Prototype Of A PID Type Temperature And Humidity Control System Of An Artificial Habitat For Animals And Plants Of Different Climate

Juan Grados, Wilver Auccahuasi, Santiago Rubiños, Ciro Teran, Gabriel Rafael and Walter Enoky

Abstract: The purpose of this research is the theoretical and practical analysis of an ideal or artificial microclimate system efficiently and systematically, without being affected by external climatic conditions. The PID type control will provide us with an accurate way to automate the Temperature and Humidity to make an artificial habitat without the need to be on the lookout 24 hours. One of the main functions that we want to perform is to maximize the reproduction of animals from different climates and thus protect them against different threats such as high and low temperatures and these cannot support it, in the case of plants the same. To perform it in a practical way, Arduino, temperature and humidity sensor will be used and for PWM control fans will be used for cooling and a spotlight to heat the area. For the humidity control, internally hot humidified gutters with an opening for the humidity outlet will be used using a fan to expand it.

Index Terms: Matlab, PWM, LabView, PID.

1 INTRODUCTION

CD-AC inverters are used in uninterruptible power sources and speed controls for AC motors. This applies to the control of the magnitude and frequency of the output signal. In most of the time, the power flow occurs from the CD side to the AC side, requiring an operation in inverter mode, which is more commonly known as a controlled inverter. Controlled inverters are of two types: VSI or voltage source inverters and CSI or current source inverters. In our case, the first type will be the subject of attention due to its greater application in industrial engineering. There are three categories in which VSIs are divided, they are:

a) PWM or pulse width modulated inverters. This type is capable of controlling the magnitude and frequency of the output signal by modulating the pulse width of the inverter switches. For this there are several schemes that are responsible for producing ac voltages with sine wave form and low harmonic content.

b) Square wave inverters. This type controls the frequency of the output signal and the output magnitude is controlled by another device at the inverter's CD input.
However, the waveform achieved through it is a square wave.

c) Single phase inverters with voltage inversion. This type combines the characteristics of the first two groups of investors mentioned and is not applicable to three-phase devices.

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Pulse Width Modulation (PWM) is a control system for inverters with which an output wave of remarkable characteristics and high performance is obtained, with reduced harmonic content and depending on the application you can opt for a parameter output fixed or variable:

- Variation of the output voltage.
- Frequency variation.
- Variation at constant relationship Voltage – Frequency.

That is, it is intended that the output voltage has great advantages over a square wave with or without offset, especially when variable output is required (we will see that there are important applications). The power circuit is the bridge, in this case single phase, normally implemented with MOS or IGBT transistors, because it generally works with a switching frequency of the order of 15 KHz. Depending on the application, PWM is used between 1KHz and 40 KHz and in fact the elements operate in switching.

2 METHODS Y MATERIALS

2.1 Crops

In agriculture, cultivation, is an ancient art that has the purpose of obtaining through different treatments the growth of vegetables and fruits, which can be used for nutritional, medicinal and aesthetic purposes. The crops are of economic sustenance for many countries, since these by action of the man give like result cereal, fruits, vegetables, among others. There are types of crops such as drying, which is where the contribution of water is not made by the farmer, if not, that this depends on rainfall or groundwater. The second is irrigated, it is where the farmer brings water through natural or artificial channels. Also, according to the ecological footprint, crops can be classified as: Intensive, these consist of small areas; or they can be extensive, which refer to large areas. Due to the farmer's taxonomy, crops can also be classified in traditional, industrial and organic farming.

2.2 Fast growing vegetables
The purpose of having a fast-harvest orchard implies the choice of vegetables that have rapid growth as their main characteristic. Like Radish, for example, it is the first in the list of vegetables that has this characteristic.

2.3 Greenhouses
According to Zoilo Serrano, a greenhouse is a structure covered and artificially sheltered with transparent materials to protect the plant from outside conditions. This installation allows the control of certain productive parameters, such as: ambient temperature, relative humidity, air and light.

2.4 Types of Greenhouses
Greenhouses can be classified in different ways, taking into account the characteristics of their construction elements. This classification is carried out as follows:

- For its external profile.
- Depending on your fixation or mobility.
- For the cover material.
- According to the structure material.

