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Prototype of the monitoring and irrigation system of a hydroponic crop with the PIC16F15244.

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Abstract - Hydroponic cultivation is carried out through the use of humidity, temperature and level sensors who control its stability. In addition, a high-level language is implemented which is C together with pic16f15244 allowing us to make use of electronic components such as LCD screens.

Keywords: sensor, culture, language c, pic.

General Objective

- Develop a prototype for monitoring and irrigation of a hydroponic crop.

Specific objectives

- Design the prototype in its mechanical, electronic and software layers.
- Implement the algorithms for the operation of the system based on the PIC16F15244.
- Experimentally validate the operation of the system.

I. INTRODUCTION

This report will develop the analysis of a hydroponic crop based on the advantages that it can have for different types of applications. Whether they are urban or rural applications. Agricultural or private uses.

In the first part, a detailed justification of the use of this type of crops for private use is developed. Then, the physical assembly of the hydroponic crop proposed for the assembly is explained. Based solely on recyclable materials that are easy to obtain.

The electronic needs that the project should have to ensure that the crop has sufficient autonomy for a good performance and also provide the user with a one-way communication to let the user know the variables of the system are then addressed.

II. METHODOLOGY

The purpose of the assembly to be carried out is to present a prototype of an alternative solution, showing a hydroponic crop which has relevant advantages compared to other models of traditional agriculture, to begin with it is worth clarifying that although the fundamental basis of hydroponic crops is water, it will allow through the implemented technology an efficient use of the resource, also the physical assembly of the crop will solve a disadvantage that traditional crops have, which is the possibility of growing in limited environmental and physical conditions. To conclude the exposition of its advantages, it is important to highlight how this prototype will be viable to obtain high quality crops by controlling with greater precision the amount of water and consequently the amount of nutrients that the crop will receive.

The crop itself will monitor two variables of importance in the crop, temperature and humidity will be the magnitudes that will allow decisions to be made in the care of the crop, based on the specific conditions required by the type of plant to be planted, also the assembly will have a level sensor in its water supply tank which will give knowledge of the status of the remaining water level in the system, in addition to providing security and to the motor pump that will feed the crop.

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I. All the variables that will be read by the sensors in addition to providing the necessary information to allow the proper functioning of the project, also the signals provided by the sensors will be displayed on an LCD which allows the user to monitor the status of the same variables.

II. DESARROLLO

Step by step to assemble the project.

Mainly we resorted to find each of the necessary materials for the conformation of the hydroponic culture, for the physical part we have PVC pipes, soil, bucket with water, etc. For the electronic part we used passive elements such as utp cable, resistors, relay and the temperature sensor (PT100 3-wire) and active elements such as the transistor and humidity sensors (FC-28), an integrated circuit as a set of operational amplifiers and the PIC16f15244. Once these materials were obtained we proceeded to the connections of the electronic assembly, that is, what goes on the Protoboard. Before starting we put as a parameter to place all the earths together to avoid connection problems, it is ideal to define a lower line of the breadboard for ground and any connection is made to this as shown in Fig. 1.

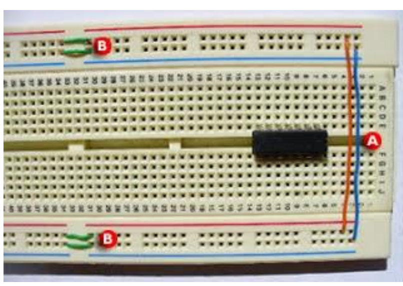

Fig. 1. The top and bottom rows are enabled as power and ground to make more organized connections on the Protoboard.

This same connection procedure was developed with all the breadboards that were necessary for the implementation of the complete assembly.

Then, we continue with the water level sensor, where we make an adaptation of the sensor with a bucket of water where the motor pump will be. In the breadboard we make the respective connection with a relay, a resistor, a transistor and the PIC which will be the same for one of the sensor terminals. In addition, it must be taken into account that it must have a Pull Up system [Fig. 2], i.e., it must be kept short for the sensor to remain in operation. On the other hand, it must be taken into account that the motor pump must always be in the water so that it will not be affected or damaged.

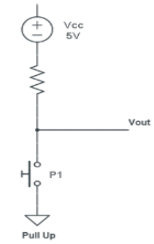

Fig. 2. Pull Down Circuit.

As for the FC-28 hygrometer [Fig. 3.] also called humidity sensor is a two-part sensor where the horseshoe is the sensor and the device called transducer or integrated circuit that comes with it. This circuit translates the signal it receives into a digital signal.

Fig. 3. FC-28 hygrometer is a sensor that measures soil moisture. They are widely used in automatic irrigation systems to detect when it is necessary to activate the pumping system

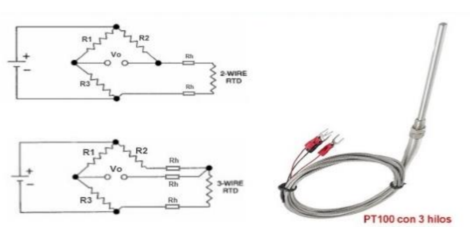

Fig. 4 Wheatstone bridge adapted to the 3-wire pt100

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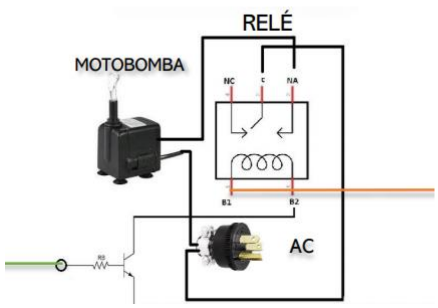

Fig. 5. Relay system

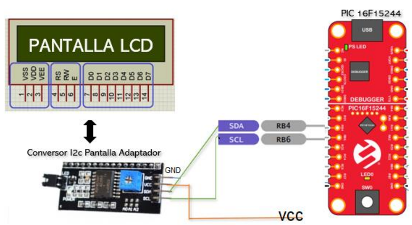

Fig. 6. LCD system.

