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CORSO DI DOTTORATO IN MICROELETTRONICA

Design and structure of a meteorological station for predicting and preventing frost as well as pest control using ultrasound waves in high Andean tropic crops located in Colombia.

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Ciclo:XXX

Title

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Introduction

In the high Andean tropic region two main problems were identified that affect the cultivators; one the frost and the other the pests, this project looks forward to solving two problems, designing and structuring a meteorological station that has autonomous energy, using arduino that communicates wirelessly with xbee technology, to alert and prevent frosts. Also, to design a portable device that controls and alienates pests, which affect crops, by means of ultrasonic waves. This device must also be portable and have its own energy i.e. with solar panel, regulator, battery, microcontroller, power circuit and amplification, transducers which supports adverse conditions[1,2].

The project entitled "Design and structure of a meteorological station for predicting and preventing frost as well as pest control using ultrasound waves with Arduino in cultures of the high Andean tropics located in Colombia," is designed for farmers who have extensive peach, apple, pear and plum plantations, it is also focused on the improvement of the harvest, to prevent the presence of frost and to avoid losses by the pest harass that affect farmers and feed on the plants fruit.

As a prevention and prediction of frost, the project is based on the use of 7 climate sensors to detect the presence of frosts via circuit implementation that acquires and sends the signals from the sensors; on the one hand, it is grounded on receiving and storing the data of climatic conditions from the circuit. On the other hand, there is a pest control system underlie on the generation of ultrasound waves, by means of a power circuit and a signal amplification circuit programmed with the Arduino software; both systems have autonomy energy because they operate by solar energy.[3,4]

Executive summary

The purpose of this project is to design, to implement and to build a meteorological station in order to prevent and predict frosts in Boyacá Department, as this phenomenon affects growers of this region in all aspects, the device is also constructed to move pests away from the crops using ultrasonic waves to avoid the use of fungicides and pesticides, these two projects are conducted using arduino technology and with clean energies such as the use of solar panels because such projects are tested on farms where there is no electricity grid.

To achieve this, it was implemented a system which gives an account of the reliability of the data collection as well as the robustness to communicate it at a distance wirelessly, by using the most available devices in the market so that the system can be reproducible by anyone.[5]

In order to carry out the project, the microcontroller ARDUINO UNO and ARDUINO NANO was chosen because it is one of the most popular microcontrollers in the world, because it is easy to program and has many applications.

ZIGBEES were used for the connection of the devices; those have a wide operational range due to the fact that the current stations commercially known usually only cover about 100 m. by implementing the device it is intended to cover at least 400m.

The data to be represented on the computer screen, the LABVIEW platform 2016 version was used, the platform integrates the function datalogger or log, it records the information in a text file (.txt), for further analysis.

Justification and problem statement

The frost phenomenon in the Department of Boyacá affects crops all over the high Andean tropics because all the investment and production of these are lost; another drawback is the excessive use of pesticides and fungicides for pest control. In this sense, this project looks forward to solving these two drawbacks at the same time, first designing and building a weather station that prevents and predicts frost and second by building a device that controls pests that affect crops by means of ultrasonic waves that reduce the use of dangerous substances to the environment.
Meteorological stations already exist, but they do not offer the flexibility to adapt to the requirements that the researchers need, ever since they come with restricted ranges and do not get to the mandatory standard norms for the station emplacement distances and collection of quality data for future decisions.[6,7]
The variables to be measured and the instruments used are:

Speed and Wind Burst (Cup Anemometer)
Wind direction (variable of resistance)
Humidity and temperature DHT11
Amount of rain (rain gauge)
Altitude above sea level and atmospheric pressure (BMP 180)
Those are transmitted in RF by means of ZEEG-BEE technology, this one reaches 400 ms. To its recipient (another ZEEG-BEE), connected to a laptop which through LABVIEW, will collect the data in real time in order to be consulted by the users who need such information.
Another crop disadvantage is the presence of pests all over. The aim is to design and construct a device which removes cleanly the pests by means of ultrasound, a solar panel, an arduino, a battery and amplification circuit, two transducers, a solar regulator; everything mentioned above will be placed is a solid portable structure, which holds out any adverse climatic conditions.[8,9]

General objective

To carry out the design, implementation and construction of a meteorological station for the prediction and prevention of frost with pest control using ultrasonic waves with Arduino and renewable energies in crops of the high Andean tropics in Colombia.

Specific objectives

- To Build a weather station using sensors under arduino control and send the information wirelessly through xbee technology.

- To Design and implement the program in arduino that acquires the information of the sensors and send the information wirelessly so that it is stored in an SD memory.

- To Develop a program in Labview which shows in real time the measurements taken by the sensors of humidity, temperature, atmospheric pressure, altitude above sea level, wind direction and wind speed.

- To Design and build the router circuit and the coordinator circuit to hold out extreme conditions for the prediction and prevention of frost.

- To Build a device that controls pest by means of ultrasonic waves powered by a solar panel, supported with a rechargeable battery to operate in extreme climate conditions.

- To Design the power circuit, the amplification circuit controlled by an arduino nano

- To Develop a software that varies the ultrasonic frequencies from minimum 8000 hz up to 10000 hz, 20000 hz and 30000 hz and start the scanning cycle again.

State of the art

Arduino is a tool used by electronic engineers. There are several projects around this platform from drones, robots and agriculture pressure equipment, controlled through Arduino. As it is an economically affordable platform, openSoftware and openHardware it allows electronic engineers to have a low-priced and affordable tool work, which has information sources in specialized communities whose objective is to develop projects with such high impact in the scientific community.

Arduino is based on a wiring programming language, derived from the C language, therefore, it is not required to have knowledge of electronic and system engineering for programming. All these characteristics make the platform to be used in research centers to conduct any electronic workshop and applied software.

The protocols and communication systems based for the project have a lot of wireless technology innovation; for the wireless transmission it has been used Xbee equipment,

which applies the Zigbee protocol. To the project, particularly the meteorological station counts on hardware that is coupled directly into Arduino One by updating the used library. Zigbee is a protocol with low cost and economic energy consumption; another important originality is that it sends data at a distance between 20 to 110 meters longitude.[10,11]

Theoretical framework

Plantation of Peach, Apple, Pear and Peach at the Veterinary Clinic San Francisco de Asis Juan de Castellanos University Foundation Vereda Otrolado, Soraca, Boyaca, Colombia

Soracá belongs to the central mountain range of the Andes and is in the foothills of the Cundiboyacense plateau; the urban area is hidden in a plateau between the Arzobispo hills, the streams and Tibará where they contrast eroded lands, cold and ravines
yellow. Soracá is a region suitable for the production of potatoes, wheat, fruit trees and pastures for livestock.

As for the departmental location, it is located in the central area of the department of Boyacá at 5º 30 latitude North and 73º west longitude of Grewnwich.
It is 2,942 m above sea level east of Tunja and at the foot of the moor Peña Negra. It is part of the province of Centro along with fourteen (14) more municipalities, occupying the tenth place after Tunja, Samaca, Ventaquemada, Cómbita, Toca, Sotaquirá, Siachoque, Tuta and Chiquiza.
Soracá presents as traditional administrative divisions the urban sector determined by the urban perimeter and the rural sector which is made up of twelve (12) lanes: Alto Negro, Centro, Cruz Blanca, Chaine, Faitoque, Other side, Puente Hamaca, Quebrada Grande , Quebrada Vieja, Rominguira, Rosal and Salitre.
In the sidewalk Otrolado in Soraca Boyaca the University Foundation Juan de Castellanos 15 years ago cultivates peach, apple, pear and plum

Figure 1. Crop sector of peach, pear, apple and plum sidewalk Other side University Foundation Juan de Castellanos
Source: Google Maps

Below are some images of the plantations of peach, apple and pear located in the truth Other side Fundacion Universitaria Juan de Castellanos.

Figure 2. Plantation of Durazno Vereda Other Side Juan de Castellanos University Foundation
Source: made by the researcher

Figure 3. Apple Plantation Vereda Otrolado Juan de Castellanos University Foundation
Source: made by the researcher

Figure 4. Plantation of pear vereda other side Juan de Castellanos University Foundation
Source: made by the researcher

Definitions of frost phenomenon

In meteorological terms it is said that the frost is the occurrence of a temperature equal to or lower than 0 ° C at 2 meters above ground level, that is to say, at the regulatory level which the meteorological measurement stands are located.

From the agrometeorological point of view a frost could be defined as the temperature which the plant tissues begin to suffer damage. In this definition, physiological aspects such as the crop resistance or susceptibility to low temperatures in its different development stages, plant height on the soil level and the temperature of the leaf come to play.

Physiologically, frost in the plant can be presented, even though the phenomenon is not present from the climatic point of view at the weather station level. Additionally, on a frosty night and under certain plant conditions, the internal temperature of the leaf may be lower than the air's; in other words, the frost strength, from the agronomic perspective, may be greater than the recorded climatic intensity [12,13]

Radiation frost

Radiation frost is caused by the loss of heat that plants and soil undergo when granting it to the atmosphere at night thanks to the radiation process; this phenomena is typical of the tropical regions and is feasible to appear from the 2500 meters above sea level (m.s.n.m). These frosts occur when a negative energy balance occurs, in other words, when more energy during the night is lost during the day.

In relation to the external effects caused by frost on plants, are divided into white frost and black frost. The first is produced from dew drops or solid condensation (change from the gaseous state to the solid one, without passing by the liquid state) of the air humidity, then crystalline ice is formed in needles or feathers shapes on the leaves surface, leading to the frost. For this to occur, absolute humidity of the air must be high enough. In the case of black frost, there is no formation of dew or frost and there is a very low atmospheric moisture content, plants suffer burns in their tissues which causes a much more damaging effect than in white frost. As consequence of low temperatures, on the plant occurs the following:

It is produced a functional activity weakening, reducing, among other things, the enzymatic actions, respiratory intensity, photosynthetic activity and the rate of water absorption.

There is a displacement of the biological equilibrium, respiration reduction, photosynthesis, transpiration, water absorption and upward circulation.

Finally, cell death and destruction of tissues occurs. It is necessary to take into account that the sensitivity that a vegetable builds to cold depends on its development state. The most vulnerable phenological states to cold are the flowering and fruit soured [14]

Frost behavior in colombia

The phenomenon of frost in Colombia is much more frequent than it could be expected and is causing millions of losses to agriculture in the highlands of the country. It affects localized areas of more than 2500 m.a.s.l (meters above the sea level), especially in the dry months of the year.

It can be stated that the only type of frost that is presented along the country, with very few exceptions is radiation frost which is originated by nocturnal cooling and therefore disappears generally at sunrise. The white frost is the most frequent in our environment and the whitening aspect of the crop can remain for a while after the sunrise, demonstrating that the frost condition still persists within the crop, even though this phenomenon does not happen at the weather station level.

In the national territory frosts mainly appear in the highlands and the most exposed crops are generally flowers, potatoes, corn and cold weather vegetables.

Spatial distribution of frosts

As mentioned above, in the national territory the frost is concentrated mainly in regions located above 2500 m.a.s.l. The most susceptible areas to frost are found in the cold Altiplanos, mainly the Cundiboyacense Altiplano in the Eastern Mountan chain and the Túquerres and Ipiales in Nariño highlands and Paletará (Cauca) to the southwest of the country. These highlands are located between 2500 and 3000 m.a.s.l, in range temperatures between 9 ° C and 12 ° C on average, which characteristics: clear skies or low cloudiness and very low air humidity favor the loss of terrestrial radiation at night and dawn [15]

Temporal distribution of frost

In Colombia, during dry seasons frosts are the most likely to occur. Yearly, the probability of frost occurrence in the critical areas of the Cundiboyacense Highlands (Funza-Madrid-Mosquera, Nemocón-Ubaté and Duitama-Sogamoso) is higher than 90%, that is to say, in 9 out of 10 years; at least one frost during the year. In regions of lower risk such as Subachoque and Cota, the likelihood rates 20%. However, it can be stated that in the greater part of the area corresponding to the Savanna of Bogota, such likelihood exceeds 50%, which is equivalent to affirm that even in the least affected places once every two years it is possible to expect frost approximately.

At the decadal level, the highest probability of frost occurring in most of the Cundiboyacense Altiplano (Duitama, Nemocón and Mosquera) and other sectors in the north of the Eastern Mountain chain (Tona and Santander) happens in December and the second decade of January, as observed in the histograms of Map 1. These histograms represent the probability of a frost ocurrence in a year in a given decade. In the cold Funza, Nemocón and Sogamoso nucleu, the likelihood in one of these decades that register frost can reach 50%,which means, once every two years, there may be a frost in the last decade of December or the second decade of January. [16]

Other susceptible to frost zones of the country, are located on the Western mountain chain and are characterized by an atypical behavior. For example, in the department of Antioquia, Santa Rosa municipality, the frost incidence is low and these occur only at the beginning of the year, especially in January 20% of likelihood. To the south of the mountain chain, in the Altiplano de Ipiales in Nariño, agricultural activity zone, the frost likelihood is moderate (close to 20%) and the highest frost concentration is in the mid-year period, particularly at the beginning of the second semester.

HISTORICAL OR STATISTICAL RECORDS

Minimum temperature and absolute minimum temperatures averages in some frost susceptibility municipalities in Colombia.

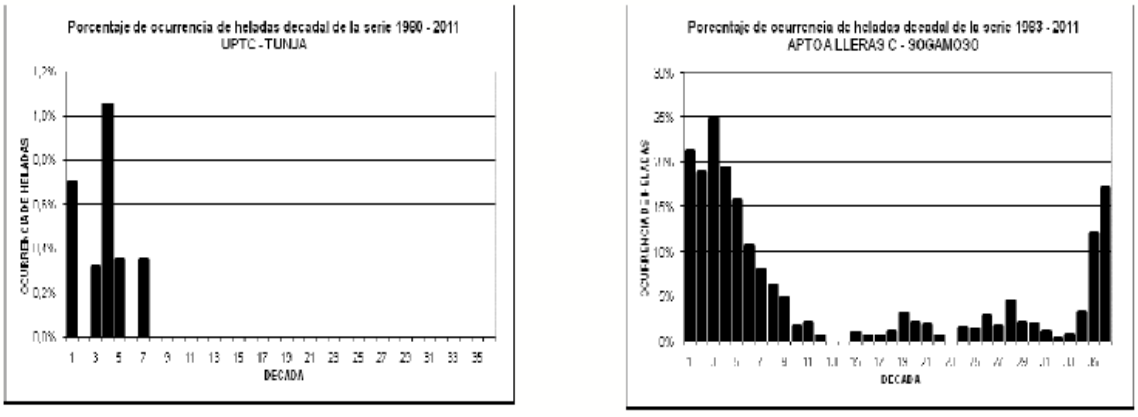
As it is shown in Tables 1, 2 and 3, the minimum temperature averages located in the most susceptible municipalities to frost occurring both in the Altiplano Cundiboyacense are presented. The historical record includes the period between 1971 and 2011, at 2500 and 3000 m.a.s.l.

Estacion		Enero	Febrero	Marzo	Abril	Mayo	Junio	Julio	Agosto	Septiembre	Octubre	Noviembre	Diciembre
UPTC	Promedio	7,34	8,15	9,02	9,81	9,79	9,21	8,55	8,48	8,19	8,79	9,04	8,05
Tunja	Absoluta	-0,6	-1,1	-0,2	3,8	4	2,2	1,8	2,2	3,4	3,2	3	0,4
BOY	dia/año	3/10	5/85	7/08	3/08	23/06	24/94	1/85	29/97	6/95	10/88	26/85	19/85
Apto A Lleras C	Promedio	3,47	4,21	5,88	7,58	7,70	6,78	5,90	5,89	5,55	6,76	7,28	4,99
Sogamoso	Absoluta	-6,2	-8,8	-6,8	-4	-0,8	-0,9	-4	-2,4	-2,4	-2,6	-1,2	-7
BOY	dia/año	29/01	15/95	24/92	15/87	25/99	4/08	13/86	29/97	30/09	9/09	12/87	19/85
Villa Carmen	Promedio	7,42	8,07	8,83	9,41	9,54	9,10	8,56	8,44	8,01	8,40	8,76	7,91
Samaca	Absoluta	-2	-2,9	1,2	1	1,2	1,2	-1,4	0,4	1	1,2	1,4	-4,2
BOY	dia/año	3/10	4/85	13/01	30/84	8/84	29/89	1/85	29/97	17/92	24/88	24/01	30/93
Tunguavita	Promedio	5,70	6,39	7,50	8,74	8,69	7,55	6,70	6,65	6,59	7,85	8,31	6,83
Paipa	Absoluta	-4	-8	-1,9	1,4	1	-0,2	-1,4	-1,6	-0,4	-1,4	1,2	-3,8
BOY	dia/año	27/02	5/85	24/92	3/08	25/99	16/89	13/86	29/97	15/86	9/09	22/02	17/87
Surbata Bonza	Promedio	4,99	5,40	6,73	8,18	7,91	6,91	6,09	6,15	5,94	7,13	7,47	6,35
Duitama	Absoluta	-6,6	-8	-4,4	1	0	-2	-1,4	-2	-0,2	-1,2	-0,3	-4
BOY	dia/año	4/10	4/07	25/10	14/87	6/84	16/89	1/85	29/97	16/86	21/91	12/87	18/85
Chita	Promedio	5,10	5,70	6,58	7,44	7,76	7,45	7,08	6,98	6,64	6,75	6,66	5,65
Chita	Absoluta	0	0	0	0	2,2	0	1,4	-1	-2	1	2	0,8
BOY	dia/año	18/80	12/80	5/80	2/80	22/06	24/80	15/95	1/80	10/80	21/80	28/80	10/84
La Copa	Promedio	5,60	6,15	7,60	8,44	8,53	7,67	7,24	7,27	6,95	7,41	7,80	6,83
Toca	Absoluta	-4,8	-9,8	-1,2	0,2	3	2,2	1,2	0,2	0,4	1,2	1,8	-2,4
BOY	dia/año	4/10	2/07	1/08	18/07	7/03	11/00	6/03	9/00	21/99	24/08	29/99	31/09
Belencito	Promedio	7,88	7,96	9,10	10,00	10,01	9,34	8,78	8,79	8,47	9,23	9,17	8,26
Nobsa	Absoluta	-2	0	1	1,4	4	2,6	1,4	0,5	0,1	0	0,2	-3,2
BOY	dia/año	26/91	4/07	8/97	25/91	5/85	21/97	19/86	16/97	30/97	8/97	23/97	18/85
San Rafael	Promedio	5,73	6,48	7,74	8,96	9,22	8,27	7,42	7,33	7,41	8,14	8,19	6,87
Tibasosa	Absoluta	-4,2	-4,2	-1,5	0,5	1,6	-0,4	0,8	-0,8	1,5	1	1	-1,2
BOY	dia/año	27/02	5/85	12/01	15/80	6/84	11/94	1/85	19/85	18/90	21/91	29/78	18/85

Table 1. Absolute minimum and minimum temperatures occurred in the Boyacá department during 1971 – 2011 periods. Source: IDEAM, Data bank.

Decadal frosts occurrence Percentage, regarding the most susceptible municipalities in the country

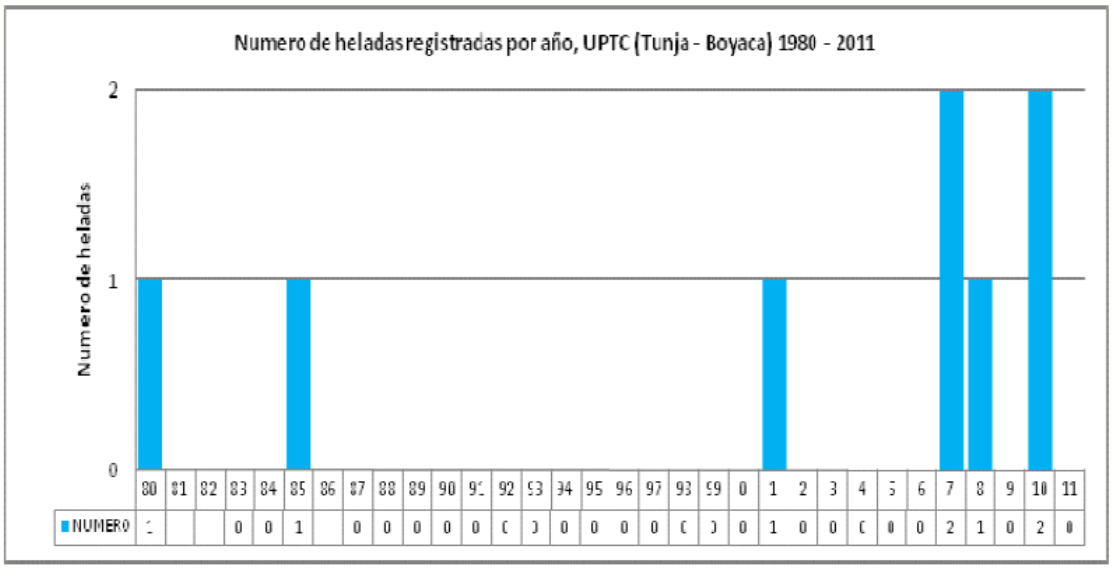
In the graphics, the decadal frosts occurrence percentage is observed in the departments of Boyacá most susceptible to this phenomenon. It can be observed in these affected municipalities that the phenomenon grants a higher percentage in the decade 35 and 36 (end of December) until the decade 6 - 7 (late February, early March) even seeing in some municipalities occurrences until the decade 9 (end of March). However, there is a presence of frost in these municipalities in the 23rd to the 29th.[17,18]



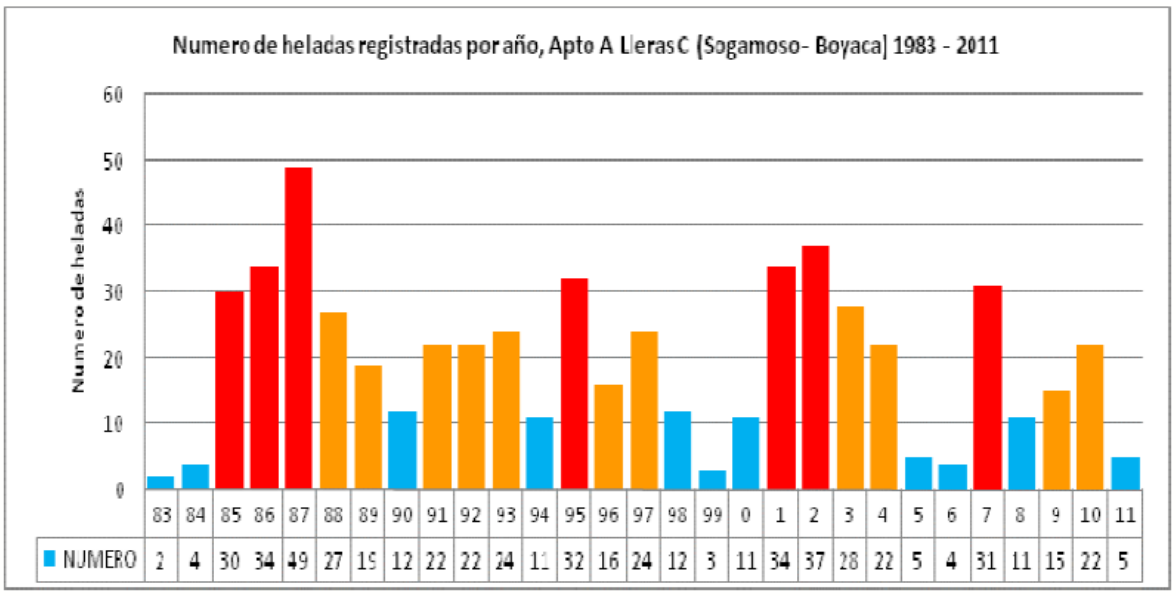
Graphic 1. Occurrence Percentage of decadal frosts in the municipalities of Tunja and Sogamoso. Source: IDEAM, Data bank.