2.5 Methodology

Parameters to consider inside the greenhouse:
The main parameters that should be taken into account when automating a greenhouse are temperature and humidity. Making the aforementioned parameters are in control, allowing the plant to perform its necessary functions within the minimum and maximum limits.

Temperature
It is one of the most important factors in a greenhouse, taking into account that the alteration of this will have an important degree in the development of plants limiting their physiological processes which will be demonstrated in the growth of foliage, abortion of flowers, size of the fruit, etc. The ideal temperature inside a greenhouse for aromatic plants and short-term vegetables should be in the range of 17 ° C to 27 °C. If the temperature is below 7 °C, it will behave like frost, which will destroy the plants. As for the maximum temperature, it cannot exceed 30 ° C, which will also influence the physiological behavior of the plants. . It is very important to know the needs and limitations of the species to crops.

2.6 Proportional Control
A PID is a feedback control mechanism that calculates the deviation or error between a measured value and the value to be obtained, to apply a corrective action that adjusts the process. The calculation algorithm of the PID control is given in three different parameters: the proportional, the integral, and the derivative. The Proportional value determines the reaction of the current error. The Integral generates a correction proportional to the integral of the error, this ensures that, by applying a sufficient control effort, the tracking error is reduced to zero. The Derivative determines the reaction of the time in which the error occurs. The sum of these three actions is used to adjust the process via a control element such as the position of a control valve or the energy supplied to a heater, for example. By adjusting these three variables in the PID control algorithm, the controller can provide a control designed for what the process to be performed requires. The response of the controller can be described in terms of the response of the control to an error, the degree to which the controller reaches the set point, and the degree of oscillation of the system. Note that the use of the PID for control does not guarantee optimum control of the system or its stability. Some applications may only require one or two modes of this control system.

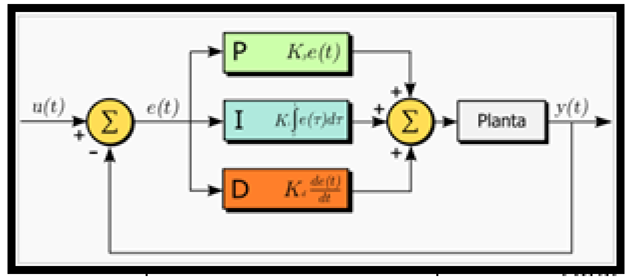

Figure 1. *Block diagrams of a PID Control.*

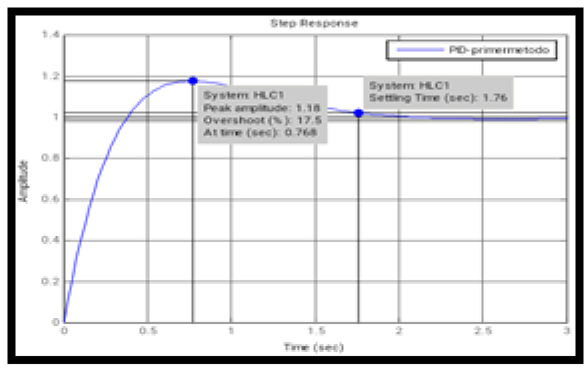

Figure 2. *Graph of the response of a PID control.*

Ziegler and Nichols proposed tuning tables for PID controllers based on delayed first-order transfer functions.

$$G(s) = \frac{Ke^{-\theta s}}{\tau s + 1}$$

Figure 3*. Tuning for Ziegler and Nichols.*

3 RESULTS
The design of the solution will be seen in the Tests or in Figure 4. What would begin with taking the samples with the sensor labview in milli volts and transforming it to a value in degrees Celsius, which will allow us to obtain the results of the temperature in time. Then I will start attaching in Matlab to perform the PID control with the Sisotool and PIDtool to obtain the parameters and visualize how the graph is modified in real time until obtaining a transfer function that allows me to have a stable temperature. First is the transfer function of the plant; in this case we will use 1 bulb to increase the temperature until they stabilize at a certain value that is approximately 24 degrees celcius; then the fan will be turned on with a value of 12v, which in analog value of the arduino pwm is 128 and the fan will be on until the temperature stabilizes. This temperature is approximately 38 degrees celcius. All values will be measured with the LM35 temperature sensor that will be connected to pin A0 of the arduino digital analog converter; and serial communication will be made between the arduino

(who will obtain the data) and the computer through a matlab function to obtain a graph of the data obtained and then using the ident command the plant transfer function will be obtained.

