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Autonomous Urban Garden

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ABSTRACT

Nowadays there are serious global problems, among them, the bad air quality in urban zones stands out, and also the lack of healthy food to guarantee quality feeding. According with some information of the United Nations Organization for agriculture and feeding, the global population is expected to increase to reach 8300 millions, and for that reason objectives for the sustainable development were fixed in the 2030 Agenda.

In Mexico, the 2013-2018 Development Plan in the goal National IV Mexico Prospero is looking to guarantee the security in feeding, that is why an opportunity area has been identified in which we can set innovations and new technology.

The main objective of this project was to develop an Autonomous Urban Garden, which allows to plant and care for different daily consumption foods on the roofs or roofs of houses or buildings through the Arduino platform and various sensors (soil moisture, rain, humidity and temperature), they can convert a large part of the carbon dioxide into oxygen, they will provide food to a family, ensuring that they are consumable since they themselves would be in charge of planting and harvesting.

Keywords – **Arduino, Autonomous, Garden, Sensors.**

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I. INTRODUCTION

Cities currently host more than half of the world's population, a proportion that can increase to two thirds in 2050 [1]. Therefore, the food consumed in these urban areas is mostly purchased in shopping centers where prices are high for a family with average incomes and as a second option in markets where products are often not quality and prices are sometimes they are accessible.

Currently, urban gardens have been chosen in some countries, which provide healthy food and at the same time help improve the air [2]. The number of urban gardens is not considerable, due to the pace of life of people who are constantly busy [3].

The project "Urban Autonomous Garden" involves issues of agriculture and technology, through which we can produce basic food for family consumption, reducing costs and promoting environmental care, it is important to emphasize that as youth or adults should raise awareness of this type of actions in children.

II. METHODOLOGY

For the realization of the Autonomous Urban Garden, a documentary research was carried out beforehand, in which several readings were analyzed about the orchards and the food that can be produced in it, and the needs of the same.

2.1 ANALISYS OF REQUIREMENTS

Applied research was used to determine the materials and tools that would be needed to develop the project.

The materials to use:

Table 1. Materials and tools.

MATERIALS AND TOOLS	
1 Protoboard	Diode
1 Arduino Uno board	Water Pump
1 FC-28 soil moisture sensor	Wooden box with small perforations
1 Rain sensor YL-83	Black plastic
1 DHT-11 temperature and humidity sensor	Thin mesh
8 Resistances 220 Ω	Land
Jumpers	Composta
8 Led	Fruits and vegetables

2.2 CLIMATIC AND EDAPHIC REQUIREMENTS

The climatic and edaphic requirements are shown below [4].

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Table 2. Climatic and edaphic requirements of the garlic.

Cultivation	Garlic
Radiation (Light)	Clear skies with high light intensity.
Temperature	The optimum average is around 18 ° C, with a maximum that should not exceed 26 ° C.
Precipitation	The cultivation coefficients in plants of 30 cm height are 0.7, 1.00 and 0.7, respectively.
Humidity	This crop prefers a dry atmosphere.
Depth of soil	It does not require deep soils, 40-60 cm of soil being sufficient, as long as the soil has good drainage.

Table 3. Climatic and edaphic requirements of the pumpkin.

Cultivation	Pumpkin
Radiation (Light)	It prefers sunny environments, but it can also develop in less luminous conditions (FAO, 1994).
Temperature	The thermal range for growth of this species is 7-30 ° C, with an optimum around 17 ° C (FAO, 1994).
Precipitation	Requires 300 to 1200 mm well distributed during the cycle. (FAO, 1994).
Humidity	For plants with average height of 30 cm, the culture coefficient for the initial, intermediate and late stages is 0.5, 0.95 and 0.75.
Depth of soil	It requires soils of medium depth (FAO, 1994), with a minimum of 50 cm of soil.

Table 4. Climatic and edaphic requirements of the Sweet pepper.

Cultivation	Sweet pepper
Radiation (Light)	It requires direct solar radiation. The amount of light required ranges from 32.3 to 86.1.
Temperature	To germinate it requires a minimum temperature of 13 ° C, with an optimum temperature of 25 ° C and a maximum temperature of 40 ° C.
Precipitation	It requires 600 to 900 mm to complete the vegetative cycle.
Humidity	The optimum relative humidity is 50-70%. Optimal 60 to 70% .
Depth of soil	Soils should be at least 70 cm deep.

Table 5. Climatic and edaphic requirements of the coriander.

Cultivation	Coriander
Radiation (Light)	It prefers sunny places but grows well in partial shade.
Temperature	Temperatures between 10 and 30 ° C, provide optimal growth conditions; tolerates light frosts.
Precipitation	The range of annual precipitation ranges from 500-1400 mm, with a minimum of 300 mm and a maximum of 2600 mm per year. (FAO, 2000).
Humidity	Around 75%.
Depth of soil	It requires deep soils. Soils with depth of 50cm (FAO, 2007).

Table 6. Climatic and edaphic requirements of the cucumber.