Total annual number of frosts per municipality

On the graphics it can be seen the number of registered frost occurrence per year in a specific season; most frost happenings recorded years were: 1977, 1978, 1985, 1993, 995, 2001, 2002, 2004, 2007 and 2010. Years which it can be registered even more than 25 events per season.[20,21]

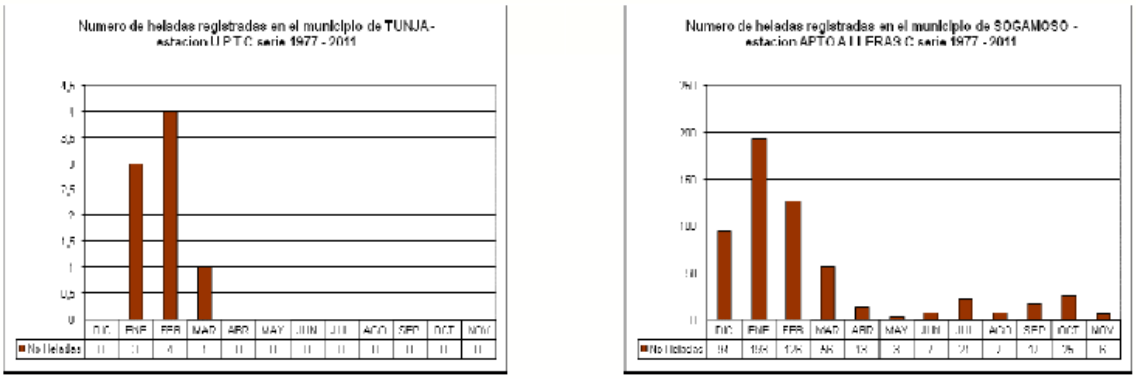


Graphic 2. Number of frost recorded per year, at the U.P.T.C, located in the municipality of Tunja - Boyacá. Source: IDEAM, Data bank.



Graphic 3. Number of frost recorded per year, at the U.P.T.C, located in the municipality of Sogamoso - Boyacá. Source: IDEAM, Data bank.

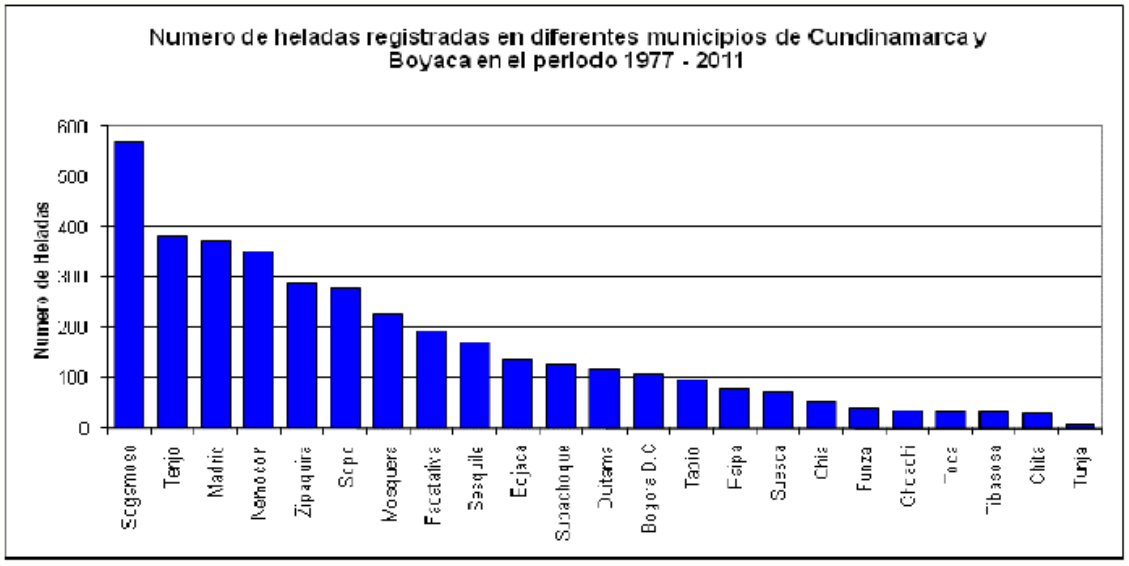
Total number of frosts recorded monthly, period 1977 – 2011



Graphic 4. Number of monthly frosts in the municipality of Tunja and Sogamoso (1977 - 2011). Source: IDEAM, Data bank.

Minimum absolute temperatures recorded per year in the Municipality of Tunja

In figure 7, the total number of frosts, presented in the municipalities which are most susceptible to this phenomenon located in between 2500 and 3000 m.a.s.l during the years 1977 - 2011 regarding the Cundinamarca and Boyacá states is evidenced.



Graphic 5. Total number of frosts presented on the main municipalities located on the Cundinamarca and Boyacá states (1977 - 2011). Source: IDEAM, Data bank.

Plagues

An herbivorous insect or other organism becomes a pest when it has reached a population level sufficient to cause economic losses. The main levels of economic damage estimated goal is to define "the economic loss" for a given crop and to calculate the level of a given pest that would cause such loss.

Pests that affect Peach, Apple, Plum and Pear crops:

The main pests that affect, cause economic damages on the Peach, Apple, Plum and Pear crops are:

Mites

Mites are small animals; many of them cannot be seen at first sight. They have four pairs of legs and feed by scraping the underside surface of the leaves and also sucking the sap. They attack mainly in dry period and produce discolorations and loss in the foliage if the attack is intense. The most common species are white mite Polyphagotarsonemus latus (Banks), red spider Tetranychus sexmaculatus (Riley), red mite of the citrus Panonychus citri (Mac Gregorla red spider Tetranychus mexicanus (Mac Gregor), flat mite Brevipalpus phoenicis (Geijskes) and others as Paratetranychus sp. On the Figure 2 it is shown a red spider under a microscopic view.

Figure 5. Mites

Fruit Fly

The Fruit Fly, also known as Mediterranean Fly, as well as Ceratitis Capitata (scientific name). It owns a very well defined characteristic shown in figure 3; they are one third smaller to the homemade fly, its brown color, almost black ivory stocked- yellow with black marks with a wavy band near the base of the ivory color. Its wings are broad and short, transparent, along with spots on the basal and apical wall.

Figure 6. Fruit Fly

The fruit fly causes direct physical damage to the fruit pulp produced by the larvae. The second damage is caused by the entry of pathogenic microorganisms, as well as indirect implications such as quarantine measures and post-harvest treatments.

Aphids

Aphids are tiny insects about 1/8 "long. They are characterized by possessing two dark color tubular structures. These structures are called cornices. The color of the different species of aphids varies from yellowish tones to dark colors. Typically, aphids do not have wings, but they can develop them to migrate to new areas because of overcrowding or food shortages. Their physical characteristics can be seen in Figure 4.

Figure 7. Aphid

Aphids feed on leaves, shoots, flowers, fruits, branches, stems and roots of a great diversity of plants, trees and shrubs. High populations of these insects cause young leaves, shoots and flowers to wrinkle or curl. Their attack causes the wilting symptoms which get worse in drought times; therefore, plants, trees and shrubs appear dull.

Common Blackbird (Turdus Merula)

This is long tailed Dark bird. The male is Black with beak and orbital yellow ring, the female has brown beak and brown plumage, it is lighter on lower parts; when the female is young, its plumage is striped and reddish. Its characteristics are shown in figure 5.

Figure 8. Blackbird

At all times it eats on the ground, using a technique that could be called “walking”, it consists on running and jumping fast; typically the path shows the advances and pauses alternation when looking for animal prey. If this operation is performed in the litter, it reveals its presence because it is particularly noisy, and may even form holes and dig up bushes. It consumes fruits on the trees and bushes.

MATERIALS AND EQUIPMENT TO BE USED

SENSORS

Sampling of atmospheric variables.

Samples will be collected using the following sensors:

Wind speed

The anemometers may be cup or propeller, the cup anemometer consists of three or four cups mounted symmetrically about a vertical axis (Fig. 9), because the force exerted by the air on the concave side is greater than in the convex side, the crown wheel rotates. The speed of rotation is proportional to the speed of the wind. The anemometer used is three semi-spherical cups, being the most used, the main advantage of cup anemometers is that they measure the two horizontal components of the wind ie if placed horizontal or vertical.

Figure 9. Wind Speed

The Anemometer measures wind speed by closing a contact as a magnet moves past a switch. One contact closure a second indicates 1.492 MPH (2.4 km/h).
The Anemometer should be pulled high to 3.3V or 5V via a 10K Ohm pullup resistor. This is intended to connect to an interrupt input on the host computer.

The Anemometer switch is connected to the inner two conductors (pins 2 and 3) of the RJ11 cable shared by the Anemometer and Wind Vane. Note that most RJ11 cables only have 4 wires instead of the six allowed by the plug.

Direction of the wind
Vane of variable resistance

The element used traditionally to measure wind direction is a wind vane, as can be seen in Fig. It consists of a device mounted on a vertical axis and of free rotation, so that it can move when the wind changes direction. Normally, the movement of the wind vane is damped to prevent too rapid changes in wind direction, the wind vane usually transmits the information using a winding wire potentiometer or a capacitive potentiometer, usually providing the maximum voltage for the north and the minimum direction around of 357º, reason why there is a small hole of 3º. The typical resolution is 0.3 º for each movement shows the most current direction on the screen, to visualize this information and to make sure that it is real, the wind vane must be correctly oriented during its installation in the northward direction before starting to collect data.

Figure 10. Vane of variable resistance

The wind vane is the most complicated of the three sensors. It has eight switches, each connected to a different resistor. The vane's magnet may close two switches at once, allowing up to 16 different positions to be indicated.

Rainfall
Pluviometer.

The rain gauge accurately measures the amount of rainfall dropped by means of an automatic drain rocker. It has a reed switch that opens each time the weight of the accumulated water makes swing the rocker, which produces a pulse that can be recorded by a datalogger or pulse counter. It is specially designed to comply with the guidelines established by the World Meteorological Organization (WMO).

Figure 11. Pluviometer.

The rain gauge is a self-emptying tipping bucket type. Each 0.011" (0.2794 mm) of rain causes one momentary contact closure that can be recorded with a digital counter or microcontroller interrupt input. The gauge's switch is connected to the two center conductors of the attached RJ11-terminated cable.

Atmospheric Pressure and Height above sea level: Sensor BMP180

The barometric pressure sensor BMP180 is designed to read the atmospheric pressure and thus indirectly estimate the Height above sea level. Atmospheric pressure is the force exerted by the air (atmosphere) on the surface of the earth. The atmospheric pressure is due to the weight of the air column over a certain area. For this reason, when the atmospheric pressure is measured at higher points, the pressure value is lower because the air quantity is lower. The atmospheric pressure also varies with the climate, mainly with the temperature, because this causes a change in the density of the air, which is reflected in a change in weight and consequently in a change of pressure.

Then, the atmospheric pressure varies with temperature and altitude, these two variables are the most representative for the pressure change. Factors such as relative humidity and wind speed also influence the atmospheric pressure in a smaller way and can be avoided.

What the BMP180 sensor measures is the absolute pressure (Barometric) and the temperature, when sensing the temperature we can compensate its influence in the pressure and thus determine more accurately the altitude.

Figure 12 Sensor BMP180

Technical specifications:

I2C communication interface
Power Supply 1.8 - 3.6Vdc
Consumption 3-32μA
Operating temperature range -40 ° C to 60 ° C (operating) 0 ° C to 45 ° C (max)
Measuring range (humidity) 300 to 1100 hPa
Accuracy (humidity) 0.03hPa
Measurement range (temperature) -40ºC - 85ºC

Temperature and relative humidity: DHT22 sensor

It is a digital temperature and humidity sensor calibrated in the factory, it consists of a microprocessor that uses a capacitive humidity sensor, to measure the relative humidity of the air, the more it approaches the value to 100% more humid is the measured environment, also includes a thermistor to measure the surrounding air, and calculate the temperature of it, displays the data by a digital signal on the data pin. New data can be obtained once every 2 seconds.

The good thing about these devices, is on the one hand its low cost and on the other the power to feel two analog parameters like the temperature and the humidity of digital form, because
the sensor does the conversions.

Figure 13. Sensor DTH22

Technical specifications:

Power from 3.3V to 5VDC
Maximum current 2.5mA during conversion
Moisture reading with +/- 2% to 5% accuracy
Temperature reading with +/- 0.5 ° C accuracy
Able to measure humidity from 0% to 100%
Able to measure temperature from -40 ° C to 125 ° C
Not more than 0.5Hz in sampling rate (once every two seconds)
Dimensions: 15.1mm x 25mm x 7.7mm.

Arduino

Arduino is an open source hardware and software platform, based on a simple board with analog and digital inputs and outputs, in a development environment that is based on the programming language Processing. That is, an open source platform for electronic prototypes.
Being open source, both its design and its distribution, can be freely used for the development of any type of project without license.
The project was conceived in Italy in 2005 by Zaragoza David Cuartielles, an electronic engineer and teacher of the University of Mälmo (Sweden) and Massimo Banzi, Italian, designer and web developer.

Figure 14. Arduino uno and Arduino Nano

Arduino Uno

Arduino Uno is responsible for carrying out all project processing, transmitting and receiving information from the connected modules. For this Arduino Uno is composed of 3 fundamental parts:
Processing unit or CPU: responsible for executing each instruction implemented in the IDE.
Memory section: responsible for storing instructions and input and output data.
Input and output pins: slots that allow Arduino ONE to connect to external modules. Some of these pins are responsible for providing the voltage to the same module so that it obtains energy.

Technical specifications:

Microcontroller: ATmega328P
Operating Voltage 5V
Input voltage (recommended) 7-12V
Input voltage (limit) 6-20V
Digital input / output pins 14 (6 of which provide PWM output) Digital PWM input / output pins 6
Analog input pins 6
Continuous current for 20 mA input / output
Continuous current for Pin 3.3V 50 mA
Flash memory 32 KB (ATmega328P) of which 0.5 KB used by the boot loader SRAM 2 KB (ATmega328P) EEPROM 1 KB (ATmega328P)
Clock speed 16 MHz
Length 68.6 mm Width 53.4 mm
Weight 25 g

Arduino Nano

The Arduino Nano is a small and complete board based on the ATmega328 (Arduino Nano 3.0) or the ATmega168 in its previous versions (Arduino Nano 2.x) that is used connecting it to a protoboard. It has more or less the same functionality as the Arduino Duemilanove, but with a different presentation. It has no external power connector, and works with a Mini-B USB cable.

Technical specifications:

Microcontroller: Atmel ATmega328 (ATmega168 previous versions)
Operating voltage (logic level): 5 V
Input voltage (recommended): 7-12 V
Input voltage (limits): 6-20 V
Digital I / O pins: 14 (of which 6 provide PWM output
Analog inputs: 8 Max current for each I / O PIN: 40 mA
Flash memory: 32 KB (ATmega328) of which 2KB is used by the bootloader (16 KB - ATmega168)
SRAM: 2 KB (ATmega328) (1 KB ATmega168)
EEPROM: 1 KB (ATmega328) (512 bytes - ATmega168)
Clock frequency: 16 MHz
Dimensions: 18.5mm x 43.2mm

Energy

The Arduino Nano has automatic selection of the power supply and can be fed through:
A Mini-B USB connection.
An unregulated 6-20V power supply (pin 30).
A regulated 5V power supply (pin 27)

XBee

According to Digi, XBee modules are integrated solutions that provide a wireless medium for interconnection and communication between devices. These modules use the network protocol called IEEE 802.15.4 to create FAST POINT-TO-MULTIPOINT networks (point-to-multipoint); or PEER-TO-PEER (point-to-point) networks. They were designed for applications that require high data traffic, low latency and predictable communication synchronization. So basically XBee is owned by Digi based on the Zigbee protocol. In simple terms, the XBee are easy to use wireless modules.

Figure 15. Xbee S2C

Zigbee

It is an alliance and a standard of MESH energy efficiency and cost networks. XBee uses the Zigbee standard and adds and wraps it in a small, elegant package (http://www.zigbee.org/).

Ultrasound

It is then defined as a series of mechanical waves, usually longitudinal, originated by the vibration of an elastic body (piezoelectric crystal) and propagated by a material medium (body tissues) whose frequency exceeds that of audible sound by the human: 20,000 cycles / second or 20 kilohertz (20 kHz).

Solar Panel 20W

These devices transform sunlight into electrical energy, a luminous particle with energy (photon) becomes an electromotive (voltaic) energy.

Figure 16. Solar Panel

Technical specifications

Power: 20W
-Voltage Maximum Power: 17.5 V
- Max Power: 1.15 A
-Voltage Circuit Open: 21.6 V
- Short Circuit: 1.3 A
- Maximum System Voltage: 1000 V DC
-Efficiency of the cell: 16.45%
-Efficiency of the module: 12.03%
-Range operating temperature: -40 ° C to 85 ° C
-Front cover (material / thickness): Tempered glass low in iron / 3.2 mm-Solar cell (quantity / type / dimensions): 36 / polycrystalline silicon / 62 x 156 mm-Frame: Anodized aluminum
-Dimensions: 475 x 350 x 25 mm
-Weight: 2.11 Kg.

Solar Panel Charge Controller Battery Regulator Safe Protection HS

Device in charge of protecting the battery against overloads and deep discharges.
The voltage regulator constantly monitors the charge status of the batteries and regulates the charging current of the batteries to extend their service life. It also generates alarms depending on the state of said load.

Figure 17. Solar Panel Charge Controller Battery Regulator

Specifications

Rated Voltage:	12V/24V AUTO Work
Charge Current:	10A
Discharge Current:	10A
Self consume:	≤10mA
Float Charge:	14.7V/29.4V
Discharge stop:	10.5V/21.0V
Discharge reconnect:	12.2V/24.4V
Operating Temperature:	-20°C to +60°C
Application:	Home, Industrial, Commercial
Weight:	135g
Size:	133*70*33mm

Solar Battery

It consists of one or more electrochemical cells that can convert stored chemical energy into electricity. Each cell consists of a positive electrode and a negative electrode and electrolytes that allow the ions to move between the electrodes, making it easy for the current to flow out of the battery to carry out its function.

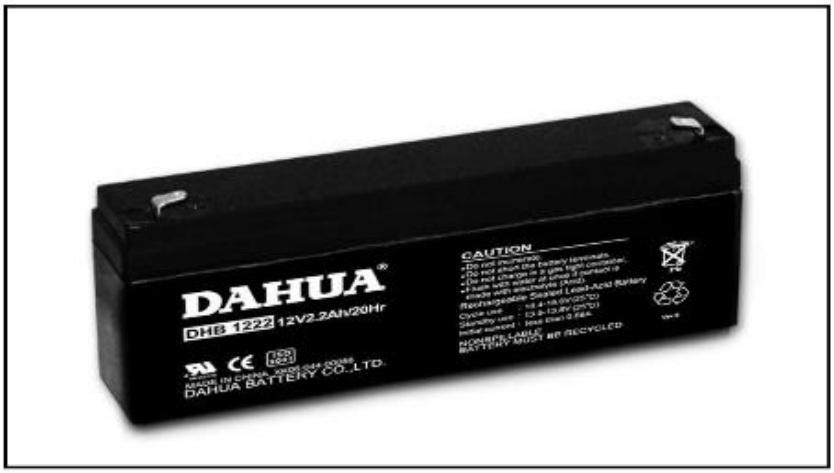


Figure 18. Solar Battery

Technical specifications:

Cycle use: 14.4-15.0 V (25ºC)
Standy use: 13.5-13.8V (25ºC)
Initial Current: less tan 0.66 A
Nominal Voltage: 12V
Nominal Capacity: 2.2Ah
Terminal Type: F1
Weight: 2.12 Lbs
Length: 178mm (7.01")
Width: 35mm (1.38")
Height: 61mm (2.40")

Methodology

After the election and approval of the research project presented here. We analyzed the overall system requirements and the consequent choice of devices. Later, a design was made that facilitated the understanding of the assembly of the system. After the assembly several algorithms were realized that a posteriori helped to the implementation of the code. Having clear the structure, the programming was realized in small fragments that later have been gathered in the general code. Finally, numerous tests were carried out to strengthen the reliability of the project.

Stages and Schedule

Next, it will show the stages distributed in the time that have been carried out for the realization of the project.
Each chart indicates a week of the month, the first chart being the first week of the month.

JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
1	1	3	5	8	8	9	7	11
1	2	3,4	6	8	8	9	9,10	11
1	2	4	6	8	8	9	9,10	11
1	2,3	4	6	8	8	9	9,10	11

Table 2: Schedule of steps

1. Search for documentation and bibliography about the project. Search for information that help you to decide the first steps of the project. Decisions like, what programming environments is more appropriate to use or planning the tasks to perform.

2. Learning the basics of Arduino. We study the Arduino programming base and its development environment.

3. Study the Arduino programming language. It is necessary to study this language as it facilitates the implementation of the necessary libraries for each project.

4. Choice of Weather Station devices. A study is carried out on which sensors and modules are the most adequate and economical to cover the needs of the project.

5. Choice of Pest Control Devices Ultrasound. A study is carried out on the appropriate and economical components to cover the needs of the project.

