SYSTEM OF CAPTURE OF PANORAMIC IMAGES THROUGH A NON-CREATED AIR VEHICLE FOR THE COMMUNICATION DEPARTMENT OF THE UNIVERSIDAD TECNICA DEL NORTE

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Abstract-The present titling work has the objective of designing an image capture system using an unmanned aerial vehicle (drone) and Open-Source technology for capturing and sending frames to a user interface, in addition to The use of microwave equipment to send the frames to the master server located in the communication department of the Universidad Técnica del Norte.

The design of the system was based on the IEEE Standard 29148, which allows to establish the most relevant aspects to be taken into account for the development of the project, such as functional requirements, architecture and stalkeholders, which serve as a foundation for the Selection of components.

The performance tests were performed according to a schedule of activities, once this process was completed, the system was implemented with the microwave link of the communication department, where it was possible to demonstrate the successful transmission of the captured frames to the master server Located in the facilities of the communication department of the Universidad Técnica del Norte.

*Keywords — **Drone, Open-Source, Microondas.***

I. INTRODUCTION

At the moment we are in a time in which the technology has progressively progressed, until arriving at the development of unmanned aerial vehicles (UAV) or also denominated drone, are vehicles piloted by remote control, in the beginning these vehicles were only used for purposes Military missions in surveillance or attack however today the use of these aircraft has expanded considerably for various applications of civil use ranging from inspections in infrastructure to use for recreation or fun.

Many institutions and companies have now opted for the inclusion of unmanned aerial vehicles as a means of acquiring information. In some cases for the obtaining of images of a certain sector and in others as a tool of work, as is the case of the drone that performs fumigations.

The system that is proposed to implement consists of the capture of panoramic images in 720x 480 format in urban areas in daytime and for the communication department of the Technical University of the North through the application of an unmanned aerial vehicle which will consist of a camera , An image processor and a transmission module for sending the data to the receiver, which will have the ability to control and address the unmanned vehicle and the open-source based image capture module, with this the operator will maintain a Autonomy of movement and verification of visual form the location of the drone, in if this allows to increase the angle of capture for the taking of different angles and to include the generation of new content.

Data transmission will be performed by a wireless communication module based on open-source from the drone to the operator. This implies that a wireless point-to-point network will be made with two communication modules, the data will be sent via microwave to a server located In the facilities of the communication department of the Technical University of the North through an infrastructure that has the communication department.

II. BIBLIOGRAPHICAL REVIEW

A. Unmanned Aerial Vehicle

An unmanned aerial vehicle (UAV) or also called a drone is a vehicle piloted by remote control, in the beginning these vehicles were only used for military purposes in missions of surveillance or attack nevertheless at the present time the use of these aircraft has been expanded Considerably for various civil applications.

As for the way to pilot this type of aircraft can be said that can be piloted by four modes of operation, which will be mentioned next:

- Manual mode
- Assisted mode
- Automatic mode
- Stand-alone mode

Classification based on infrastructure

They can be classified on the basis of two characteristics: the degree to which they are accessible to a particular actor; And basic technology and infrastructure, where four categories are identified, as can be seen in Fig. 1:

- Amateur Drones: Easily available for purchase - usually no more than a few thousand dollars - by any interested party.
- Medium size military and commercial aircraft: Not available for people due to cost or infrastructure requirements.
- Specifically large military aircraft: They require substantial military infrastructure to operate and are generally not accessible or operable by agents outside large armies.
- Combat aircraft: Contains highly sophisticated technologies, such as low-observation features, and are not accessible to non-military personnel.

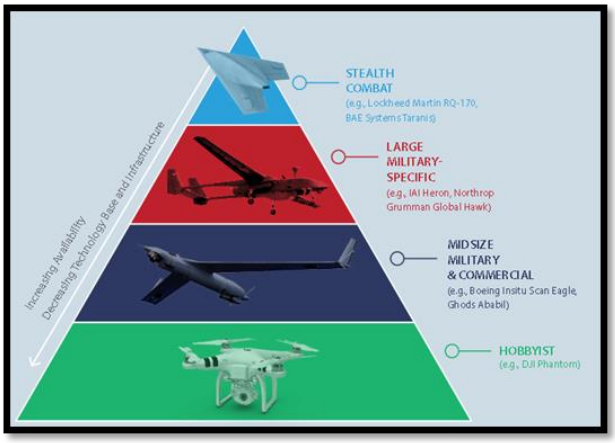

Fig. 1 Classification of unmanned aerial vehicles based on their infrastructure

B. *Wireless Network*

It is a data communications system that transmits and receives data using electromagnetic waves using air as the transmission medium providing peer to peer wireless peer-to-peer connectivity within a limited area.

Main features.