Cultivation	Cucumber
Radiation (Light)	The greater the amount of solar radiation, the greater the production.
Temperature	Temperatures between 10 and 30 ° C, provide optimal growth conditions; tolerates light frosts.
Precipitation	It is cultivated preferably under irrigation; in temporary, 900 to 1200 mm are usually adequate.
Humidity	It requires intermediate conditions of environmental humidity.
Depth of soil	It requires moderately deep soils, of at least 60 cm (INIFAP, 1994).

Table 7. Climatic and edaphic requirements of the parsley.

Cultivation	Parsley
Radiation (Light)	It is grown in full sun. Acceptable results are obtained with moderate shading, but it is not recommended.
Temperature	At 24 ° C the plants retard their growth. Germination is slow and reduced when the soil has temperatures> 32 ° C or <4 ° C.
Precipitation	It requires 300-2800 mm of annual rainfall, with an optimum range of 900-1500 mm (FAO, 2000).
Humidity	Humidity less than 80%, since very humid atmospheres favor the appearance of leaf spots and leaf blights caused by insects.
Depth of soil	It requires shallow soils of 20-50 cm (FAO, 2000).

2.3 GARDEN SKETCH

Next in figure 1, the measures that will be used in the model of the autonomous urban garden are presented.

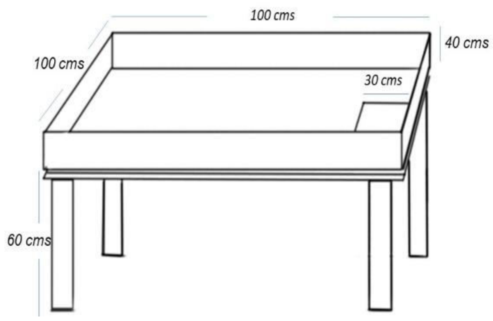

Figure 1. Measures of the garden model.

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III. RESULTS

After knowing the materials, tools and climatic requirements for the autonomous urban garden, we proceeded to the assembly, configuration and coding in the Arduino platform.

3.1 ASSEMBLY OF AUTONOMOUS URBAN GARDEN

For the design of the autonomous urban garden, the Arduino platform [5] was used, a mini water pump and it was necessary to install an HL298N bridge to control it, an FC-28 soil moisture sensor [6] was installed in order to help in the measurement of the humidity of the soil where the plants are, also installed the rain sensor YL-83 to know if it is raining [7] and thus not activate the irrigation of plants, finally installed the temperature sensor DHT-11 to know the temperature and humidity [8] in the environment and later installed LEDs to tell us if the measurements are indicated or not to activate the irrigation of the plants.

In Figure 2, the connection diagram of the elements of the autonomous urban garden is shown.

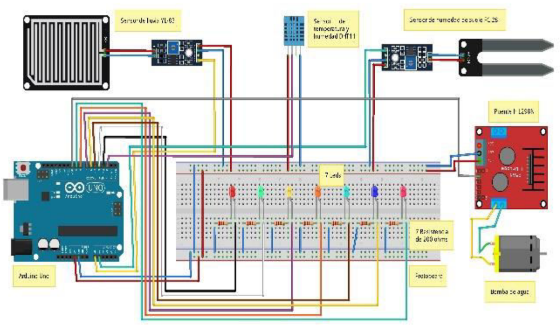

Figure 2. Connection diagram of the autonomous urban garden.

In figure 3, the preparation of compost that will be used to plant the plants is observed.

Figure 3. Compost preparation.

Figure 4 shows how the containers are prepared where the plants of the autonomous urban garden will be planted.

Figure 4. Assembly of electronic cards and sensors

It is observed in figure 5, the assembly of the base with the compost that will be used for the planting of the plants.

Figure 5. Final design of the two vehicles.

Figure 6 shows the physical circuit that is used in the urban autonomous garden.

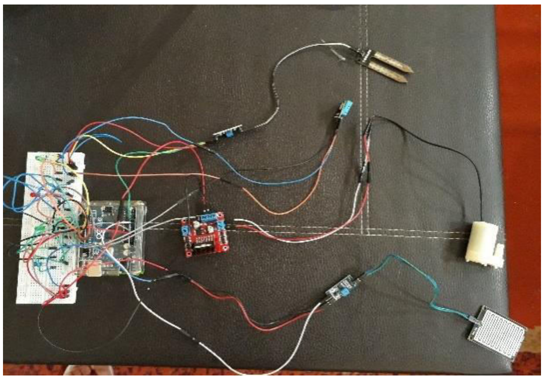

Figure 6. Circuit of the urban autonomous garden.

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In figure 7, the assembled circuit is shown in one of the containers with plant to perform the operation test.