6. Assembly design. Plots are made indicating the connections between arduino and the sensors `for the weather station and the pest control device by ultrasound.

7. Assembly. Connections, Welding, Installation, etc.

8. Implementation algorithms. Algorithms of the different code fragments to be implemented.

9. Implementation of the Arduino code and libraries. Implementation of the necessary code for the reception of data of the sensors in Arduino and the transmission Xbee. Implementation of the

Arduino code and libraries for pest control device with ultrasound. Implementation of the code for the emission of frequencies from 8khz to 30khz.

10. Implementation and design of the application using Labview 2016 for the weather station ..

11. Testing the systems. Check if both systems work correctly.

Analysis and results

Modality of research

In the present project a field research has been carried out, since it was necessary to carry out a study in the exact place where the problem is generated, in order to collect information that was useful in the development of the investigation, besides being a contribution for meet the objectives.
A bibliographic investigation of scientific journals, scientific contributions and electronic publications was carried out in order to deepen the different parameters that the subject to investigate so requires, in this way it will collect the necessary information for the research support of the project, applying concepts and theories of diverse authors according to the parameters of the research.[22]

Processing and data analysis

For the accomplishment of the processing and analysis of the data the following parameters were carried out:
- Data collection through the use of interviews with the sample population.
- Thorough review of the information obtained to help approach the solution of the problem through the proposal.
- Reading articles related to research.
- Interpretation of results with the support of the theoretical framework in each of the aspects.
- Data collection through field research.

Development of the research project

The following are the steps that were followed for the development of the research project:
Compilation of information.
- Observations of the two problems were made on the frost and the pests that affect the crops of the peach, apple, pear and plum located in the sidewalk Otrolado Juan de Castellanos University Foundation
- Surveys were carried out to the Agricultural Engineers and employees in charge of the crops of the Juan de Castellanos University Foundation with the objective of collecting information and knowing the current situation of the crops.

Determination of system requirements based on problems encountered in the area.

The analysis of the answers to the questions posed in the surveys to the people in charge of the crops was carried out.

Taking data at the site of the problem through Field Research.

Photographs were taken and videotapes were made on the crops of the Juan de Castellanos Vereda Otro Universalizada University Foundation in order to predict frost and detect the most significant pests incident on crops.

Design of the system of prediction and prevention of freezing and pest control in the crops of the University Foundation Juan de Castellanos Vereda Otrolado.

- The algorithm of the System Prediction and Prevention of Frost S was started in terms of the variables used such as: temperature, relative humidity, sea level, atmospheric pressure, wind speed, wind direction and rainfall.

- The algorithm of the Pest Control System was started in terms of the variables used such as birds, fruit fly, mites and thrips.

- The corresponding simulations were performed based on the logic algorithm.

- The equipment and materials suitable for use in the prototype were determined.

Construction of the prototype of the system of prevention and prediction of frost in the peach, apple, pear and plum crops of the Juan de Castellanos University Foundation Otrolado Soraca Boyacá Colombia.

Construction of the prototype of the pest control system by ultrasound in the peach, apple, pear and plum crops of the Juan de Castellanos University Foundation Vereda Otrolado Soraca Boyacá Colombia.

- The necessary tests were carried out in Protoboard for eight months to verify the correct functioning of the System of prediction and prevention of frost and the System of ultrasonic control of plagues located in the University Foundation Juan de Castellanos Vereda Otrolado Soraca Boyaca Colombia.

-The assembly of the research projects was done in plates and was coupled to the materials used in the prototype.

Testing the prototype of the designed system.

- The corresponding functional tests were carried out to verify that all the system requirements were fulfilled, such as:

-The implementation of an electronic system of prediction and prevention of frosts that affect the apple, peach, pear and plum crops.

-The implementation of an electronic system to control the most significant pests by means of ultrasound.

Programming setting and software.

The main features of these settings, as well as their main advantages, are described below:

Arduino IDE
Arduino programming setting is available on the official website . And is also available for GNU / Linux, Mac OS and Windows, free software. Based on a programming language inspired by the Processing language, it offers a very familiar language maintaining programming patterns, whether creating variables, loops, logical blocks, etc.
This IDE has several tools that facilitate the programs execution, creation and testing themselves.

The interface and its component parts are displayed:

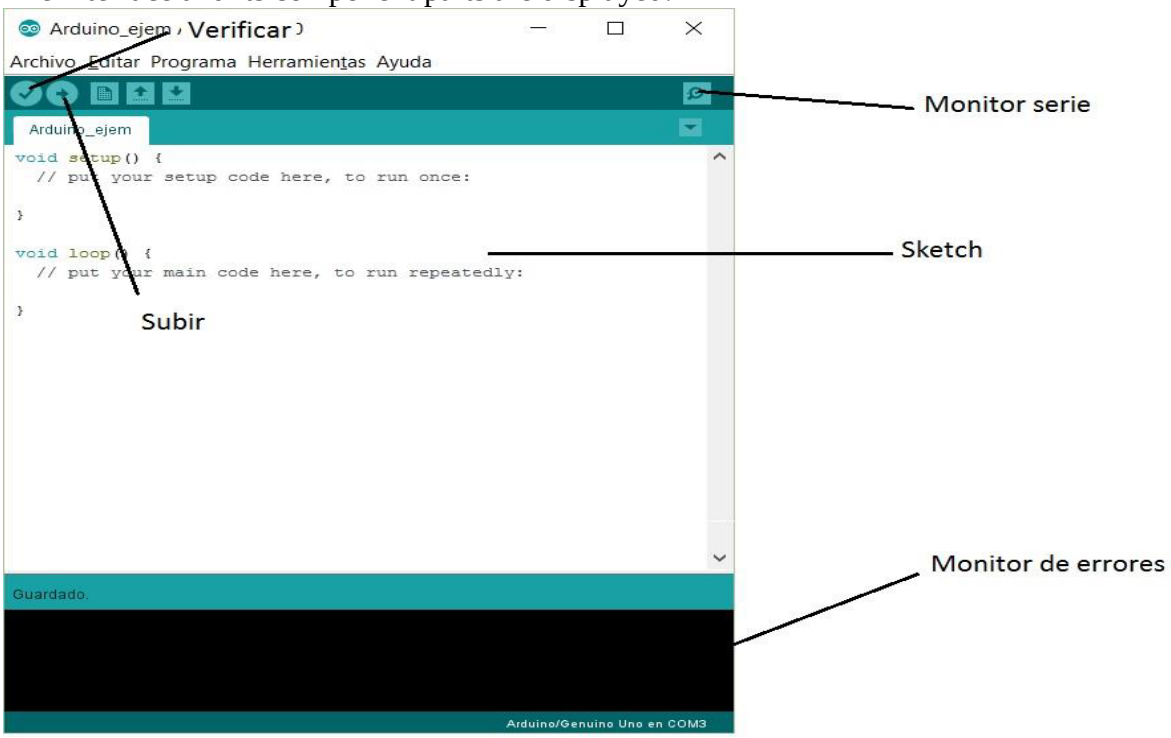


Figure19. Arduino IDE Interface

- Check: compiler, check if there is any code error in both the sketch itself and an imported library.
- Upload: compiles and loads the program on the Arduino board.
- Monitor series: allows to observe the communication of the connected USB of Arduino to our computer. It can verify if the program works correctly by observing program results or notifications.
- Sketch: IDE text editor.

-Monitor of errors: shows the errors that have occurred when running the compiler. It indicates in which file and line the error occurred, as well as a small description of the error.
The program code can be extended by importing own IDE libraries or external ones using a ZIP compression format. The environment itself has a number of very useful default libraries installed.

Xbee Software Configuration XCTU

XBee Explorer USB

The first, install the XBee Explorer USB drivers, which will allow to configure and operate the Xbee modem from any PC. Put the "XBee Series 2" modem in the "Xbee Explorer USB" and plug the USB port into the PC, for versions of Windows Vista and former, the drivers will be installed automatically. For Windows 7 it must be performed the process of installing the drivers manually from the device manager.

Figure 20. Xbee programmer to assign router and coordinator in XCTU software

Setting the Xbee S2C Network Series

There are not many differences in its basic configuration form with Series 1, although in this version we will find more fields and a slightly different distribution of them. For the following configuration it will be used 2 XBee series 2 and 2 XBee Explorer USB to show one of the new advantages of the software. The configuration process is shown in the figures 21, 22, 23, 24, 25 y 26.
To configure the modules, open the XCTU software and select the "Discover Radio" option.

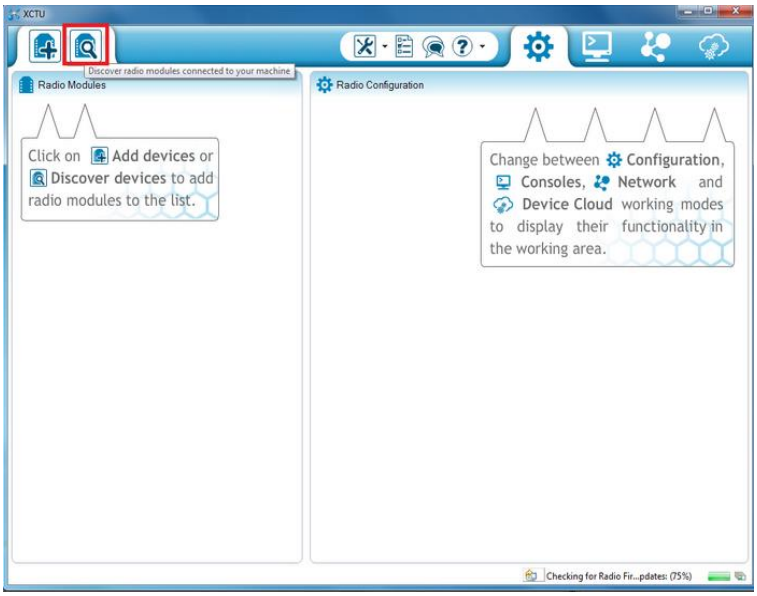


Figure 21

We must select the COM port assigned to the XBee Explorer USB

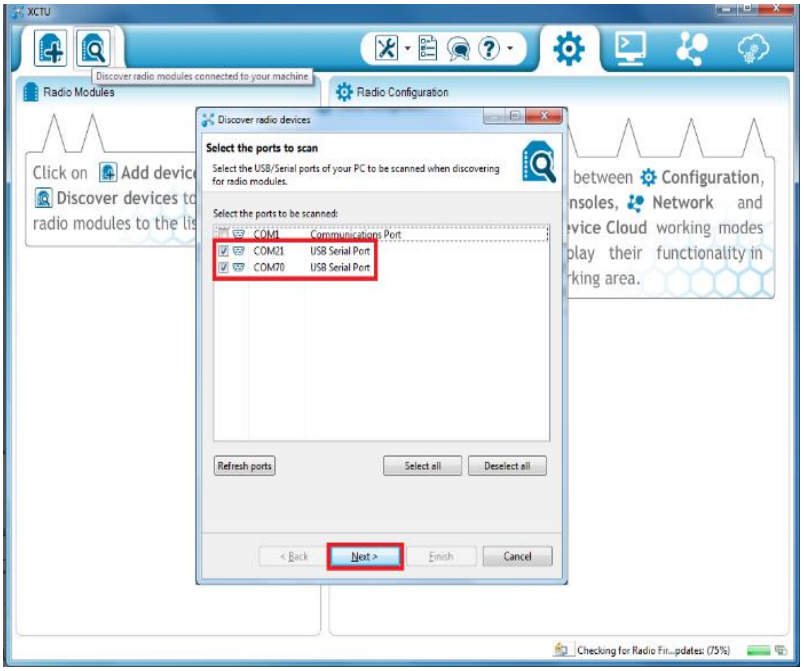


Figure 22

Select COM port

In the case of a module factory sealed, the parameters are those on the image, then press the Finish button and start searching for devices.

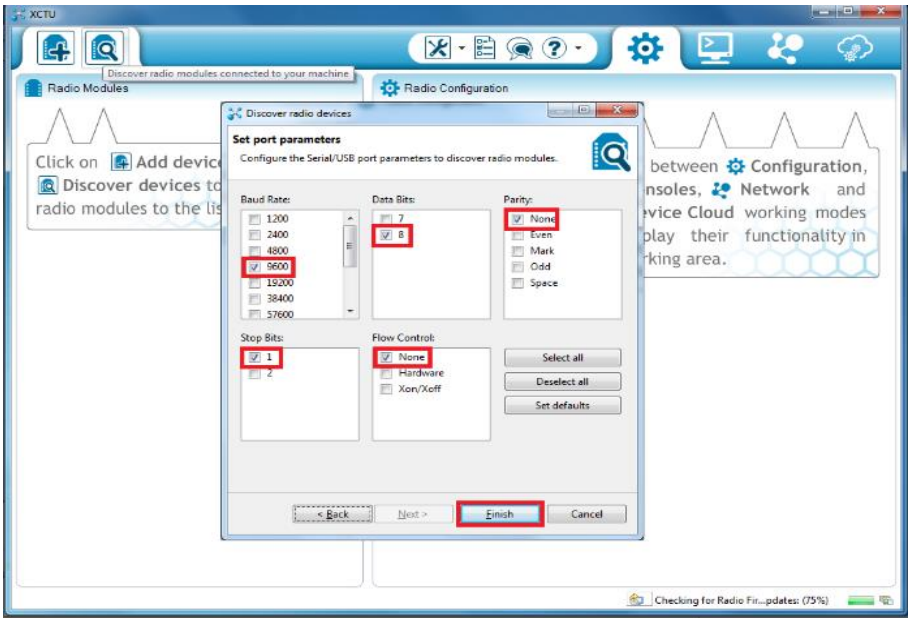


Figure 23

Settings

The software will start looking for the modules. When the devices are found, press the button "Add selected devices"

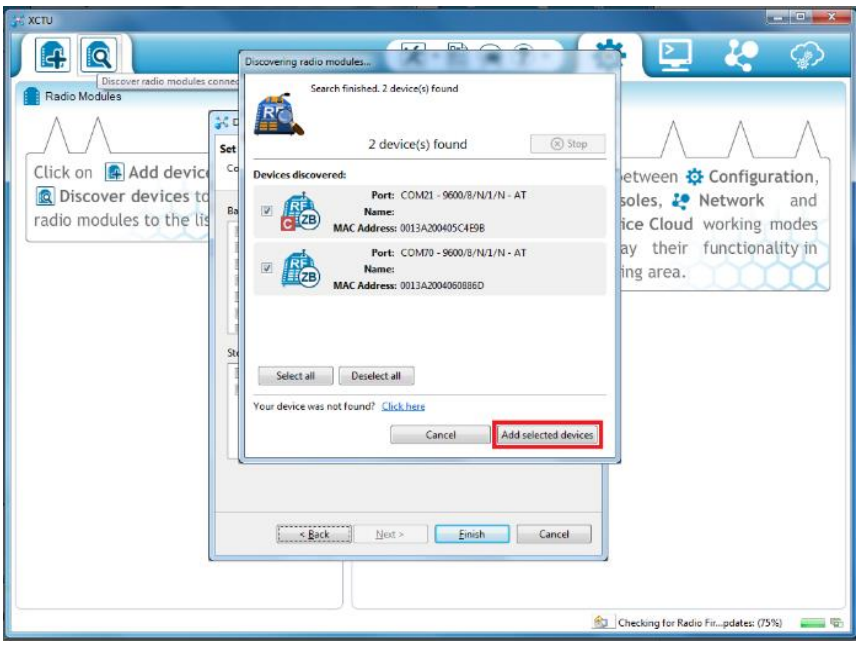


Figure 24

Found Devices

Having the devices assigned, we can check the configuration parameters of each one by pressing on the device that we want to see.

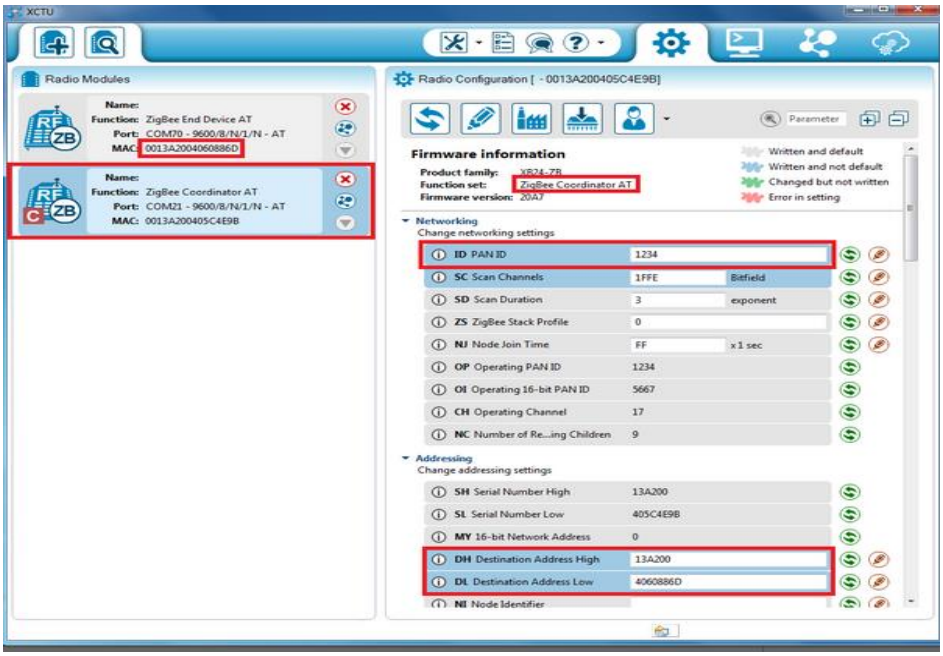


Figure 25

Configuration Parameters

In the following tables, can be found: the description of the fields and the values that need to be assigned to each one to configure the Xbee Series 2 in "transparent mode" or in a point-to-point connection

Indicator Name	
DH	Destination Address High
DL	Destination Address Low
MY	16-bit Network Address
SH	Serial Number High
SL	Serial Number Low
PAN ID	Operating PAN ID

The following is an example of how to configure the two modules

XBee A Values	XBee B Values
DH 13A200	DH 13A200
DL 4076E267	DL 4076E26E
MY AAAA	MY AAAA
PAN ID 234	PAN ID 234
SH 13A200 (comes by default)	SH 13A200 (comes by default)
SL 4076E26E (comes by default)	SL 4076E267 (comes by default)

The advantage of the Xbee Series 2 modems is that it can set more complete networks (mesh type). This gives users the advantage of being able to have networks that cover much

wider geographical areas than with the series 1, although these networks are much more complex. An example of setting up a Coordinator AT point to point.

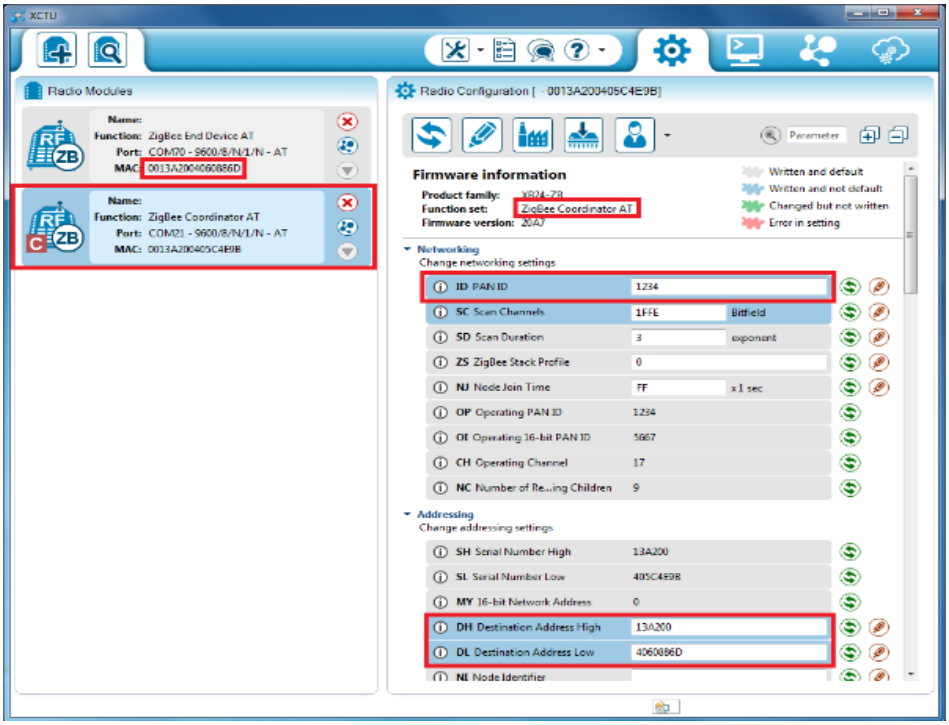


Figure 26

Testing of data sensors meteorological station in the headquarters Alvaro Castillo Juan de Castellanos University Foundation Tunja Boyaca Colombia

Figure 27. Tests meteorological station at the Juan de Castellanos University Foundation Headquarters with the router circuit and coordinating circuit with data transmission.

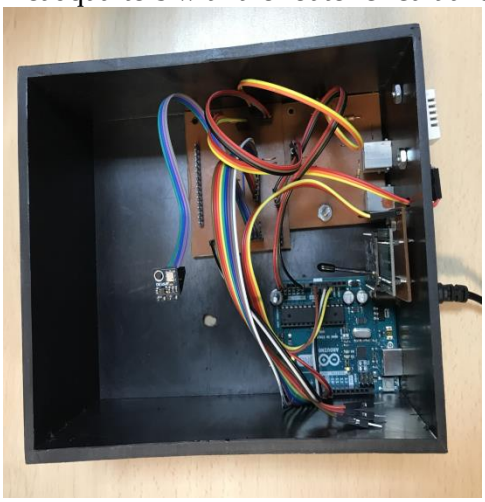


Figure 28. Circuit box router meteorological station and Xbee transmitter.

Figure 29 Box router circuit with sensor of Temperature, Humidity and Inputs sensor of publiocity, speed of wind and direction of wind.

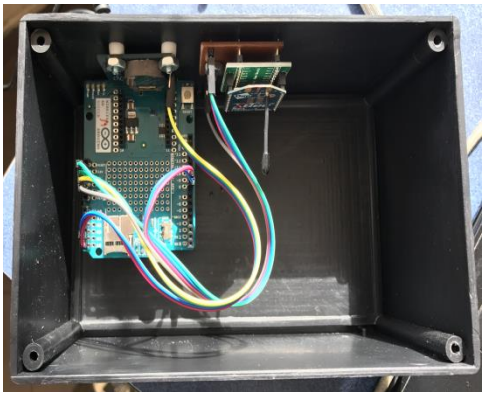


Figure 30. Circuit box coordinator meteorological station and receiver Xbee.