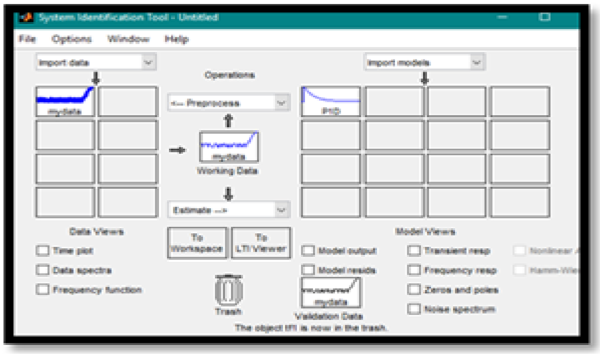

Figure 4. *Function to get data in labview.*

```
>> tf(PID)

ans =

  From input "u1" to output "y1":
                     1.013
  exp(-8.55*s) * -----------
                  46.06 s + 1
```

Figure 5. *Importamos los datos con el comando IDENT.*

The data obtained from the labview samples will be imported that data in matlab, then the variables are declared as input "IN" that would be the SetPoint and the output "OUT" that would be the data obtained from the labview. After obtaining the variables, the "IDENT" command is used and the input and output variables must be placed. As shown in the previous figure, we estimate the response and that will be transferred to the "To workspace".

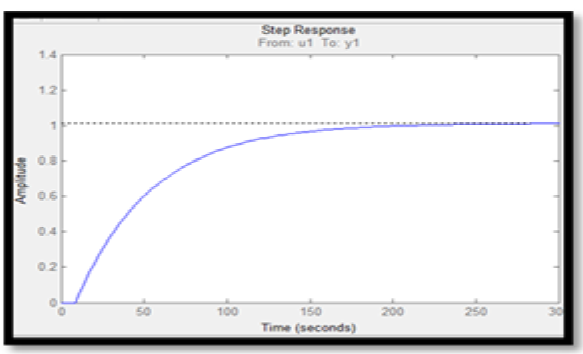

Figure 6. *Graph of our PID signal response.*

```
#include <LiquidCrystal.h> //libreria del lcd
LiquidCrystal lcd(12,11,5,4,3,2);
volatile unsigned long tiempoAnterior;// variable para mantener el tiempo de muestreo
volatile double Ts;
long duracion;
double kp,ti,td,q0,q1,q2,T=0.5;
double SetPoint=24;
double e=0.0,e_1=0.0,e_2=0.0,U=0,U_1=0;
double ex=0.0,e_a=0.0,e_b=0.0,Ux=0,U_a=0;
float k=2,tao=46.06,theta=0.4;
int val;
int foco=9;
float temperatura;
const int boton = 8;
const int tiempoAntirebote = 10;
const int buton=7;
int estadoBoton;
int estadoBotonAnterior;
int estadoButon;
int estadoButonAnterior;
boolean antirebote(int pin) {

  int contador=0;
  boolean estado;
  boolean estadoAnterior;

  do{

    estado=digitalRead(pin);
```

Figure 7. *Entering the parameters to the Arduino code.*

```
Nuevo documento de texto.txt: Bloc de notas
Archivo  Edición  Formato  Ver  Ayuda
40        31.0546875
40        31.640625
40        31.640625
40        31.0546875
40        31.640625
40        32.2265625
40        32.2265625
40        32.8125
40        33.3984375
40        33.984375
40        33.984375
40        34.5703125
40        34.5703125
40        34.5703125
40        34.5703125
```

I

Figure 7. *Data for every second with a 40th entry.*

4 CONCLUSIONS

It is known that we can modify the parameters of the PID until the right balance is achieved. This large-scale prototype would generate broad control of the environment; either for specific plants, etc. Thanks to this prototype, it would be possible to optimize the development of plants or even animals in areas where they are not natural habitats.

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