A. Materials

COST TABLES FOR HYDROPONIC CULTIVATION IMPLEMENTS

IMPLEMENTOS ELECTRONICOS	*CANTIDAD*	*PRECIO*
PT100 3 hilos de 2 metros	*1*	*32,700*
Higrómetro FC-28	*2*	*14,00*
Nivelador de agua vertical	*1*	*13,000*
LCD 16 x 2	*1*	*7,000*
Resistencias	*1*	*4,000*
Adaptador IC2 LCD	*1*	*7,000*
INA122	*1*	*30,000*
Motobomba	*1*	*22,000*
Capacitor de 0.1 uF	*1*	*200*
Capacitor de 10 uF	*1*	*200*
Relé 12v	*1*	*3,000*
LM7805	*1*	*1,500*
Total		*134,600*

Database on costs for hydroponic cultivation, author

IMPLEMENTOS FISICOS	*CANTIDAD*	*PRECIO*
Tubo PVC	*1 metro*	
Codos PVC	*3*	
Tapa tubo PVC	*1*	
Patas Madera	*-*	
Base madera	*-*	*v*
Manguera para la motobomba	*4 metros*	*7.000*
Materas	*4*	*16.000*
Tierra	*1 kilo*	*5.000*
Suplementos	*4 tipos*	*20.000*
Total		

Database on costs for hydroponic cultivation, author

1. Plants

- In the annexes of the plants are on land because they were mainly in water, but attracted a lot of mosquitoes, so while the relationship of the physical part of the crop was made, these were placed on land, but when placed back in water, i.e., already working in the crop will not have any affectation.

- ONION

onions can be grown directly from seed stage or you can plant bulbs first, in this case it was, mainly took a small bulb and put it in a container with water and cotton to help with their livelihood by letting it grow to a certain point. It was then lightly inserted into the hydroponic setup. It should also be noted that it requires at least 12 hours of light for its well-being

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Fig. 7. Onion growth stage.

TOMATO

Tomatoes are quite hardy plants that respond very well to hydroponic growing methods. In addition, tomatoes are vulnerable to a lot of different bacteria, viruses, fungi and pests on the other hand, seeds germinated in the soil outdoors could be contaminated by pests and germs so that's why they were kept in soil at first, to protect them from this.

Fig. 8. Tomato growth stage

- CUCUMBER

Apart from the fact that cucumbers are quite delicate and require special treatment even in hydroponic systems, it was one of the easiest to grow. Well, the seeds were mainly extracted from a cucumber in good condition, then, these were put on a napkin to achieve a natural drying, and after a few hours they were placed in water and cotton, where the seeds began to grow after 4 days.

Fig. 9. Cucumber growth stage..

- CILANTRO

For cilantro mainly kept in soil for 28 days so that the plant should be able to hold the substrate without detaching from the root. From a height of 10 to 12 cm and at least about 6 to 8 leaves.

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Fig. 10 Cilantro growth stage

In an approach to the project it was desired to make an I2C communication to allow monitoring on an LCD of the physical magnitudes provided by the sensors used in the crop, but in the end it was decided to use port B of the pic16F15244 to send and allow communication with the LCD.

ADVANTAGES

- Allows to reduce production costs
- It is produced with little water (only 10% of what is consumed in a traditional crop).
- Foods of high nutritional value
- Pesticide-free food
- Allows production of off-season crops
- No agricultural machinery is used
- Improved cleanliness and hygiene in the finished product
- Crops with much better pest control (bacteria, fungi, viruses)
- Crop uniformity is obtained
- Provides a solution to crop problems in cold or hot soils.
- No need to level the crop
- Significant water savings

DISADVANTAGES

- High initial investment

Lack of technical knowledge

III. ANNEXES

Fig. 11. Physical assembly

Fig. 12. Code fragment for the humidity sensor.

Fig. 13. LCD in operation.

IV. CONCLUSIONS

- The versatility of implementing a proposal or project such as a hydroponic crop means that there are many possibilities in its applications, which can range from vertical crops that maximize indoor space, to crops for agricultural production in places where the possibility of conventional planting can not be developed.

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- During the development of the project, it was necessary to develop the electronic part based on the proposed practical design. From this practical design depended the number of elements and what types of sensors would be appropriate to implement in order to meet the basic needs of the project operation.

- In an approach to the project it was desired to make an I2C communication to allow monitoring on an LCD of the physical magnitudes provided by the sensors used in the crop, but in the end it was decided to use port B of the PIC (name of the PIC) to send and allow communication with the LCD.

- the microcontroller option with which the project is developed is a good option because of the practicality it brings to hydroponic cultivation. It is a microcontroller that does not take up much space and does not need to include additional elements other than those already included in its printed circuit, such as the serial communication port that allows programming the microcontroller or the crystal for the reference of its internal frequency. In addition to its size and its practical way of use, it also has as advantages the wide functionalities that have each of its pins allowing analog and digital readings and writings. Use of PWM. An internal led and a push button

V. REFERENCIAS

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