In the Figure 27 shows the test of the station with solar energy ie solar panel, regulator and battery this set feeds the black box this contains the sensor DHT22, the sensor BMP180 and receives anemometer data, wind direction and rain gauge, also the xbee that is in charge of transmitting the information and is called Router this is shown in figure 28 and 29, in the figure 30 shows the coordinating circuit the one receives the information through the xbee and registers the data with date and time by half of the clock in a microdro sd memory, this information is very valuable to analyze the frost phenomenon. These data are shown in the annexes.

Circuit design

Circuit of the system of prediction and prevention of frost

The figure shows the general circuit of the System of prediction and prevention of frost realized in the simulator Proteus 8.0 Professional.

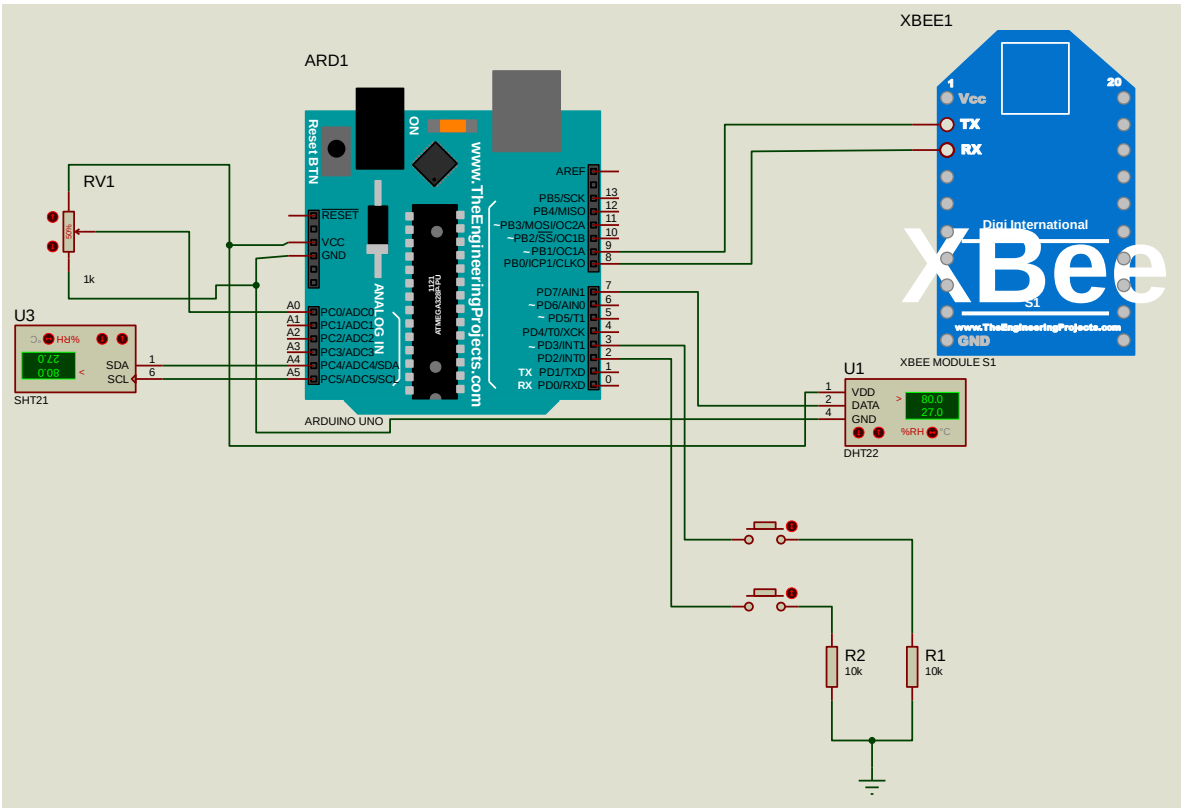


Figure 31. Circuit Router Meteorological Station with Xbee.
Source: Prepared by the Researcher at Proteus

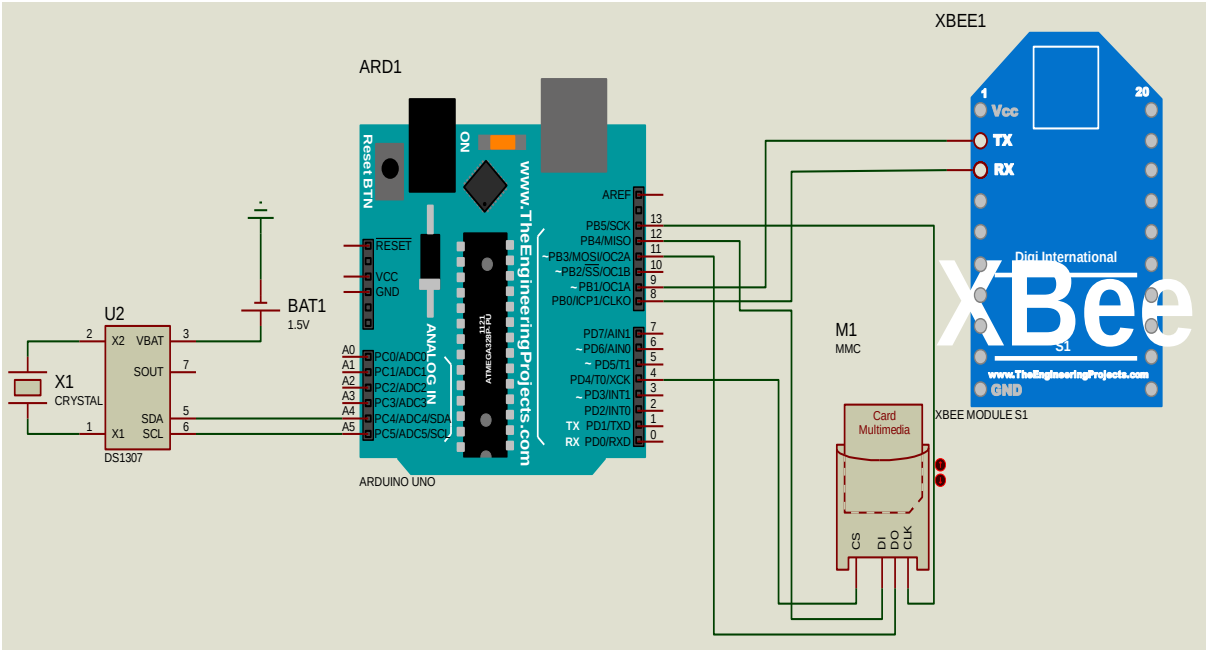


Figure 32. Circuit Meteorological Station Coordinator with Xbee
Source: Prepared by the Researcher at Proteus

Block diagram circuit prediction and prevention of frost

The electronic control systems required by farmers are described below.

Circuit Router

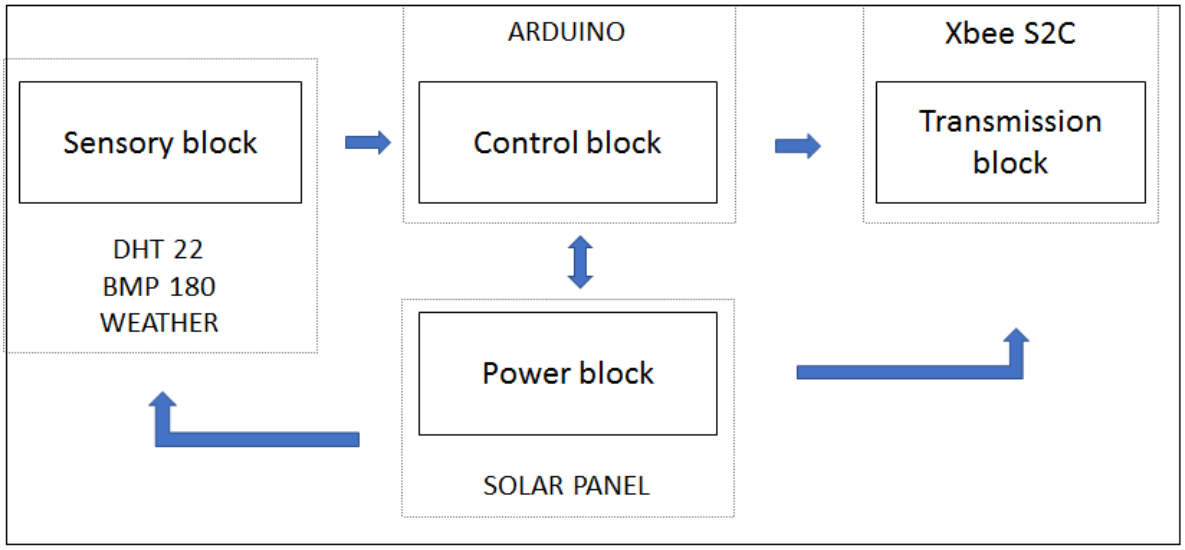


Figure 33. Block Diagram Circuit Router Meteorological Station with Xbee.
Source: Prepared by the Researcher

The Circuit Weather Station Router with Xbee is designed in an order and perform a specific action:
1. There is a system activation and deactivation device.
2. Once the system is turned on the 7 sensors start to transmit measurements of humidity, temperature, atmospheric pressure, altitude, wind speed, wind direction and rainfall by means of Xbee technology to be received by the coordinating circuit.
. The figure shows the stage of power, control and reception of the router circuit of the weather station, for its operation is backed with a solar panel, with a solar controller and a rechargeable battery, in the day the solar panel provides its power and at night is backed by the battery.

Block Diagram Coordinator Circuit

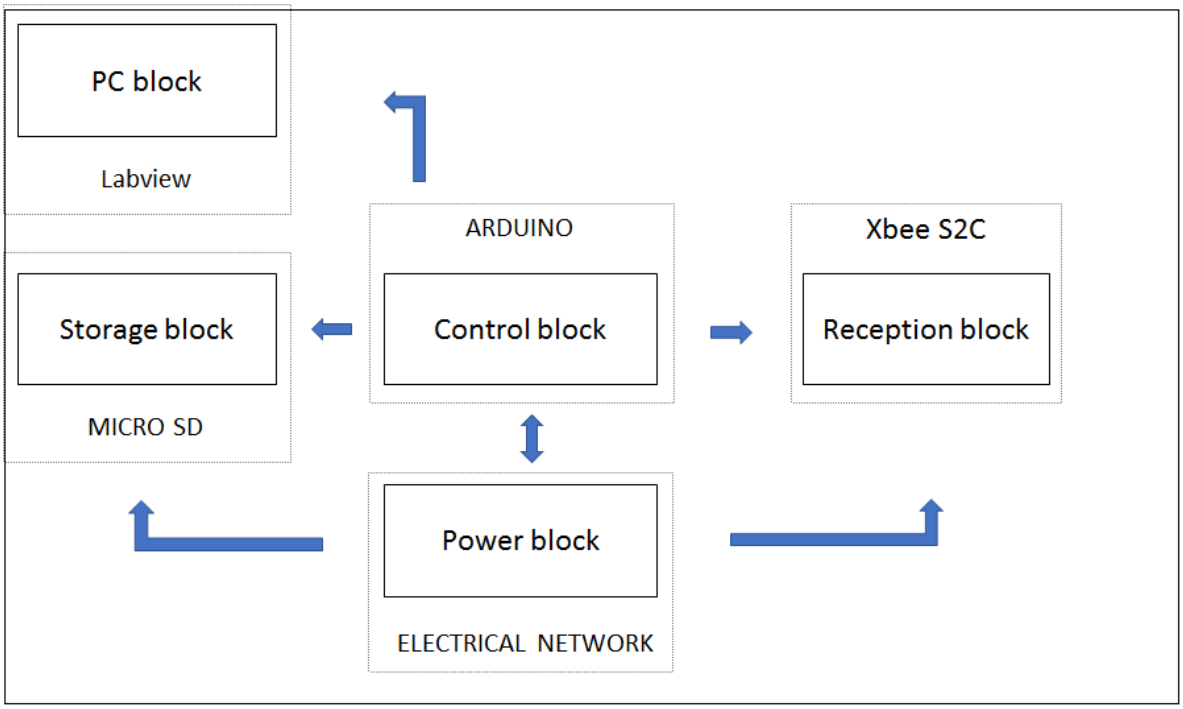


Figure 34. Block Diagram Circuit Coordinator Meteorological Station with Xbee.
Source: Prepared by the Researcher

The Weather Station Coordinator Circuit with Xbee is designed in an order and perform a specific action:
1. There is a system activation and deactivation device.
2. Once the system is turned on the circuit receives the transmission of the 7 sensors whose measurements are humidity, temperature, atmospheric pressure, altitude, wind speed, wind direction and rainfall by means of Xbee technology to be received and stored in an SD memory with date and time.
. The figure shows the power, control and reception stage of the coordinator circuit of the meteorological station, for its operation is backed by an adapter connected to the network because the user must obtain the data stored in the memory to be analyzed for the prediction and prevention of frost.

Arduino software flowchart for data transmission from the weather station

Transmition sensors

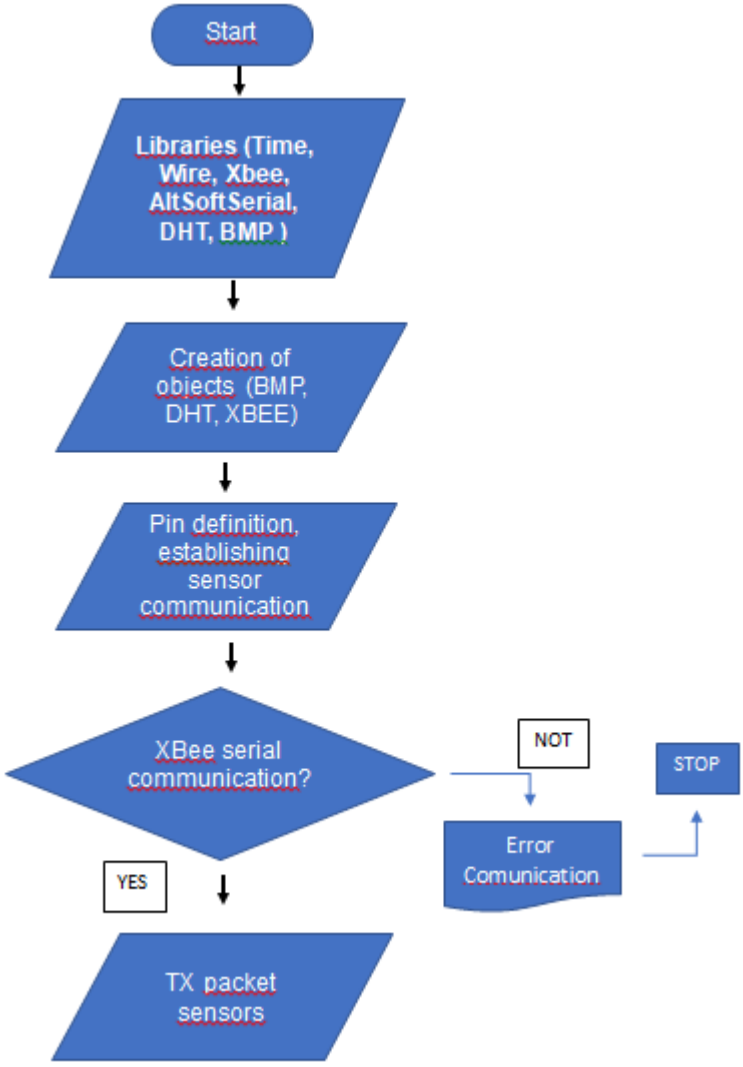


Figure 35.

Transmition Sensors

Figure 36

Reception Sensors

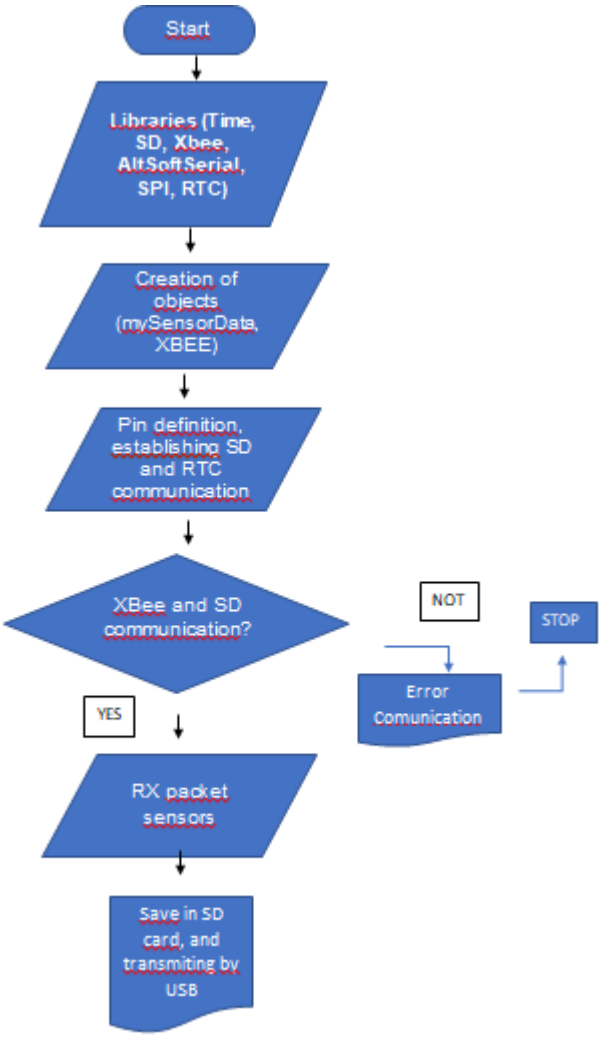


Figure 37

Figures 35, 36 and 37 explain in detail the flow diagrams of the program in arduino for the router and the coordinator.

Arduino software for acquisition and reception of data for the weather station with Xbee technology.

Software arduino circuit router meteorological station.

```
// This example reads values from a DHT22 sensor every 10 seconds and
// sends them to the coordinator XBee, to be read by Coordinator.ino.

// #define RXPIN 9  with DIN
// #define TXPIN 8 with DOUT
#include <Time.h>
#include <Wire.h>
#include <XBee.h>
#include <Printers.h>
#include <AltSoftSerial.h>
#include <DHT.h>
#include "binary.h"
#include <SPI.h> //Load SPI Library
#include <Adafruit_BMP085.h>
#include "SDL_Weather_80422.h"

Adafruit_BMP085 mySensor;  // create sensor object called mySensor
XBeeWithCallbacks xbee;

AltSoftSerial SoftSerial;
#define DebugSerial Serial
#define XBeeSerial SoftSerial

#define pinAnem    2  // Anenometer connected to pin 18 - Int 5 - Uno pin2
#define pinRain    3  // Anenometer connected to pin 2 - Int 0 - Uno Pin 3
#define intAnem    0  // int 0 (check for Uno)
#define intRain    1  // int 1

// initialize SDL_Weather_80422 library
SDL_Weather_80422 weatherStation(pinAnem, pinRain, intAnem, intRain, A0,
SDL_MODE_INTERNAL_AD);
//SDL_Weather_80422(int pinAnem, int pinRain, int intAnem, int intRain, int ADChannel, int
ADMode);

uint8_t i;

float currentWindSpeed;
float currentWindGust;
float totalRain;

float tempC;  // Variable for holding temp in C
float altitude;  // Variable for holding temp in F
float pressure; //Variable for holding pressure reading
float humidity;  // Variable for holding temp in C

// Sensor type is DHT22, connected to pin D7.
```

```
DHT dht(7, DHT22);


void setup() {


  // Setup debug serial output
  dht.begin();        //initialize dht sensor
  mySensor.begin();   //initialize pressure sensor mySensor BMP085

  DebugSerial.begin(9600);
  DebugSerial.println(F("Starting..."));


   weatherStation.setWindMode(SDL_MODE_SAMPLE, 5.0);
   //weatherStation.setWindMode(SDL_MODE_DELAY, 5.0);
    totalRain = 0.0;

  // Setup XBee serial communication
  XBeeSerial.begin(9600);
  xbee.begin(XBeeSerial);
  delay(1);

  // Setup callbacks
  xbee.onPacketError(printErrorCb, (uintptr_t)(Print*)&DebugSerial);
  xbee.onResponse(printErrorCb, (uintptr_t)(Print*)&DebugSerial);

  // Setup DHT sensor


  // Send a first packet right away
  sendPacket();
}

void sendPacket() {


    currentWindSpeed = weatherStation.current_wind_speed()/1.6;
  currentWindGust = weatherStation.get_wind_gust()/1.6;
  totalRain = totalRain + weatherStation.get_current_rain_total()/25.4;
    // Prepare the Zigbee Transmit Request API packet
    ZBTxRequest txRequest;
    txRequest.setAddress64(0x0013A200414FAB5A);

    // Allocate 32 payload bytes: 1 type byte plus two floats of 4 bytes each
    AllocBuffer<33> packet;


    packet.append<float>(dht.readTemperature());
    packet.append<float>(dht.readHumidity());
    packet.append<float>(mySensor.readPressure()); //Read Pressure
```

```
    packet.append<float>(mySensor.readAltitude()); //Lee Altitud
    packet.append<float>(totalRain);
    packet.append<float>(currentWindSpeed);
    packet.append<float>(currentWindGust);
    packet.append<float>(weatherStation.current_wind_direction());

    txRequest.setPayload(packet.head, packet.len());

    // And send it
    xbee.send(txRequest);
}

unsigned long last_tx_time = 0;

void loop() {
  // Check the serial port to see if there is a new packet available
  xbee.loop();

  // Send a packet every 10 seconds
  if (millis() - last_tx_time > 200) {
    sendPacket();
    last_tx_time = millis();
  }
}
```

