state from closed to open and opens the solenoid valve for a certain time until the soil humidity sensor detects that it is already has the correct humidity, see figure 12.

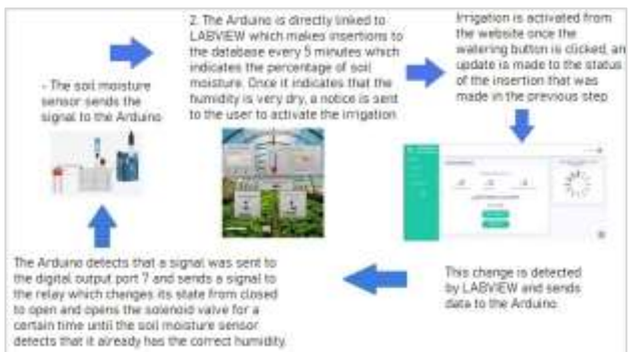

Figure 12 Values sent by the soil moisture sensor

Once automatic irrigation has started, figure 13 shows the irrigation process and the humidity of the beds.

Figure 13 Automatic closing process

Thanks

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The collaboration and dedication of the authors of the article who participated responsibly in the research until the results presented were achieved are appreciated; The objective of this research is to be able to disseminate the findings to the academic community and the general public about the work carried out at the Institution.

Conclusions

Protected agriculture is the most used technique that, due to its characteristics, can produce various types of crops under a greenhouse. Monitoring crops during their development cycle is of utmost importance since when it is carried out, it anticipates the appearance of possible problems that may occur according to Alvarado (2015).

The advantages of greenhouses having an automatic drip irrigation system are greater productivity, the guarantee of producing a quality product, detecting and controlling pests and diseases in time, and the opportunity to market the products. quality on the market

Finally, I can say that the communication capacity of smart devices with electronic circuits opens a range of possibilities for future work. This project will continue with a view to strengthening alternative low-cost solutions that can be acquired by greenhouses located in communities. small and remote areas that help improve the social problems that society faces today.

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