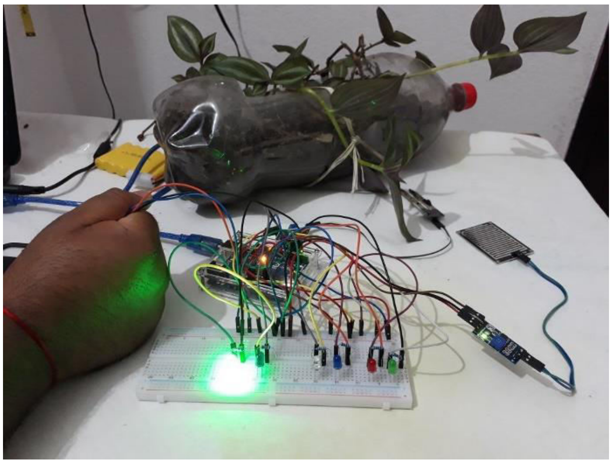

Figure 7. Circuit tests.

Figure 8 shows the final prototype of the functional urban autonomous garden.

Figure 8. Prototype of the urban autonomous garden.

3.2 SOURCE CODE

Next, the C ++ code loaded on the electronic card based on the Atmega328 processor is presented.

```
#include "DHT.h" //cargamos la librería DHT
#include "SPI.h" //cargamos la libreria de la bomba
#define DHTPIN 2 //Seleccionamos el pin en el que se
//conectará el sensor
#define DHTTYPE DHT11 //Se selecciona el DHT11 (hay
//otros DHT)
DHT dht(DHTPIN, DHTTYPE); //Se inicia una variable
que será usada por Arduino para comunicarse con el
sensor

const int sensorllu = A0;
const int sensorPin = A1;

int water_pump_pin = 9;
//Se declara la variable mini bomba de agua y lo asocio al
pin 9
int water_pump_speed = 255;
//Velocidad de la minibomba de agua oscila entre 100
como mínimo y 255 como máximo. Yo he
//elegido 255 pero ustedes pueden elegir la que estimen
conveniente. A más velocidad, mayor
//bombeo de agua

void setup() {
  pinMode(3,OUTPUT);
  pinMode(4,OUTPUT);
  pinMode(5,OUTPUT);
  pinMode(6,OUTPUT);
  pinMode(7,OUTPUT);
  pinMode(8,OUTPUT);
  Serial.begin(9600); //Se inicia la comunicación serial
  dht.begin(); //Se inicia el sensor
}


void loop() {

  //sensor de lluvia
  int lluvia=analogRead(sensorllu);
  Serial.println(lluvia);
  delay(2000);//Se espera 2 segundos para seguir leyendo


   if(lluvia>=1000)
   {
      digitalWrite(3,HIGH);
      delay(1000);
      digitalWrite(3,LOW);
      Serial.println("Sin señal de lluvia");
      Serial.println(" ");
   }

  else

   {
      digitalWrite(4,HIGH);
      delay(1000);
      digitalWrite(4,LOW);
      Serial.println("Lluvia Proxima");
      Serial.println(" ");
    }

  //sensor de humedad suelo
   int humedad=analogRead(sensorPin);
   Serial.println(humedad);
   delay(2000);//Se espera 2 segundos para seguir leyendo

   if((humedad<=700))
   {
      digitalWrite(5,HIGH);
      delay(1000);
      digitalWrite(5,LOW);
      Serial.println("Suelo humedo");
      Serial.println(" ");
   }
```

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```
else
 {
    digitalWrite(6,HIGH);
    delay(1000);
    digitalWrite(6,LOW);
    Serial.println("Suelo seco");
    Serial.println(" ");
  }

//sensor Dht11
float h = dht.readHumidity(); //Se lee la humedad
float t = dht.readTemperature(); //Se lee la temperatura
//Se imprimen las variables
Serial.println("Humedad: ");
Serial.println(h);
Serial.println("Temperatura: ");
Serial.println(t);
delay(0005); //Se espera 2 segundos para seguir leyendo
//datos

 if((t>=20)&&(t<=30))
 {
    digitalWrite(7,HIGH);
    delay(1000);
    digitalWrite(7,LOW);
    Serial.println(" ");
 }

else
 {
    digitalWrite(8,HIGH);
    delay(1000);
    digitalWrite(8,LOW);
    Serial.println(" ");
  }

//bomba de agua

if( humedad >=701 && t >= 30) {
     digitalWrite(9, HIGH);
     //Serial.println("Regar");
     analogWrite(9, water_pump_speed);
    //El motor de la bomba de agua arranca con la
    velocidad elegida anteriormente en el código
   }
 else{
     digitalWrite(9, LOW);
     //Serial.println("No Regar");
    //El motor de la bomba de agua se para y no riega
   }
  delay (100);
}
```

IV. Conclusion

It was concluded that the orchards are very beneficial for all people because they provide food and are economical, you can plant reusing the roots, seeds or stems of some foods which reduces the purchase of seeds to obtain healthy and nutritious food.

This project helps the environment, since the trees make an exchange of gases which is very beneficial for all living beings on Earth.

On the other hand, it serves as educational material to promote the care of the environment and the production of healthy and nutritious foods.

V. Discussion

Evaluate the prototype to make improvements in the current circuit, in the same way add a roof that protects at a certain moment of the sun or rain the orchard, this with the purpose of taking care of the plants providing only the humidity and light that they require.

Make a mobile application that allows to control the functions of the garden and know how the variables of soil moisture, temperature and humidity, rain.

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Biographies and Photographs

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