Software Arduino circuit coordinator weather station

```
// This example receives packets containing temperature and humidity
// data, as sent by the DhtSend.ino sketch, and prints their contents to
// serial.

#include <SPI.h>
#include <SD.h>
#include <XBee.h>
#include <Printers.h>
#include <AltSoftSerial.h>
#include "binary.h"
#include "SDL_Weather_80422.h"
#include <LiquidCrystal.h>
#include "RTClib.h"

const int chipSelect = 4;
File mySensorData;

char input;  //variable para almacenar el dato recibido por el puerto serie
byte temp;


XBeeWithCallbacks xbee;

AltSoftSerial SoftSerial;
```

```
#define DebugSerial Serial
#define XBeeSerial SoftSerial
//LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

//RTC_Millis rtc;                       // software RTC time
RTC_DS1307 rtc; //Crea el objeto RTC

void setup() {
rtc.begin();       //initialize clock
//rtc.adjust(DateTime(__DATE__, __TIME__));


  // Setup debug serial output
  DebugSerial.begin(9600);

//  DebugSerial.println(F("Starting..."));

// Serial.print("Initializing SD card...");

  if (!SD.begin(4)) {
//    Serial.println("initialization failed!");
    return;
  }
//  Serial.println("initialization done.");

  mySensorData = SD.open("Datos.txt", FILE_WRITE);

  // Setup XBee serial communication
  XBeeSerial.begin(9600);
  xbee.begin(XBeeSerial);
  delay(1);

  // Setup callbacks
  xbee.onPacketError(printErrorCb, (uintptr_t)(Print*)&DebugSerial);
  xbee.onResponse(printErrorCb, (uintptr_t)(Print*)&DebugSerial);
  xbee.onZBRxResponse(processRxPacket);

    do{
 // TCNT1=0;
  temp=Serial.readBytes(&input,1);
  }while(!temp);
}

//  DateTime now = rtc.now();

void processRxPacket(ZBRxResponse& rx, uintptr_t) {



  DateTime now = rtc.now();
  Buffer b(rx.getData(), rx.getDataLength());
```

```
  uint8_t type = b.remove<uint8_t>();

 if (now.second() == 00) {
    Buffer b(rx.getData(), rx.getDataLength());
 //  if (type == 1 && b.len() == 32) {
 //    DebugSerial.print(F("Guardando en SD "));
    mySensorData.print("Date: "); //Print Your results
    mySensorData.print(now.year(), DEC);
    mySensorData.print('/');
    mySensorData.print(now.month(), DEC);
    mySensorData.print('/');
    mySensorData.print(now.day(), DEC);
    mySensorData.print(",");
    mySensorData.print("Time: "); //Print Your results
    mySensorData.print(now.hour(), DEC);
    mySensorData.print(':');
    mySensorData.print(now.minute(), DEC);
    mySensorData.print(':');
    mySensorData.print(now.second(), DEC);
    mySensorData.print(",");
    mySensorData.println();
    mySensorData.print(F("Temperature: "));
    mySensorData.println(b.remove<float>());
    mySensorData.print(F("Humidity: "));
    mySensorData.println(b.remove<float>());
    mySensorData.print(F("Pressure: "));
    mySensorData.println(b.remove<float>());
    mySensorData.print(F("Altitude: "));
    mySensorData.println(b.remove<float>());
    mySensorData.print(F("TotalRain: "));
    mySensorData.println(b.remove<float>());
    mySensorData.print(F("currentWindSpeed: "));
    mySensorData.println(b.remove<float>());
    mySensorData.print(F("currentWindGust: "));
    mySensorData.println(b.remove<float>());
    mySensorData.print(F("wind_direction: "));
 //    mySensorData.println(b.remove<float>());


  int val;


  val = b.remove<float>();
 //  DebugSerial.print(val);

 //   DebugSerial.println(b.remove<float>());

  if (val==15,3)
  {
    mySensorData.print("S");
    }
```

```
 else if (val==17)
  {
    mySensorData.print("SW");
    }

 else if (val==20,4)
  {
    mySensorData.print("W");
    }

     else if (val==22,1)
  {
    mySensorData.print("NW");
    }

     else if (val==25,5)
  {
    mySensorData.print("N");
    }
        else if (val==1,7)
  {
    mySensorData.print("NE");
    }
        else if (val==5,1)
  {
    mySensorData.print("E");
    }
        else if (val==11,9)
  {
    mySensorData.print("SE");
    }

    mySensorData.println();
    mySensorData.close();
  //  return;
  // }

  //  DebugSerial.println(F("Unknown or invalid packet"));
 //  printResponse(rx, DebugSerial);

}

else

{
//void processRxPacket(ZBRxResponse& rx, uintptr_t) {

      Buffer b(rx.getData(), rx.getDataLength());
//    uint8_t type = b.remove<uint8_t>();

//  if (type == 1 && b.len() == 64) {
```

```
  //  DebugSerial.print();
    DebugSerial.print(F("T"));    //Temperature
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("#"));
    DebugSerial.print(F("H"));    //Humidity
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("#"));
    DebugSerial.print(F("P"));    //Pressure
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("#"));
    DebugSerial.print(F("A"));    //Altitude
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("#"));
    DebugSerial.print(F("R"));    //TotalRain
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("#"));
    DebugSerial.print(F("W"));    //CurrentWindSpeed
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("#"));
    DebugSerial.print(F("C"));    //CurrentWindGust
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("#"));
    DebugSerial.print(F("D"));    //Wind_direction
    DebugSerial.print(b.remove<float>());
    DebugSerial.print(F("X"));
 //   return;

//    }
 //   DebugSerial.println(F("Unknown or invalid packet"));
//  printResponse(rx, DebugSerial);
}
}


void loop() {

  // Check the serial port to see if there is a new packet available
  xbee.loop();
 // void processRxPacket2();

}
```

Labview software interface showing the real-time sensor data of the weather station

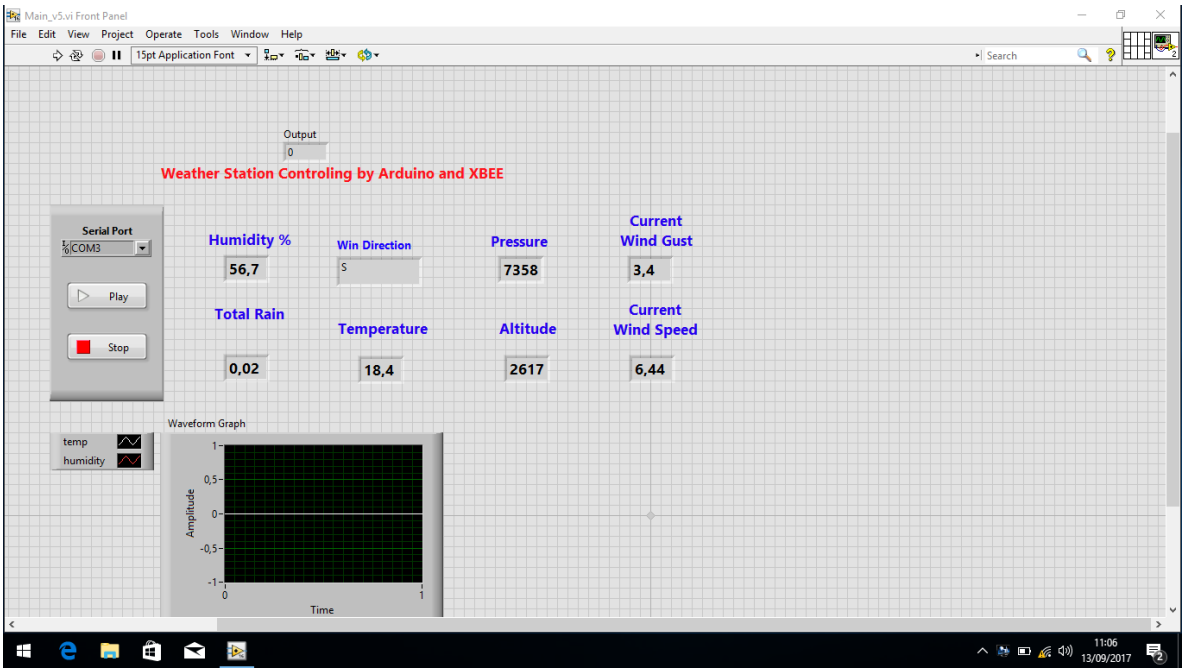


Figure 38. Labview software interface of the measurements of the 7 sensors in real time.

Block diagram of the measurement of the sensors of the meteorological station

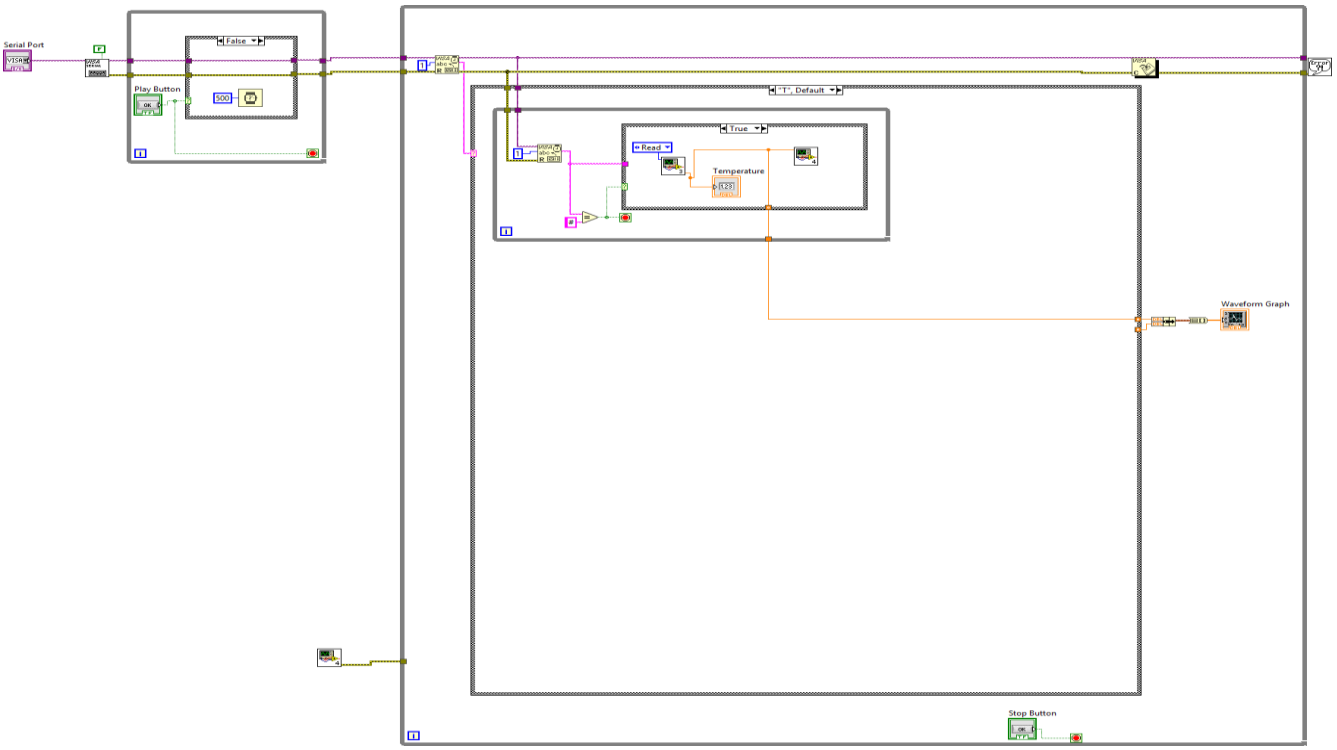


Figure 39. Display showing in real time the data of the sensors of the weather station.

The explanation of this diagram is simple data arrives in frames and this software is responsible for distributing each measurement of each sensor to be displayed on screen in Labview in real time.

Analysis Data Acquired by the Seven Sensors Weather Station for Frost Prevention and Prediction.

Frozen phenomenon analysis in the Andean tropics

When reading the IDEAM Frost Report for the presence of frost by radiation, it must have the following climatic conditions: Temperature below zero degrees, wind speed zero, altitude above sea level from 2600 m to 3000 m , humidity of 10%, atmospheric pressure of 700 hpa and amount of rain zero. In the period of data collection, no frost was reported according to the literature review due to two main characteristics. First, according to the study area, frost occurs in the months of January, February and March, and second, the climatic conditions mentioned.

The meteorological station built and designed at the Juan de Castellanos University Foundation with Arduino and Xbee technology, measures seven climatic parameters mentioned above, these measures are a primordial tool if it meets the climatic conditions to predict and prevent frost and avoid economic losses to the farmers. The novelty of this station is that it is very economical and made in Colombia than a commercial station.

In the test period of the season there have been no frosts with the conditions mentioned above at the end of the report, the data obtained can be consulted and corroborate the climatic variables that characterize the frosts.

Pest control system in peach, apple, pear and plum crops located in la Vereda Otrolado Juan de Castellanos University Foundation.

Blocks diagram

The electronic control systems required by farmers are described below.

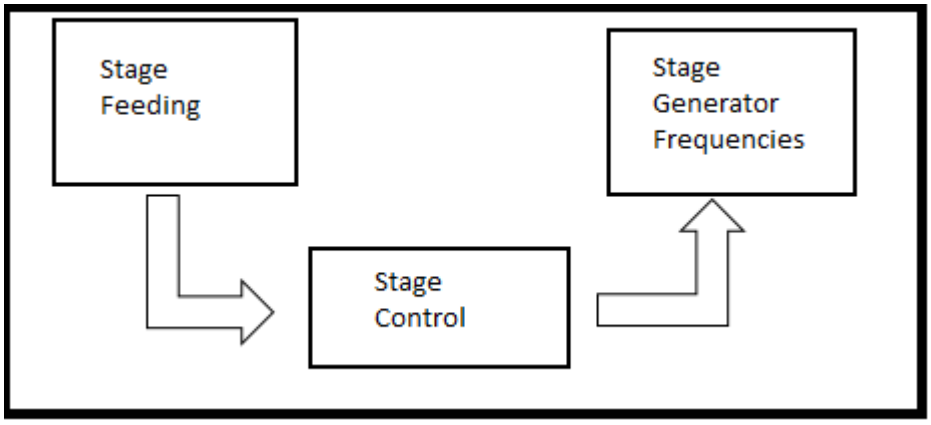


Figure 40. Block Diagram of the Pest Control System
Source: Prepared by the researcher

The Pest Control System in the plantations of peach, apple, pear and plum is designed in an order and perform a specific action:
1. There is a system activation and deactivation device.
2. Once the system is turned on it starts to generate the frequencies according to the pest so that it moves away from the plant without doing any damage to it.
3. The pest feels the frequency sent by the Pest Control System and scatters without any damage.
The Pest Control System has an on / off switch to activate the circuit to be used if necessary since the System is automatic, once the system is activated the circuit in charge of emitting the optimum frequency for a time indeterminate so that the birds, flies, mites, thrips that prowl the plantations are frightened and do not destroy.

The figure 41 shows the power stage in this case is a 20w solar panel, a solar controller and a backup battery, the control stage is the arduino nano, the regulators for 5v and 12v, the LEDs that indicate the operation in 5v and 12v, the heatsink, the transducers and the volume control of the transducers.

Figure 41.Pest management device showing the circuit and its internal and external components in an apple crop of the Juan de Castellanos University Foundation in Soraca Boyacà Colombia.
Source: Prepared by the researcher

Design of the Pest Control Circuit

The figure shows the general circuit of the Pest Management System performed in the Proteus 8.0 simulator.

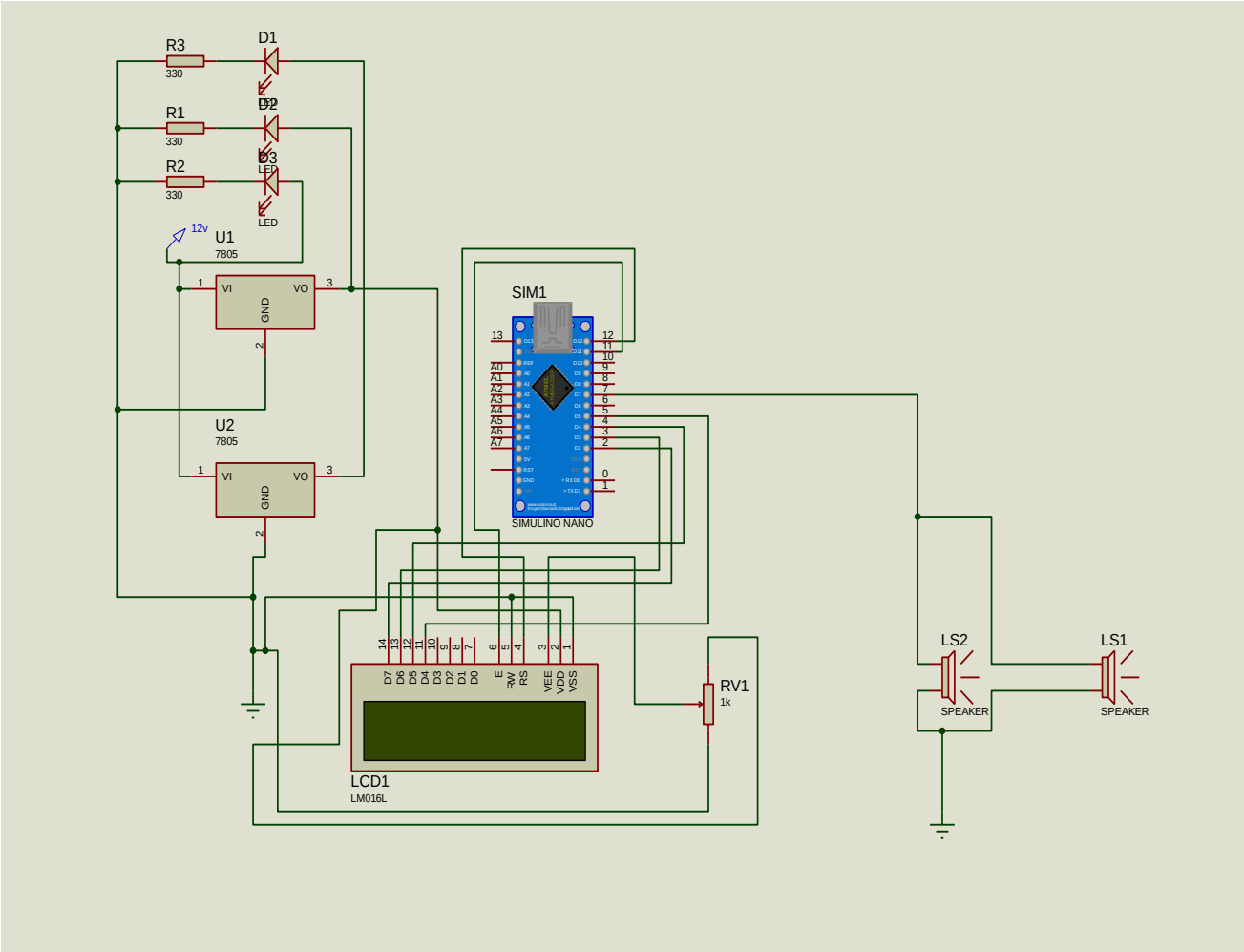


Figure 42. Circuit Feed, Control and Transmission of pest management by means of ultrasound.

The operation of the circuit is supported by the solar panel and backed by the battery, the LEDs indicate the operation at 5v and 12v the regulators are in charge of delivering the power needed to transmit frequencies to the transducers, the lcd shows the operating frequencies, the arduino nano is the brain of the circuit where software can vary the frequencies to drive away pests that affect crops.

Description of each of the Components of the Ultrasonic Pest Management Circuit.

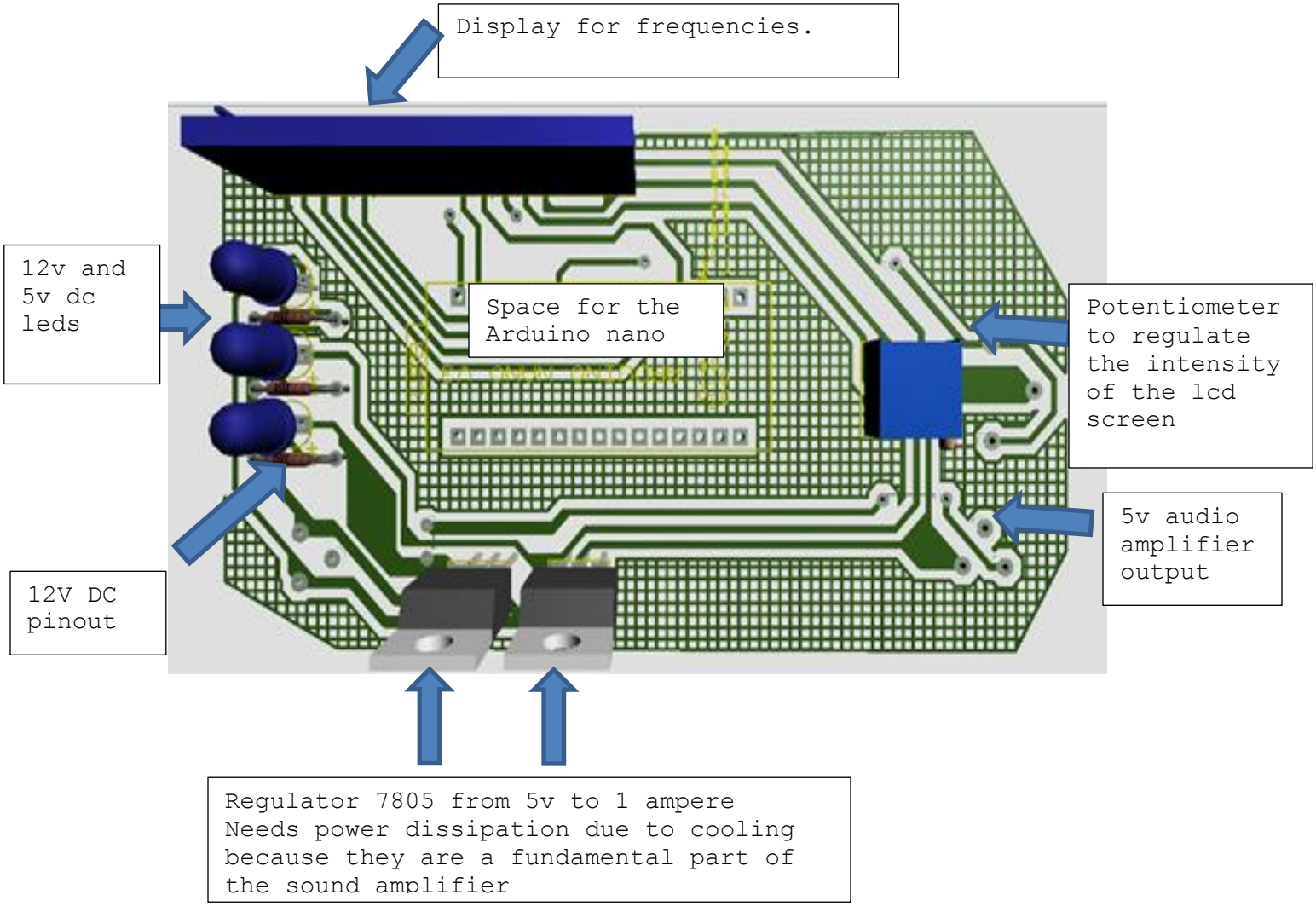


Figure 43. Pest Control with Ultrasound
Source: Realized by the researcher

The figure below shows the audible frequency ranges of some animals however the animals to be taken into account for the project are those considered as pests for crops and are birds, fruit flies, mites and thrips.

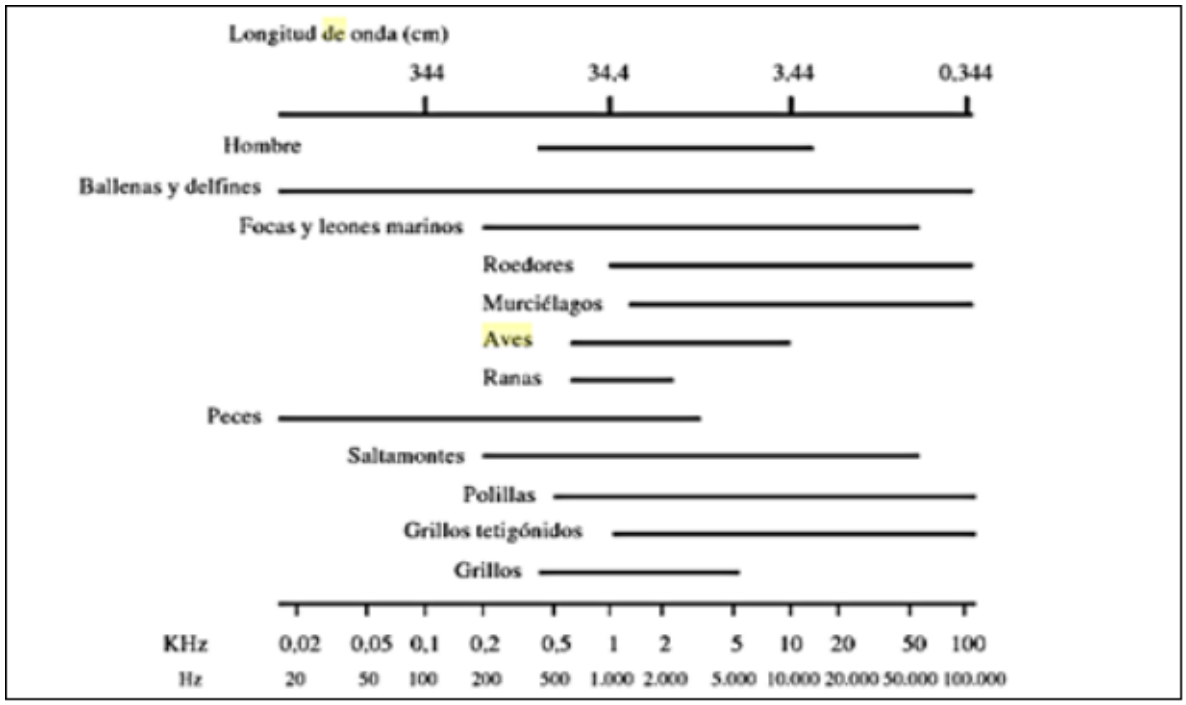


Figure 44. Audible Frequency of Animals
Source Physical for Science and Engineering Raymond Serway 2010

FEEDING STAGE

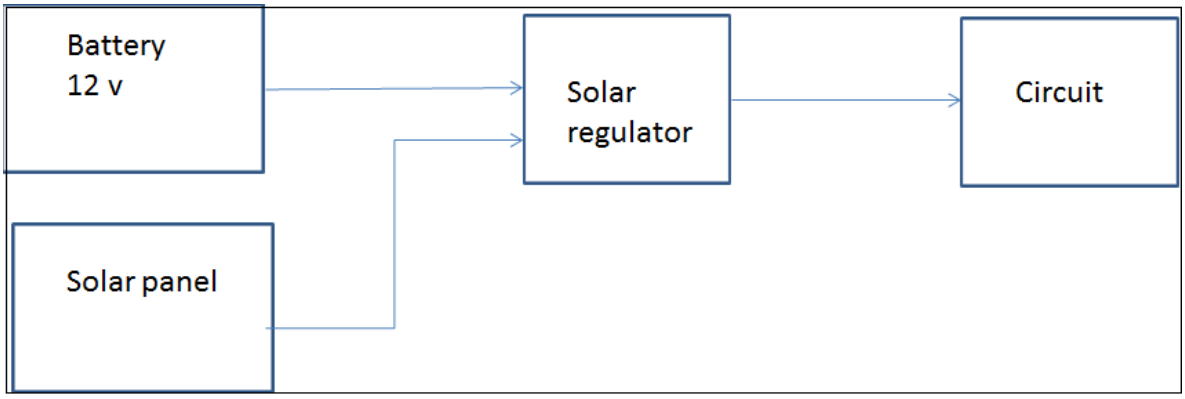


Figure 44 . Block Diagram Feeding Stage
Source: Prepared by the researcher

For the power supply there is a 12 V input generated by the battery and at the same time by the solar panel reaching the solar regulator, which will serve as a power supply for the microcontroller and the transducers.

To activate the leakage circuit it is necessary to use a switch: it will be used for arduino power, and for the frequency generation stage.
Once the switch is pressed the circuit closes giving way to the voltage regulator, which is responsible for generating the voltage appropriate for the correct operation of the subsequent stages.

STAGE OF CONTROL

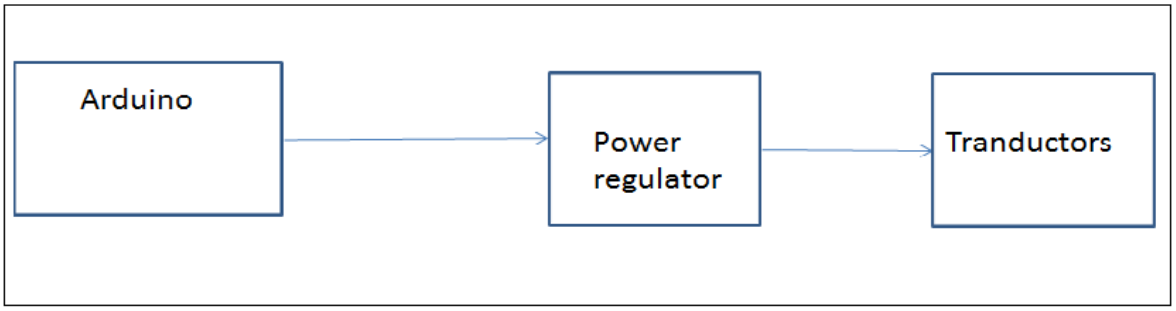


Figure 45. Block Diagram Control Stage
Source Elaborated by the Investigator.

The system is activated with the swicth, the arduino starts to generate the frequencies with the aid of the power circuit and the amplification circuit, the frequencies start from 8000 Hz to 20000 Hz continuously and cyclically, when it reaches 20000 Hz again starts at 8000hz until reaching 20000hz and start over, the system shuts off when the solar controller swicth is depressed.

Arduino Ultrasound Generation Program Flow Chart

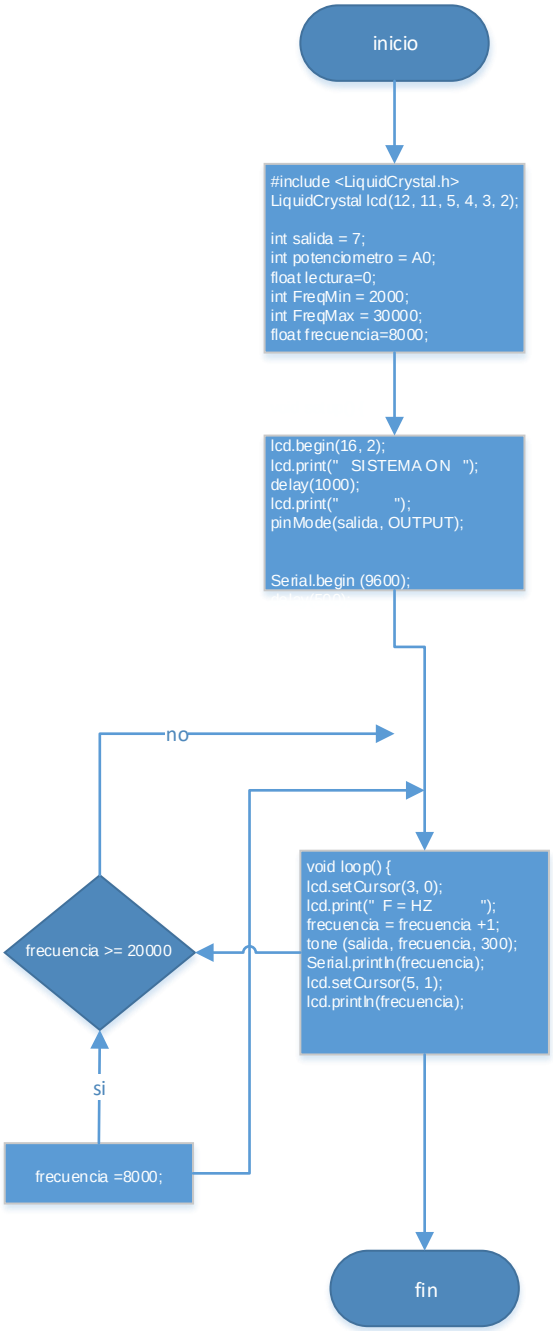


Figure 46. Flow Chart of the software Arduino for the control frequencies for the control pest device.

Ultrasonic Wave Generation Program in Arduino

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

int salida = 7; //   port declaration and name
int potenciometro = A0; // port declaration and name (ADC)
float lectura=0; // the floating variable is used to have a better reading of a number of probabilities of the potentiometer
int FreqMin = 2000; // frequencies you want to oscillate the sound
int FreqMax = 30000;
float frecuencia=8000;

void setup() {
lcd.begin(16, 2);
lcd.print("   SISTEMA ON   ");
delay(1000);
lcd.print("            ");
pinMode(salida, OUTPUT); // variable declaration
pinMode(potenciometro, INPUT); // variable declaration
Serial.begin (9600);
delay(500);
}

void loop() {
lcd.setCursor(3, 0);
lcd.print("  F = HZ          ");
frecuencia = frecuencia +1;
//float frecuencia = map(lectura, 0, 10023, FreqMin, FreqMax);
tone (salida, frecuencia, 300);
//delay(50);
Serial.println(frecuencia);
lcd.setCursor(5, 1);
lcd.println(frecuencia);
if(frecuencia >= 20000 ){
  frecuencia =8000;
  }
//Serial.println(lectura);
//lectura = lectura+1;

}
```

Analysis of the results of the ultrasonic device to ward off pests in the Juan de Castellanos University Foundation

In carrying out the corresponding studies for the pest control circuit, a working and field research frequency for f = 12.5 [KHz] birds was established for thrips, mites and fruit fly f = 8.5 [KHz] these frequency values produce optimal results for the research project.

Prototype Budget

The tables show the necessary budget for the implementation of the prototype of:
Design and construction of a meteorological station for the prediction and prevention of frost with pest control with ultrasound in high Andean tropic crops in Colombia.

Cost components weather station

DESCRIPTION	QUANTITY	UNIT COST	TOTAL COST
Arduino Uno	2	25	50
Wireless Shield SD	2	25	50
Xbee S2C	2	30	60
Sensor DTH22	1	7	7
Sensor BMP180	1	7	7
Memory Micro SD 1GB	1	3	3
Base Xbee S2C	2	3	6
configuration module Xbee	2	10	20
Data cable	2	4	8
PCB	2	25	50
Plug RJ11	4	2	8
Plastic Boxes	2	7	14
Screws with Nut	12	2	24
I support station	1	30	30
Adapters	2	5	10
Clock I2C	1	10	10
Solar Panel	1	50	50
Regulador Panel Solar	1	20	20
Battery	1	35	35
TOTAL EUROS			462

Cost components pest control device with ultrasound

DESCRIPTION	QUANTITY	UNIT COST	TOTAL COST
Arduino nano	1	25	25
PCV	1	20	20
Led	2	2	4
Resistencia	4	2	8
Regulator	2	4	8
Disipator	1	5	5
LCD	1	15	15
Transductors	2	20	40
Solar Panel	1	50	50
Solar Panel Regulator	1	20	20
Battery	1	30	30
Swicht Volume	1	5	5
Potentiometer LCD	1	3	3
Acrilic Box	1	1	25
USB Cable	1	10	10
Suport	1	100	100
Screws and nuts	12	2	24
Plugs	2	2	4
TOTAL EUROS			392

Conclusions

When designing, building and testing the weather station using sensors, it was possible to take measurements of these to be able to predict and prevent frost in the Juan de Castellanos University Foundation.

When designing and implementing the program in arduino, the sensor information was acquired and wirelessly sent the information through xbee technology to be stored in an SD memory.

When elaborating a program in Labview to show in real time the measurements taken by the sensors of humidity, temperature, atmospheric pressure, altitude above sea level, wind direction, wind speed.

The router circuit and the coordinating circuit were designed and built to withstand extreme conditions for the prediction and prevention of frost.

A pest control device was designed and built by ultrasonic waves powered by solar panel, backed up with a rechargeable battery to operate in extreme conditions,

We designed the power circuit, the amplification circuit that is controlled by an arduino nano to drive away pests by means of ultrasound

The software was programmed in arduino which varies the ultrasonic frequencies from minimum 8000 Hz to 10000 Hz, 20000 Hz and 30000 Hz and start the scanning cycle again.

When carrying out the corresponding studies for the pest control circuit, a working and field research frequency for birds f = 5.15 [KHz] was established for thrips, mites and fruit fly f = 2.5 [KHz] these frequency values produce optimal results for the research project.

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Annexes

Testing data collection Meteorological Station

Date	Time:	Temperature	Humidity	Pressure	Altitude	TotalRain	currentWindSpeed	currentWindGust	wind_direction
14/09/2017	10:09:00	23.90	34.40	73642.00	2611.21	0.02	3.34	3.86	SW
14/09/2017	10:10:00	23.80	35.10	73649.00	2611.10	0.02	2.93	0.00	E
14/09/2017	10:11:00	23.30	33.90	73644.00	2611.32	0.02	2.93	0.90	N
14/09/2017	10:12:00	23.10	34.50	73641.00	2611.21	0.02	1.95	0.00	SW
14/09/2017	10:13:00	22.70	37.10	73650.00	2611.10	0.02	2.63	0.00	NW
14/09/2017	10:14:00	22.50	36.10	73657.00	2610.13	0.02	3.51	1.51	W
14/09/2017	10:15:00	22.30	38.60	73650.00	2610.24	0.02	2.78	0.00	
14/09/2017	10:16:00	22.40	38.20	73648.00	2610.67	0.02	1.17	0.00	S
14/09/2017	10:17:00	22.20	37.30	73653.00	2609.81	0.02	5.56	1.60	NW
14/09/2017	10:18:00	21.90	37.90	73651.00	2610.67	0.02	4.68	1.27	E
14/09/2017	10:19:00	21.90	40.20	73651.00	2610.24	0.02	3.51	1.22	SW
14/09/2017	10:20:00	21.90	39.10	73659.00	2610.24	0.02	4.10	4.52	SW
14/09/2017	10:21:00	21.80	38.10	73652.00	2610.46	0.02	2.63	1.36	SW
14/09/2017	10:22:00	21.80	38.70	73658.00	2609.70	0.02	0.83	0.00	NW
14/09/2017	10:23:00	21.60	38.40	73652.00	2610.78	0.02	2.63	2.80	SW
14/09/2017	10:24:00	21.50	40.70	73656.00	2610.46	0.02	1.46	0.56	SW
14/09/2017	10:25:00	21.20	40.90	73644.00	2610.78	0.02	5.00	0.00	SW
14/09/2017	10:26:00	21.20	40.30	73644.00	2610.99	0.02	0.88	0.00	SW
14/09/2017	10:27:00	21.10	40.20	73651.00	2610.67	0.02	4.39	2.90	NE
14/09/2	10:28	21.10	40.80	73649	2610.	0.02	1.95	0.00	SW

017	:00			.00	89				
14/09/2017	10:29:00	21.30	41.80	73650.00	2609.81	0.02	2.34	0.00	E
14/09/2017	10:30:00	21.30	41.30	73649.00	2611.21	0.02	1.17	0.00	W
14/09/2017	10:31:00	21.10	40.40	73642.00	2611.21	0.02	3.89	2.47	NE
14/09/2017	10:32:00	21.00	39.90	73657.00	2610.99	0.02	2.34	0.00	
14/09/2017	10:33:00	21.60	39.70	73646.00	2611.96	0.02	3.51	2.05	W
14/09/2017	10:34:00	21.80	41.20	73638.00	2612.18	0.02	1.17	0.00	SW
14/09/2017	10:35:00	22.00	40.30	73645.00	2611.43	0.02	3.80	0.00	SW
14/09/2017	10:36:00	22.30	41.10	73646.00	2612.07	0.02	4.10	2.18	
14/09/2017	10:37:00	22.40	40.30	73645.00	2610.89	0.02	2.34	0.00	SW
14/09/2017	10:38:00	22.70	38.90	73633.00	2611.43	0.02	2.34	1.22	W
14/09/2017	10:39:00	22.50	38.90	73653.00	2611.64	0.02	1.17	0.47	SW
14/09/2017	10:40:00	22.40	39.30	73637.00	2612.07	0.02	2.05	3.24	SW
14/09/2017	10:41:00	22.60	40.30	73636.00	2612.39	0.02	4.45	1.42	NE
14/09/2017	10:42:00	22.70	38.20	73633.00	2613.37	0.02	2.34	0.00	SW
14/09/2017	10:43:00	22.90	38.00	73630.00	2613.37	0.02	1.46	0.00	SW
14/09/2017	10:44:00	23.10	38.40	73635.00	2612.50	0.02	8.62	3.76	SE
14/09/2017	10:45:00	23.20	36.60	73627.00	2613.04	0.02	2.63	0.00	SE
14/09/2017	10:46:00	23.00	36.80	73609.00	2614.66	0.02	4.68	3.82	SW
14/09/2017	10:47:00	22.30	37.40	73628.00	2613.04	0.02	3.06	2.20	SW
14/09/2017	10:48:00	22.20	39.00	73628.00	2612.83	0.02	4.68	4.05	NE
14/09/2017	10:49:00	22.00	37.70	73625.00	2613.47	0.02	7.61	5.01	
14/09/2017	10:50:00	22.00	38.10	73620.00	2614.55	0.02	6.15	6.38	SW
14/09/2017	10:51:00	22.00	38.80	73623.00	2614.98	0.02	2.93	3.38	SW

14/09/2017	10:52:00	22.00	38.10	73620.00	2613.91	0.02	2.05	0.77	SW
14/09/2017	10:53:00	22.20	38.70	73617.00	2615.20	0.02	2.63	0.00	SW
14/09/2017	10:54:00	22.20	39.70	73608.00	2615.42	0.02	2.93	0.00	SW
14/09/2017	10:55:00	22.10	38.40	73616.00	2614.88	0.02	2.63	0.00	W
14/09/2017	10:56:00	22.00	39.40	73614.00	2614.88	0.02	4.10	1.82	SE
14/09/2017	10:57:00	22.00	38.70	73615.00	2614.88	0.02	4.45	2.03	SW
14/09/2017	10:58:00	22.00	38.80	73613.00	2614.77	0.02	3.22	1.01	SW
14/09/2017	10:59:00	22.10	38.90	73612.00	2614.77	0.02	6.44	4.97	SW
14/09/2017	11:00:00	22.10	38.40	73606.00	2615.20	0.02	1.67	0.00	SW
14/09/2017	11:01:00	22.00	39.40	73601.00	2615.85	0.02	4.68	1.56	N
14/09/2017	11:02:00	22.20	37.90	73608.00	2614.77	0.02	3.51	0.00	E
14/09/2017	11:03:00	22.30	38.40	73607.00	2614.77	0.02	3.33	0.00	NE
14/09/2017	11:04:00	22.50	37.60	73607.00	2615.09	0.02	0.59	0.00	NE
14/09/2017	11:05:00	22.70	38.00	73602.00	2615.95	0.02	5.27	3.95	NE
14/09/2017	11:06:00	22.90	38.00	73599.00	2615.20	0.02	2.93	0.93	W
14/09/2017	11:07:00	22.70	35.70	73598.00	2616.38	0.02	0.88	0.51	SW
14/09/2017	11:08:00	22.60	37.30	73593.00	2616.49	0.02	5.27	0.00	SW
14/09/2017	11:09:00	22.60	38.20	73603.00	2616.60	0.02	5.27	3.12	NE
14/09/2017	11:10:00	22.80	37.50	73598.00	2616.92	0.02	2.34	0.00	NW
14/09/2017	11:11:00	22.90	36.90	73596.00	2616.92	0.02	3.22	0.00	NE
14/09/2017	11:12:00	22.90	37.40	73593.00	2616.38	0.02	1.17	0.00	SW
14/09/2017	11:13:00	23.00	36.80	73597.00	2616.60	0.02	3.34	0.00	NE
14/09/2017	11:14:00	22.90	35.20	73590.00	2616.92	0.02	3.22	0.00	SE
14/09/2	11:15	23.20	34.30	73597	2616.	0.02	4.97	3.74	SW

017	:00			.00	28				
14/09/2017	11:16:00	23.00	35.30	73593.00	2617.90	0.02	2.22	0.00	W
14/09/2017	11:17:00	23.10	36.50	73588.00	2616.60	0.02	2.05	1.77	SW
14/09/2017	11:18:00	23.50	34.50	73585.00	2617.79	0.02	3.22	2.46	
14/09/2017	11:19:00	23.70	35.20	73590.00	2617.68	0.02	5.00	1.54	N
14/09/2017	11:20:00	23.60	34.60	73587.00	2617.14	0.02	2.05	0.00	W
14/09/2017	11:21:00	23.30	33.20	73579.00	2618.22	0.02	2.63	0.70	SE
14/09/2017	11:22:00	23.40	36.30	73588.00	2616.82	0.02	2.05	1.05	S
14/09/2017	11:23:00	23.60	35.30	73583.00	2617.36	0.02	2.93	0.00	NE
14/09/2017	11:24:00	23.90	35.20	73587.00	2618.00	0.02	2.63	0.00	N
14/09/2017	11:25:00	23.40	34.50	73582.00	2617.57	0.02	4.39	1.01	SW
14/09/2017	11:26:00	23.30	34.70	73574.00	2618.76	0.02	1.76	0.00	SW
14/09/2017	11:27:00	23.40	34.10	73583.00	2617.79	0.02	4.68	0.00	W
14/09/2017	11:28:00	23.70	34.80	73578.00	2618.87	0.02	0.88	0.00	N
14/09/2017	11:29:00	23.50	36.30	73575.00	2619.30	0.02	6.39	1.44	SW
14/09/2017	11:30:00	23.20	34.30	73574.00	2618.76	0.02	3.22	3.04	NW
14/09/2017	11:31:00	22.70	35.40	73575.00	2618.33	0.02	2.93	0.00	SE
14/09/2017	11:32:00	22.70	35.90	73574.00	2618.97	0.02	0.83	1.40	W
14/09/2017	11:33:00	22.70	36.20	73578.00	2619.30	0.02	2.05	0.00	W
14/09/2017	11:34:00	22.90	36.70	73568.00	2618.54	0.02	2.34	1.26	SW
14/09/2017	11:35:00	23.00	36.40	73576.00	2618.65	0.02	0.28	0.14	E
14/09/2017	11:36:00	23.50	38.00	73573.00	2618.65	0.02	6.44	3.43	SE
14/09/2017	11:37:00	23.90	36.00	73577.00	2618.33	0.02	3.22	1.16	SW
14/09/2017	11:38:00	24.10	33.40	73571.00	2619.30	0.02	1.76	0.00	SW

14/09/2017	11:39:00	24.20	36.60	73569.00	2619.08	0.02	3.22	1.46	SW
14/09/2017	11:40:00	24.00	34.70	73566.00	2619.84	0.02	1.76	0.00	S
14/09/2017	11:41:00	23.40	36.50	73562.00	2620.59	0.02	2.05	0.00	W
14/09/2017	11:42:00	23.40	36.50	73570.00	2619.62	0.02	2.63	0.75	SW
14/09/2017	11:43:00	23.70	36.10	73565.00	2619.73	0.02	4.10	3.53	NE
14/09/2017	11:44:00	23.50	35.30	73570.00	2620.05	0.02	4.98	2.01	SW
14/09/2017	11:45:00	23.60	37.00	73559.00	2620.38	0.02	1.67	1.38	SW
14/09/2017	11:46:00	23.30	35.00	73562.00	2620.38	0.02	2.05	0.00	S
14/09/2017	11:47:00	23.30	35.90	73561.00	2620.16	0.02	1.76	0.00	S
14/09/2017	11:48:00	22.90	36.30	73559.00	2621.13	0.02	2.22	0.62	SW
14/09/2017	11:49:00	22.90	37.30	73558.00	2619.94	0.02	2.34	0.00	W
14/09/2017	11:50:00	23.10	37.30	73560.00	2620.70	0.02	1.17	2.50	E
14/09/2017	11:51:00	23.10	36.70	73560.00	2620.70	0.02	2.50	0.95	
14/09/2017	11:52:00	22.80	37.60	73544.00	2621.24	0.02	3.22	0.00	NE
14/09/2017	11:53:00	22.60	38.70	73546.00	2622.54	0.02	1.75	0.00	
14/09/2017	11:54:00	22.30	38.30	73553.00	2621.24	0.02	7.23	4.80	N
14/09/2017	11:55:00	22.10	38.20	73557.00	2620.38	0.02	3.51	1.87	N
14/09/2017	11:56:00	22.20	38.70	73556.00	2621.24	0.02	2.05	0.00	NE
14/09/2017	11:57:00	22.10	38.60	73555.00	2621.13	0.02	2.05	1.55	SW
14/09/2017	11:58:00	22.20	40.40	73553.00	2621.24	0.02	2.34	2.18	SW
14/09/2017	11:59:00	22.30	39.80	73548.00	2621.56	0.02	0.59	0.00	N
14/09/2017	12:00:00	22.30	40.70	73543.00	2622.75	0.02	9.37	2.68	SW
14/09/2017	12:01:00	22.50	39.10	73545.00	2622.32	0.02	4.73	3.56	SW
14/09/2	12:02	22.40	38.30	73550	2622.	0.02	3.22	2.94	SW

017	:00			.00	10				
14/09/2017	12:03:00	21.80	40.00	73540.00	2622.86	0.02	5.85	2.94	
14/09/2017	12:04:00	21.70	40.40	73535.00	2623.29	0.02	3.89	2.50	NE
14/09/2017	12:05:00	21.70	40.30	73540.00	2623.18	0.02	4.10	3.14	SW
14/09/2017	12:06:00	21.40	41.60	73540.00	2621.99	0.02	4.68	0.00	SW
14/09/2017	12:07:00	21.50	40.70	73543.00	2622.43	0.02	3.89	0.00	W
14/09/2017	12:08:00	21.60	42.40	73537.00	2622.86	0.02	1.46	0.58	SW
14/09/2017	12:09:00	21.60	42.30	73529.00	2623.83	0.02	3.51	0.00	SW
14/09/2017	12:10:00	21.50	41.20	73536.00	2623.94	0.02	6.11	2.44	SW
14/09/2017	12:11:00	21.40	41.10	73536.00	2622.97	0.02	4.97	3.41	SW
14/09/2017	12:12:00	21.20	42.80	73534.00	2622.86	0.02	7.02	4.68	SW
14/09/2017	12:13:00	20.70	41.90	73531.00	2623.83	0.02	8.19	3.25	N
14/09/2017	12:14:00	20.40	42.80	73533.00	2623.51	0.02	7.61	3.59	SW
14/09/2017	12:15:00	20.30	44.30	73534.00	2623.40	0.02	3.22	0.00	W
14/09/2017	12:16:00	20.50	45.20	73524.00	2624.15	0.02	3.51	1.63	SW
14/09/2017	12:17:00	20.70	44.10	73531.00	2623.29	0.02	2.34	0.74	NE
14/09/2017	12:18:00	20.60	43.40	73521.00	2624.69	0.02	4.10	3.67	SW
14/09/2017	12:19:00	20.70	44.30	73524.00	2625.23	0.02	1.76	0.65	SW
14/09/2017	12:20:00	20.60	43.80	73525.00	2624.26	0.02	1.67	1.22	W
14/09/2017	12:21:00	20.30	43.40	73513.00	2625.34	0.02	4.68	1.60	W
14/09/2017	12:22:00	20.30	45.30	73517.00	2624.80	0.02	2.34	0.00	W
14/09/2017	12:23:00	20.50	44.70	73514.00	2624.91	0.02	4.72	2.41	SW
14/09/2017	12:24:00	20.40	45.20	73512.00	2625.56	0.02	6.73	4.06	NW
14/09/2017	12:25:00	20.30	44.70	73517.00	2624.59	0.02	3.22	2.11	NW

14/09/2017	12:26:00	20.20	44.80	73522.00	2625.13	0.02	4.17	0.00	S
14/09/2017	12:27:00	20.20	46.20	73524.00	2624.80	0.02	2.05	0.00	SW
14/09/2017	12:28:00	20.30	47.30	73521.00	2624.80	0.02	4.97	3.27	NE
14/09/2017	12:29:00	20.00	45.30	73522.00	2624.69	0.02	2.93	1.95	N
14/09/2017	12:30:00	20.20	45.90	73516.00	2625.66	0.02	1.17	0.00	NE
14/09/2017	12:31:00	20.30	45.40	73518.00	2624.91	0.02	4.10	1.80	S
14/09/2017	12:32:00	20.30	47.20	73524.00	2624.91	0.02	6.15	2.04	E
14/09/2017	12:33:00	20.40	46.20	73515.00	2625.45	0.02	2.93	0.00	
14/09/2017	12:34:00	20.40	45.30	73515.00	2625.99	0.02	12.88	5.96	E
14/09/2017	12:35:00	20.50	45.40	73515.00	2625.13	0.02	5.85	2.20	SW
14/09/2017	12:36:00	20.60	45.00	73512.00	2626.10	0.02	11.12	6.40	
14/09/2017	12:37:00	20.70	44.70	73505.00	2625.45	0.02	2.63	0.89	SW
14/09/2017	12:38:00	20.60	44.00	73500.00	2626.85	0.02	4.10	3.46	N
14/09/2017	12:39:00	20.30	44.00	73500.00	2627.07	0.02	7.23	6.31	SW
14/09/2017	12:40:00	20.40	45.20	73506.00	2627.07	0.02	7.02	3.67	N
14/09/2017	12:41:00	20.20	45.70	73504.00	2627.39	0.02	4.10	5.85	E
14/09/2017	12:42:00	20.20	45.30	73507.00	2626.96	0.02	2.78	2.69	SW
14/09/2017	12:43:00	20.00	45.80	73499.00	2627.07	0.02	3.51	0.00	S
14/09/2017	12:44:00	20.10	45.90	73489.00	2628.36	0.02	3.22	6.40	SE
14/09/2017	12:45:00	20.10	45.00	73491.00	2627.18	0.02	4.97	1.52	NW
14/09/2017	12:46:00	20.10	46.60	73493.00	2627.72	0.02	3.22	0.00	W
14/09/2017	12:47:00	20.10	45.30	73494.00	2628.26	0.02	10.53	8.48	SW
14/09/2017	12:48:00	20.10	44.70	73490.00	2627.83	0.02	5.27	1.65	W
14/09/2	12:49	20.00	45.70	73488	2627.	0.02	5.85	2.01	SW

017	:00			.00	39				
14/09/2017	12:50:00	20.00	46.10	73489.00	2627.72	0.02	6.14	0.00	NE
14/09/2017	12:51:00	19.90	46.90	73497.00	2627.93	0.02	1.76	0.00	NE
14/09/2017	12:52:00	20.00	47.60	73490.00	2628.90	0.02	2.50	1.49	SE
14/09/2017	12:53:00	20.00	46.90	73493.00	2628.26	0.02	12.29	8.45	SW
14/09/2017	12:54:00	19.90	46.40	73482.00	2629.12	0.02	3.80	1.32	NE
14/09/2017	12:55:00	19.70	46.60	73480.00	2629.23	0.02	4.44	2.53	
14/09/2017	12:56:00	19.90	47.60	73474.00	2629.44	0.02	9.07	6.00	NW
14/09/2017	12:57:00	19.90	46.90	73485.00	2629.23	0.02	2.34	0.00	E
14/09/2017	12:58:00	19.90	46.40	73472.00	2629.98	0.02	7.23	4.82	SW
14/09/2017	12:59:00	19.70	47.40	73474.00	2631.28	0.02	2.63	0.00	NE
14/09/2017	13:00:00	19.70	46.80	73467.00	2630.20	0.02	4.09	2.59	NW
14/09/2017	13:01:00	19.30	46.40	73469.00	2630.63	0.02	3.22	0.71	
14/09/2017	13:02:00	19.20	47.40	73471.00	2630.31	0.02	5.85	0.00	SW
14/09/2017	13:03:00	19.20	47.00	73465.00	2630.42	0.02	2.63	0.00	N
14/09/2017	13:04:00	19.20	47.70	73473.00	2630.20	0.02	5.27	3.59	NE
14/09/2017	13:05:00	19.40	48.10	73469.00	2629.77	0.02	1.76	0.00	N
14/09/2017	13:06:00	19.50	47.90	73466.00	2630.42	0.02	4.10	0.00	SW
14/09/2017	13:07:00	19.50	46.60	73469.00	2629.88	0.02	2.34	0.00	SW
14/09/2017	13:08:00	19.70	48.30	73461.00	2631.17	0.02	3.06	2.84	NE
14/09/2017	13:09:00	19.70	47.30	73464.00	2631.28	0.02	2.34	1.35	NE
14/09/2017	13:10:00	19.80	46.60	73462.00	2630.74	0.02	8.19	5.53	NE
14/09/2017	13:11:00	19.70	46.70	73463.00	2631.07	0.02	2.78	1.15	W
14/09/2017	13:12:00	19.60	47.90	73464.00	2631.07	0.02	9.95	7.24	E

14/09/2017	13:13:00	19.70	48.20	73465.00	2631.28	0.02	3.22	2.35	SW
14/09/2017	13:14:00	19.80	46.90	73452.00	2631.60	0.02	6.95	4.91	NE
14/09/2017	13:15:00	19.70	46.80	73455.00	2631.93	0.02	5.56	2.34	N
14/09/2017	13:16:00	19.40	46.90	73454.00	2632.15	0.02	6.44	2.21	SW
14/09/2017	13:17:00	19.50	47.20	73454.00	2632.47	0.02	8.06	6.42	SW
14/09/2017	13:18:00	19.50	47.60	73461.00	2631.28	0.02	6.44	6.43	N
14/09/2017	13:19:00	19.60	47.10	73457.00	2632.79	0.02	2.63	0.00	SW
14/09/2017	13:20:00	19.70	48.50	73446.00	2632.58	0.02	4.98	7.40	SW
14/09/2017	13:21:00	19.80	47.00	73450.00	2632.04	0.02	4.39	2.72	SW
14/09/2017	13:22:00	19.80	48.30	73445.00	2633.44	0.02	9.95	6.12	N
14/09/2017	13:23:00	19.80	46.60	73439.00	2633.01	0.02	3.80	6.34	SW
14/09/2017	13:24:00	19.70	46.80	73440.00	2634.09	0.02	5.83	1.27	NW
14/09/2017	13:25:00	19.90	46.90	73444.00	2633.12	0.02	4.10	3.09	SW
14/09/2017	13:26:00	19.90	47.20	73446.00	2633.33	0.02	4.10	4.01	
14/09/2017	13:27:00	20.00	46.30	73441.00	2633.44	0.02	2.78	2.10	SW
14/09/2017	13:28:00	20.20	47.20	73434.00	2634.41	0.02	2.05	2.43	NE
14/09/2017	13:29:00	20.40	46.40	73428.00	2634.95	0.02	3.51	3.52	N
14/09/2017	13:30:00	20.30	45.60	73434.00	2633.44	0.02	6.67	8.52	SW
14/09/2017	13:31:00	20.10	45.50	73434.00	2634.09	0.02	9.36	7.40	E
14/09/2017	13:32:00	19.90	45.60	73427.00	2635.28	0.02	4.68	5.20	W
14/09/2017	13:33:00	19.90	46.00	73422.00	2634.95	0.02	4.45	4.65	SW
14/09/2017	13:34:00	20.20	46.00	73413.00	2636.04	0.02	6.44	0.00	NE
14/09/2017	13:35:00	20.10	44.80	73424.00	2635.71	0.02	6.44	6.65	SW
14/09/2	13:36	20.00	45.30	73424	2635.	0.02	7.61	0.00	NE

017	:00			.00	17				
14/09/2017	13:37:00	20.00	45.90	73413.00	2636.68	0.02	5.56	2.05	SW
14/09/2017	13:38:00	20.10	46.10	73425.00	2635.49	0.02	4.97	4.97	E
14/09/2017	13:39:00	20.00	45.40	73423.00	2635.17	0.02	4.10	1.53	SW
14/09/2017	13:40:00	20.10	46.10	73420.00	2635.71	0.02	4.68	2.66	W
14/09/2017	13:41:00	20.40	47.40	73423.00	2636.04	0.02	6.44	5.54	SW
14/09/2017	13:42:00	20.30	45.80	73418.00	2636.90	0.02	2.63	1.56	N
14/09/2017	13:43:00	20.40	45.80	73412.00	2636.47	0.02	3.06	3.37	SW
14/09/2017	13:44:00	20.50	45.80	73408.00	2637.01	0.02	2.34	2.16	SW
14/09/2017	13:45:00	20.30	45.00	73402.00	2636.79	0.02	2.93	0.00	SW
14/09/2017	13:46:00	20.30	45.40	73405.00	2636.90	0.02	2.78	0.95	SW
14/09/2017	13:47:00	20.30	45.50	73402.00	2637.76	0.02	2.05	0.00	S
14/09/2017	13:48:00	20.20	45.80	73396.00	2637.87	0.02	4.10	0.00	SW
14/09/2017	13:49:00	20.20	47.00	73399.00	2637.33	0.02	1.95	0.74	SW
14/09/2017	13:50:00	20.40	46.60	73399.00	2638.20	0.02	3.80	1.28	SW
14/09/2017	13:51:00	20.40	45.30	73409.00	2638.09	0.02	8.19	4.02	SW
14/09/2017	13:52:00	20.50	45.50	73409.00	2636.90	0.02	2.34	3.64	SW
14/09/2017	13:53:00	20.40	44.70	73401.00	2637.01	0.02	2.93	2.60	S
14/09/2017	13:54:00	20.00	45.50	73407.00	2637.66	0.02	2.05	1.89	NW
14/09/2017	13:55:00	20.00	47.00	73404.00	2638.31	0.02	6.73	4.47	SE
14/09/2017	13:56:00	19.90	46.70	73401.00	2638.31	0.02	4.97	4.52	NE
14/09/2017	13:57:00	19.70	46.30	73400.00	2637.66	0.02	7.02	0.00	SW
14/09/2017	13:58:00	19.70	46.90	73405.00	2636.90	0.02	4.39	4.02	SW
14/09/2017	13:59:00	19.80	46.90	73404.00	2637.12	0.02	3.06	0.00	

14/09/2017	14:00:00	19.90	46.30	73410.00	2636.57	0.02	1.76	0.00	SW
14/09/2017	14:01:00	19.70	46.90	73405.00	2637.22	0.02	4.68	0.00	SW
14/09/2017	14:02:00	19.60	46.70	73406.00	2636.79	0.02	3.61	2.67	E
14/09/2017	14:03:00	19.60	47.70	73402.00	2637.12	0.02	3.51	0.00	NE
14/09/2017	14:04:00	19.50	47.80	73403.00	2637.66	0.02	2.34	3.73	N
14/09/2017	14:05:00	19.50	46.60	73396.00	2637.76	0.02	2.22	0.00	NE
14/09/2017	14:06:00	19.40	46.50	73402.00	2637.22	0.02	2.63	2.18	W
14/09/2017	14:07:00	19.20	48.00	73402.00	2637.98	0.02	8.48	4.80	
14/09/2017	14:08:00	19.30	47.80	73401.00	2638.31	0.02	5.27	2.39	E
14/09/2017	14:09:00	19.30	47.20	73396.00	2638.74	0.02	1.76	0.00	SE
14/09/2017	14:10:00	19.30	47.10	73402.00	2637.66	0.02	3.51	2.54	SW
14/09/2017	14:11:00	19.20	47.10	73401.00	2637.01	0.02	3.22	1.70	E
14/09/2017	14:12:00	19.10	48.60	73402.00	2637.33	0.02	2.93	2.79	SW
14/09/2017	14:13:00	19.00	47.60	73405.00	2637.33	0.02	4.10	2.39	SW
14/09/2017	14:14:00	19.00	48.00	73404.00	2636.79	0.02	4.39	1.51	W
14/09/2017	14:15:00	19.10	49.00	73401.00	2637.87	0.02	4.73	0.00	SW
14/09/2017	14:16:00	19.20	48.50	73400.00	2637.33	0.02	0.88	0.00	SW
14/09/2017	14:17:00	19.00	47.90	73399.00	2637.87	0.02	3.81	0.00	SW
14/09/2017	14:18:00	18.90	48.00	73400.00	2637.55	0.02	2.50	0.00	SW
14/09/2017	14:19:00	18.90	48.80	73392.00	2637.66	0.02	2.05	2.23	E
14/09/2017	14:20:00	18.90	49.30	73390.00	2638.74	0.02	2.34	0.00	NE
14/09/2017	14:21:00	18.90	49.40	73389.00	2638.74	0.02	2.50	0.00	W
14/09/2017	14:22:00	18.80	48.90	73388.00	2639.17	0.02	3.80	0.00	NW
14/09/2	14:23	18.80	49.60	73386	2639.	0.02	2.05	0.77	SW

017	:00			.00	39				
14/09/2017	14:24:00	18.80	49.00	73381.00	2640.25	0.02	1.17	7.92	SW
14/09/2017	14:25:00	18.80	48.50	73379.00	2639.92	0.02	3.80	2.16	SW
14/09/2017	14:26:00	18.70	49.30	73374.00	2640.25	0.02	2.93	1.89	SE
14/09/2017	14:27:00	18.50	49.60	73375.00	2640.90	0.02	7.02	6.83	NE
14/09/2017	14:28:00	18.50	50.20	73372.00	2641.22	0.02	12.59	7.62	E
14/09/2017	14:29:00	18.40	50.20	73376.00	2640.57	0.02	2.93	2.00	W
14/09/2017	14:30:00	18.50	49.60	73367.00	2641.44	0.02	4.39	6.42	
14/09/2017	14:31:00	18.50	50.10	73374.00	2640.90	0.02	5.28	4.31	SW
14/09/2017	14:32:00	18.50	49.00	73372.00	2640.90	0.02	4.39	1.89	SW
14/09/2017	14:33:00	18.50	50.10	73361.00	2641.12	0.02	5.56	3.90	SW
14/09/2017	14:34:00	18.40	51.50	73370.00	2641.22	0.02	4.17	6.00	SE
14/09/2017	14:35:00	18.50	52.10	73366.00	2642.41	0.02	6.73	4.95	NE
14/09/2017	14:36:00	18.50	51.20	73367.00	2641.33	0.02	7.90	3.62	SW
14/09/2017	14:37:00	18.50	51.20	73355.00	2641.66	0.02	7.51	3.91	SW
14/09/2017	14:38:00	18.40	51.10	73366.00	2641.12	0.02	2.63	0.00	NE
14/09/2017	14:39:00	18.40	51.80	73362.00	2641.98	0.02	5.27	3.18	N
14/09/2017	14:40:00	18.30	52.00	73370.00	2641.33	0.02	2.05	0.72	SW
14/09/2017	14:41:00	18.20	52.20	73370.00	2642.09	0.02	3.51	1.24	N
14/09/2017	14:42:00	18.30	52.80	73368.00	2641.87	0.02	3.22	2.22	NE
14/09/2017	14:43:00	18.40	52.40	73365.00	2641.44	0.02	4.10	2.26	N
14/09/2017	14:44:00	18.50	52.10	73364.00	2641.76	0.02	11.41	6.08	SW
14/09/2017	14:45:00	18.40	52.10	73358.00	2641.66	0.02	7.90	2.56	NE
14/09/2017	14:46:00	18.40	52.30	73366.00	2641.98	0.02	4.68	1.25	NE

14/09/2017	14:47:00	18.40	52.20	73358.00	2641.66	0.02	7.50	0.00	NE
14/09/2017	14:48:00	18.40	52.20	73357.00	2641.87	0.02	4.68	4.65	NE
14/09/2017	14:49:00	18.60	51.60	73352.00	2642.84	0.02	4.68	2.88	SW
14/09/2017	14:50:00	18.60	51.50	73359.00	2642.20	0.02	4.72	0.00	W
14/09/2017	14:51:00	18.70	51.30	73360.00	2642.41	0.02	4.68	2.18	W
14/09/2017	14:52:00	18.60	50.90	73347.00	2643.39	0.02	2.63	2.93	NE
14/09/2017	14:53:00	18.50	52.20	73348.00	2642.95	0.02	5.00	6.95	NE
14/09/2017	14:54:00	18.70	51.00	73355.00	2642.63	0.02	2.05	0.00	SW
14/09/2017	14:55:00	18.60	51.60	73350.00	2643.17	0.02	4.68	2.41	E
14/09/2017	14:56:00	18.70	51.90	73348.00	2643.60	0.02	3.06	2.41	SW
14/09/2017	14:57:00	18.80	51.90	73346.00	2643.71	0.02	4.10	0.00	SW
14/09/2017	14:58:00	18.90	51.40	73349.00	2642.84	0.02	3.22	1.17	NE
14/09/2017	14:59:00	19.00	52.30	73349.00	2643.60	0.02	1.17	0.00	SW
14/09/2017	15:00:00	19.10	50.90	73345.00	2643.71	0.02	1.46	0.00	E
14/09/2017	15:01:00	19.10	50.40	73346.00	2643.28	0.02	3.81	0.00	
14/09/2017	15:02:00	19.10	50.00	73351.00	2642.84	0.02	3.80	0.00	SW
14/09/2017	15:03:00	19.20	50.10	73355.00	2642.74	0.02	2.34	0.00	SW
14/09/2017	15:04:00	19.20	49.90	73356.00	2643.28	0.02	6.44	3.78	NE
14/09/2017	15:05:00	19.20	50.40	73348.00	2643.71	0.02	7.32	2.27	E
14/09/2017	15:06:00	19.20	49.50	73342.00	2643.60	0.02	6.39	3.14	W
14/09/2017	15:07:00	19.20	49.70	73340.00	2643.93	0.02	5.56	4.86	SW
14/09/2017	15:08:00	19.10	49.10	73345.00	2644.04	0.02	4.10	4.08	NE
14/09/2017	15:09:00	19.10	49.90	73344.00	2644.36	0.02	12.79	7.10	SE
14/09/2	15:10	19.20	49.10	73346	2643.	0.02	6.73	2.34	W

017	:00			.00	49				
14/09/2017	15:11:00	19.10	48.90	73344.00	2644.14	0.02	4.97	2.62	SW
14/09/2017	15:12:00	19.10	48.60	73342.00	2643.82	0.02	5.28	2.33	NE
14/09/2017	15:13:00	19.20	49.30	73341.00	2643.28	0.02	3.51	1.82	E
14/09/2017	15:14:00	19.20	48.20	73344.00	2644.36	0.02	1.76	4.13	N
14/09/2017	15:15:00	19.40	48.30	73336.00	2644.25	0.02	2.34	0.00	SW
14/09/2017	15:16:00	19.40	48.70	73339.00	2644.36	0.02	4.68	0.00	NE
14/09/2017	15:17:00	19.40	49.30	73334.00	2644.79	0.02	7.31	4.67	N
14/09/2017	15:18:00	19.30	49.20	73333.00	2644.36	0.02	4.39	4.65	NW
14/09/2017	15:19:00	19.30	49.40	73329.00	2644.58	0.02	2.34	0.86	W
14/09/2017	15:20:00	19.40	49.40	73333.00	2644.68	0.02	1.17	0.32	NE
14/09/2017	15:21:00	19.40	47.70	73349.00	2643.82	0.02	5.27	4.86	NW
14/09/2017	15:22:00	19.40	49.10	73347.00	2644.36	0.02	1.39	0.53	W
14/09/2017	15:23:00	19.20	48.20	73348.00	2643.93	0.02	1.76	0.00	NE
14/09/2017	15:24:00	19.20	48.50	73346.00	2643.39	0.02	4.97	2.45	SW
14/09/2017	15:25:00	19.00	48.60	73347.00	2644.04	0.02	2.50	0.00	SW
14/09/2017	15:26:00	19.00	49.10	73342.00	2643.71	0.02	1.17	0.00	SE
14/09/2017	15:27:00	19.10	49.70	73347.00	2643.71	0.02	4.68	0.00	NE
14/09/2017	15:28:00	19.20	49.80	73351.00	2643.06	0.02	1.11	0.00	N
14/09/2017	15:29:00	19.30	49.50	73342.00	2644.04	0.02	0.59	0.00	SE
14/09/2017	15:30:00	19.30	49.10	73348.00	2643.82	0.02	2.92	1.35	N
14/09/2017	15:31:00	19.30	49.30	73352.00	2643.71	0.02	1.46	0.00	SW
14/09/2017	15:32:00	19.20	49.10	73348.00	2642.84	0.02	1.46	0.88	
14/09/2017	15:33:00	19.20	49.50	73344.00	2644.36	0.02	2.93	1.83	E

14/09/2017	15:34:00	19.10	50.80	73338.00	2644.68	0.02	0.59	0.00	S
14/09/2017	15:35:00	18.90	49.60	73338.00	2643.93	0.02	2.63	0.00	NE
14/09/2017	15:36:00	19.10	49.90	73328.00	2644.79	0.02	3.22	0.85	SW
14/09/2017	15:37:00	19.00	50.10	73335.00	2645.01	0.02	7.03	0.00	NW
14/09/2017	15:38:00	18.90	50.60	73334.00	2644.36	0.02	5.28	3.10	SW
14/09/2017	15:39:00	19.00	49.80	73335.00	2644.90	0.02	0.59	0.00	SW
14/09/2017	15:40:00	18.90	49.20	73334.00	2644.47	0.02	2.34	0.00	
14/09/2017	15:41:00	18.90	51.00	73327.00	2645.33	0.02	3.61	0.00	SW
14/09/2017	15:42:00	19.00	50.30	73326.00	2646.31	0.02	0.88	0.00	N
14/09/2017	15:43:00	19.00	49.90	73339.00	2644.36	0.02	2.05	0.59	SW
14/09/2017	15:44:00	19.00	50.50	73332.00	2644.58	0.02	1.67	1.36	N
14/09/2017	15:45:00	18.80	49.60	73342.00	2644.90	0.02	2.34	0.00	SW
14/09/2017	15:46:00	18.90	50.50	73332.00	2644.90	0.02	1.46	0.00	SW
14/09/2017	15:47:00	18.90	49.40	73337.00	2645.12	0.02	1.46	1.72	SW
14/09/2017	15:48:00	18.90	49.50	73334.00	2644.04	0.02	2.34	0.81	SW
14/09/2017	15:49:00	18.80	49.50	73340.00	2643.82	0.02	3.51	2.10	SW
14/09/2017	15:50:00	18.70	49.00	73341.00	2643.06	0.02	3.51	1.72	SW
14/09/2017	15:51:00	18.70	50.10	73337.00	2644.68	0.02	0.59	0.00	E
14/09/2017	15:52:00	18.70	50.40	73345.00	2643.28	0.02	2.05	0.00	SW
14/09/2017	15:53:00	18.60	49.30	73342.00	2643.60	0.02	3.81	1.22	SW
14/09/2017	15:54:00	18.60	50.60	73354.00	2642.63	0.02	0.56	0.00	
14/09/2017	15:55:00	18.60	50.50	73350.00	2643.28	0.02	2.34	1.31	SW
14/09/2017	15:56:00	18.50	50.90	73352.00	2642.63	0.02	1.46	1.47	SW
14/09/2	15:57	18.40	51.20	73347	2643.	0.02	3.34	0.00	E

017	:00			.00	49				
14/09/2017	15:58:00	18.30	50.90	73353.00	2643.82	0.02	1.46	0.70	N
14/09/2017	15:59:00	18.30	52.40	73344.00	2642.63	0.02	4.68	1.24	SW
14/09/2017	16:00:00	18.30	52.20	73346.00	2643.06	0.02	1.95	0.77	S

Date:	15/08/2017	Time:	14:30:00
Temperature:	22.50		
Humidity:	39.80		
Pressure:	73158.00		
Altitude:	2663.20		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	15/08/2017	Time:	14:31:00
Temperature:	24.30		
Humidity:	36.90		
Pressure:	73158.00		
Altitude:	2664.06		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	15/08/2017	Time:	14:45:00
Temperature:	21.00		
Humidity:	43.90		
Pressure:	73127.00		
Altitude:	2668.29		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	15/08/2017	Time:	17:01:00
Temperature:	22.70		
Humidity:	41.90		
Pressure:	73114.00		
Altitude:	2668.40		
TotalRain:	0.00		

currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	8:23:00
Temperature:	26.30		
Humidity:	39.50		
Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	8:37:00
Temperature:	21.50		
Humidity:	36.20		
Pressure:	235.00		
Altitude:	30355.89		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	8:39:00
Temperature:	22.60		
Humidity:	34.90		
Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	8:46:00
Temperature:	27.40		
Humidity:	26.00		
Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	8:49:00
Temperature:	23.30		

Humidity:	34.60		
Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	E		
Date:	16/08/2017	Time:	10:07:00
Temperature:	23.40		
Humidity:	36.70		
Pressure:	73429.00		
Altitude:	2635.17		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	10:08:00
Temperature:	23.70		
Humidity:	35.80		
Pressure:	73426.00		
Altitude:	2634.95		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	10:11:00
Temperature:	23.60		
Humidity:	36.30		
Pressure:	73436.00		
Altitude:	2634.63		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	10:26:00
Temperature:	43.00		
Humidity:	11.70		
Pressure:	73425.00		
Altitude:	2636.04		
TotalRain:	0.00		
currentWindSpeed:	0.00		

currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	11:26:00
Temperature:	20.30		
Humidity:	41.00		
Pressure:	73387.00		
Altitude:	2639.71		
TotalRain:	3.05		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	11:58:00
Temperature:	21.70		
Humidity:	39.10		
Pressure:	73375.00		
Altitude:	2640.25		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	17:56:00
Temperature:	21.50		
Humidity:	41.10		
Pressure:	72960.00		
Altitude:	2684.90		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	23:08:00
Temperature:	24.50		
Humidity:	31.30		
Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	16/08/2017	Time:	23:12:00
Temperature:	25.70		
Humidity:	29.20		

Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	16/08/2017	Time:	23:39:00
Temperature:	21.30		
Humidity:	36.80		
Pressure:	73231.00		
Altitude:	2655.83		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	23:44:00
Temperature:	20.80		
Humidity:	38.90		
Pressure:	73225.00		
Altitude:	2656.81		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	16/08/2017	Time:	23:49:00
Temperature:	20.30		
Humidity:	41.00		
Pressure:	73229.00		
Altitude:	2657.46		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	17/08/2017	Time:	0:25:00
Temperature:	20.50		
Humidity:	43.40		
Pressure:	73211.00		
Altitude:	2657.35		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		

wind_direction:	S		
Date:	17/08/2017	Time:	0:52:00
Temperature:	20.20		
Humidity:	45.10		
Pressure:	73173.00		
Altitude:	2662.22		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	17/08/2017	Time:	9:28:00
Temperature:	19.70		
Humidity:	44.90		
Pressure:	73486.00		
Altitude:	2628.69		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	17/08/2017	Time:	9:48:00
Temperature:	19.40		
Humidity:	45.20		
Pressure:	73477.00		
Altitude:	2629.77		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	17/08/2017	Time:	11:39:00
Temperature:	20.00		
Humidity:	43.10		
Pressure:	73404.00		
Altitude:	2637.01		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	17/08/2017	Time:	11:43:00
Temperature:	20.00		
Humidity:	43.00		
Pressure:	73395.00		

Altitude:	2637.12		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	18/08/2017	Time:	10:11:00
Temperature:	20.40		
Humidity:	43.00		
Pressure:	235.00		
Altitude:	30355.89		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	18/08/2017	Time:	10:14:00
Temperature:	21.40		
Humidity:	41.50		
Pressure:	235.00		
Altitude:	30355.89		
TotalRain:	0.25		
currentWindSpeed:	0.29		
currentWindGust:	0.00		
wind_direction:	S		
Date:	18/08/2017	Time:	10:16:00
Temperature:	21.00		
Humidity:	41.40		
Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.26		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	18/08/2017	Time:	10:17:00
Temperature:	20.90		
Humidity:	41.70		
Pressure:	235.00		
Altitude:	30355.89		
TotalRain:	0.26		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		

Date:	18/08/2017	Time:	10:18:00
Temperature:	20.80		
Humidity:	42.10		
Pressure:	235.00		
Altitude:	30355.89		
TotalRain:	0.26		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	18/08/2017	Time:	11:46:00
Temperature:	21.90		
Humidity:	43.40		
Pressure:	73224.00		
Altitude:	2656.81		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	23/08/2017	Time:	10:01:00
Temperature:	18.90		
Humidity:	41.90		
Pressure:	73415.00		
Altitude:	2636.68		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	23/08/2017	Time:	10:10:00
Temperature:	19.20		
Humidity:	42.10		
Pressure:	73421.00		
Altitude:	2635.71		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	23/08/2017	Time:	10:11:00
Temperature:	19.20		
Humidity:	40.50		
Pressure:	73415.00		
Altitude:	2635.82		

TotalRain:	0.53		
currentWindSpeed:	2.05		
currentWindGust:	0.00		
wind_direction:	S		
Date:	23/08/2017	Time:	10:27:00
Temperature:	20.30		
Humidity:	40.20		
Pressure:	73401.00		
Altitude:	2637.12		
TotalRain:	7.08		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	N		
Date:	23/08/2017	Time:	10:32:00
Temperature:	20.20		
Humidity:	39.30		
Pressure:	73408.00		
Altitude:	2637.01		
TotalRain:	7.41		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	N		
Date:	23/08/2017	Time:	10:39:00
Temperature:	19.70		
Humidity:	39.00		
Pressure:	73406.00		
Altitude:	2636.90		
TotalRain:	0.17		
currentWindSpeed:	0.56		
currentWindGust:	0.00		
wind_direction:	NW		
Date:	23/08/2017	Time:	11:21:00
Temperature:	18.80		
Humidity:	41.10		
Pressure:	73370.00		
Altitude:	2641.87		
TotalRain:	0.01		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	E		
Date:	23/08/2017	Time:	11:26:00

Temperature:	18.90		
Humidity:	41.70		
Pressure:	73375.00		
Altitude:	2641.44		
TotalRain:	1.44		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	23/08/2017	Time:	11:30:00
Temperature:	19.00		
Humidity:	41.40		
Pressure:	73364.00		
Altitude:	2641.98		
TotalRain:	1.95		
currentWindSpeed:	11.68		
currentWindGust:	9.86		
wind_direction:			
Date:	23/08/2017	Time:	11:34:00
Temperature:	21.70		
Humidity:	35.20		
Pressure:	73355.00		
Altitude:	2643.06		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	23/08/2017	Time:	11:52:00
Temperature:	23.20		
Humidity:	39.60		
Pressure:	73338.00		
Altitude:	2644.04		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	22.20		
Humidity:	33.60		
Pressure:	73337.00		
Altitude:	2644.47		
TotalRain:	0.00		

currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	21.40		
Humidity:	35.10		
Pressure:	73333.00		
Altitude:	2644.90		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.60		
Humidity:	39.60		
Pressure:	73307.00		
Altitude:	2646.96		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.80		
Humidity:	38.90		
Pressure:	73303.00		
Altitude:	2648.58		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.80		
Humidity:	39.20		
Pressure:	73298.00		
Altitude:	2648.36		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.60		

Humidity:	39.00		
Pressure:	73295.00		
Altitude:	2648.90		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.60		
Humidity:	39.20		
Pressure:	73300.00		
Altitude:	2649.01		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.60		
Humidity:	39.10		
Pressure:	73292.00		
Altitude:	2649.44		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.60		
Humidity:	39.10		
Pressure:	73299.00		
Altitude:	2649.44		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.50		
Humidity:	39.20		
Pressure:	73298.00		
Altitude:	2648.47		
TotalRain:	0.00		
currentWindSpeed:	0.00		

currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.50		
Humidity:	39.70		
Pressure:	73293.00		
Altitude:	2649.12		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.50		
Humidity:	39.30		
Pressure:	73300.00		
Altitude:	2649.34		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	01/01/2000	Time:	0:00:00
Temperature:	20.00		
Humidity:	38.40		
Pressure:	73291.00		
Altitude:	2649.66		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.60		
Humidity:	42.60		
Pressure:	73292.00		
Altitude:	2649.44		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.60		
Humidity:	39.80		

Pressure:	73297.00		
Altitude:	2649.55		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.40		
Humidity:	39.20		
Pressure:	73297.00		
Altitude:	2648.58		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	nan		
Humidity:	0.00		
Pressure:	73290.00		
Altitude:	2649.34		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	22.60		
Humidity:	32.80		
Pressure:	73288.00		
Altitude:	2649.55		
TotalRain:	0.15		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	EN		
Date:	01/01/2000	Time:	0:00:00
Temperature:	22.40		
Humidity:	32.70		
Pressure:	73286.00		
Altitude:	2649.44		
TotalRain:	0.16		
currentWindSpeed:	4.40		
currentWindGust:	0.00		

wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	22.10		
Humidity:	33.10		
Pressure:	73283.00		
Altitude:	2650.74		
TotalRain:	0.18		
currentWindSpeed:	0.55		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	21.70		
Humidity:	33.70		
Pressure:	73288.00		
Altitude:	2650.31		
TotalRain:	0.18		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.40		
Humidity:	40.00		
Pressure:	73271.00		
Altitude:	2652.15		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.30		
Humidity:	39.90		
Pressure:	73269.00		
Altitude:	2652.15		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	0.00		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.30		
Humidity:	39.90		

Pressure:	73262.00		
Altitude:	2652.80		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	18.70		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.30		
Humidity:	40.10		
Pressure:	73270.00		
Altitude:	2652.37		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	25.50		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.30		
Humidity:	40.10		
Pressure:	73268.00		
Altitude:	2652.26		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	25.50		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.20		
Humidity:	40.10		
Pressure:	73257.00		
Altitude:	2652.80		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	25.50		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.20		
Humidity:	40.50		
Pressure:	73266.00		

Altitude:	2651.72		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	25.50		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.10		
Humidity:	40.50		
Pressure:	73266.00		
Altitude:	2652.26		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	25.50		
Date:	01/01/2000	Time:	0:00:00
Temperature:	19.40		
Humidity:	46.50		
Pressure:	234.00		
Altitude:	30367.23		
totalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	0.00		
Date:	24/08/2017	Time:	10:29:00
Temperature:	19.50		
Humidity:	46.60		
Pressure:	234.00		
Altitude:	30367.23		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	24/08/2017	Time:	10:49:00
Temperature:	20.20		
Humidity:	44.60		
Pressure:	73423.00		
Altitude:	2635.60		
TotalRain:	0.00		

currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	24/08/2017	Time:	10:52:00
Temperature:	20.10		
Humidity:	44.40		
Pressure:	73425.00		
Altitude:	2634.63		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	24/08/2017	Time:	11:10:00
Temperature:	20.10		
Humidity:	44.50		
Pressure:	73429.00		
Altitude:	2634.20		
TotalRain:	0.17		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	24/08/2017	Time:	11:55:00
Temperature:	20.40		
Humidity:	45.80		
Pressure:	73378.00		
Altitude:	2640.90		
TotalRain:	0.02		
currentWindSpeed:	0.59		
currentWindGust:	0.00		
wind_direction:	S		
Date:	24/08/2017	Time:	12:07:00
Temperature:	20.30		
Humidity:	45.90		
Pressure:	73368.00		
Altitude:	2642.09		
TotalRain:	0.03		
currentWindSpeed:	0.28		
currentWindGust:	0.00		
wind_direction:			
Date:	24/08/2017	Time:	12:36:00
Temperature:	20.60		

Humidity:	44.30		
Pressure:	73306.00		
Altitude:	2649.01		
TotalRain:	0.03		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	24/08/2017	Time:	12:37:00
Temperature:	20.60		
Humidity:	44.50		
Pressure:	73310.00		
Altitude:	2648.90		
TotalRain:	0.03		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	24/08/2017	Time:	12:46:00
Temperature:	20.30		
Humidity:	45.00		
Pressure:	73290.00		
Altitude:	2650.63		
TotalRain:	0.05		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	24/08/2017	Time:	14:25:00
Temperature:	19.10		
Humidity:	48.10		
Pressure:	73220.00		
Altitude:	2658.54		
TotalRain:	0.01		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	24/08/2017	Time:	14:32:00
Temperature:	19.60		
Humidity:	46.70		
Pressure:	73193.00		
Altitude:	2660.71		
TotalRain:	0.01		
currentWindSpeed:	9.36		

currentWindGust:	2.62		
wind_direction:			
Date:	24/08/2017	Time:	14:34:00
Temperature:	19.80		
Humidity:	46.30		
Pressure:	73185.00		
Altitude:	2661.25		
TotalRain:	0.01		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	24/08/2017	Time:	14:42:00
Temperature:	20.10		
Humidity:	45.20		
Pressure:	73158.00		
Altitude:	2664.50		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:			
Date:	24/08/2017	Time:	15:29:00
Temperature:	20.70		
Humidity:	40.50		
Pressure:	73128.00		
Altitude:	2667.53		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		
Date:	29/08/2017	Time:	15:45:00
Temperature:	18.50		
Humidity:	48.60		
Pressure:	73269.00		
Altitude:	2650.74		
TotalRain:	0.00		
currentWindSpeed:	2.93		
currentWindGust:	1.09		
wind_direction:	S		
Date:	29/08/2017	Time:	16:18:00
Temperature:	16.80		
Humidity:	62.70		

Pressure:	73285.00		
Altitude:	2650.09		
TotalRain:	0.02		
currentWindSpeed:	1.46		
currentWindGust:	0.00		
wind_direction:			
Date:	29/08/2017	Time:	16:22:00
Temperature:	16.50		
Humidity:	66.20		
Pressure:	73294.00		
Altitude:	2649.66		
TotalRain:	0.02		
currentWindSpeed:	3.51		
currentWindGust:	1.07		
wind_direction:	S		
Date:	30/08/2017	Time:	9:59:00
Temperature:	16.30		
Humidity:	50.10		
Pressure:	73578.00		
Altitude:	2618.54		
TotalRain:	0.00		
currentWindSpeed:	0.00		
currentWindGust:	0.00		
wind_direction:	S		