- It has similar bandwidths as traditional wired networks offer.
- Ease of deployment and mobility for users.
- Lower security level compared to wired networks so there is the possibility of interference from other nearby systems.
- They can be public or private.
- They basically use radiofrequency waves in the GHz range.

C. *Wireless Modules*

There are a large variety of electronic modules designed for the development of wireless networks, which depending on their range of use can be used in PAN (Personal Area Network) networks such as bluetooth modules, or to develop networks with Such as Xbee or Wi-fi modules, these modules being one of the most popular in the market for the development of embedded systems, domotics, radio control and other applications due to their small size, weight and low economic cost.

Fig. 2 Examples of electronic modules for the development of wireless networks

D. *Arducam Modules*

They are optional digital cameras as can be seen in Fig.3. These are inexpensive, small and very light weight cameras. There is a wide variety of such cameras, everything depends on the applicability that you want to give this can be from IoT to applications with embedded systems are also compatible with open-source technologies such as Arduino.

Fig. 3 Example of an Arducam camera type module

E. *Microwave Communication*

Refers to the transmission of data or voice through radio frequencies with wavelengths in the region of microwave frequencies.

Microwaves are used in broadcasting, as they pass easily through the atmosphere with less interference than other longer wavelengths.

Main features.

- There is more bandwidth in the microwave spectrum than in the rest of the radio spectrum.
- Its frequency ranges from 300Mhz to 30Ghz.
- They have relatively small wavelengths.
- They are used in television news programs to transmit a signal from a remote location to a television station using a specially equipped van.
- Wireless LAN protocols such as Bluetooth and Wi-Fi specifications IEEE 802.11g and b also use microwaves in the ISM band.

F. Microwave Link

For the transmission of very high-frequency (electromagnetic waves) radio signals called microwaves, two stations, one transmitter and one receiver, are used, which must be able to be displayed directly to one another and using parabolic antennas (transmitter / signal collector assembly And reflector) of adequate dimensions, depending on the wavelength of the signal to be transmitted and the available power ranges.

The link can be terrestrial "between two stations located on the ground", as indicated in Fig.4, which consists of the elements to establish and perform the communication, or spatial using a communications satellite as an intermediate signal repeater.

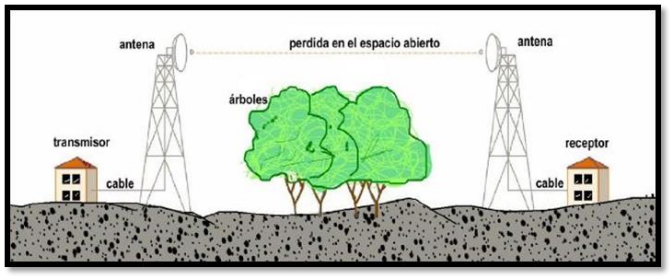

Fig. 4 Microwave terrestrial link between a receiving station and a transmitting station

G. Open Source Hardware

It is hardware whose design is made available to the public so that anyone can study, modify, distribute, make and sell the design or hardware that is based on said design. The design from which it is built is available in the format that is preferred for modifications to be made. Ideally, free hardware uses readily available elements and materials, standardized processes, open infrastructure, unrestricted content, and free design tools to maximize the ability of individuals to make and use hardware.

Free hardware also called Open-source English shares the vast majority of the objectives and methods of free software, providing users and designers to study its operation, to be able to modify it, reuse it, improve it and generate this information to share in open forums.

H. Arduino

Arduino is an open source prototype platform based on easy-to-use hardware and software. He was born in Interaction Design Institute Ivrea as an easy tool for rapid prototyping, aimed at students with no experience in electronics and programming.

All Arduino boards are completely open source, allowing users to independently create and ultimately adapt them to their particular needs.

Arduino boards are available in two ways: assembled or in kit form. In general it can be said that the Arduino boards consist of digital inputs / outputs, analog inputs / outputs, depending on the type of board can contain more than one configurable PWM pin. Each connection pin can provide or receive a maximum of 40 mA.

Arduino boards range from the simplest, with improved features, oriented to IoT, and also Arduinos designed to carry over or "Shields". The difference between the different Arduino plates lies first in the voltage used in the plates. The microcontrollers with CortexM3 have a voltage of 3.3 volts, while the plates with AVR use a voltage of 5 volts.

III. CURRENT SITUATION

An interview was made to the Telecommunications Technician "Ing. Paola Tirira ", which is in charge of the microwave transmissions carried out by the university channel and obtained the following information:

In the first instance, it was determined that the university channel belonging to the Department of Communication of the Technical University of North is in charge of the transmission of the most relevant news on issues concerning the university housing and northern sector of the country, which is why in certain Staff mobilization is required.

The university channel works with analog technology with 720x480 pixel format, however, the frames may be of a larger format because they can be modified with the equipment that is in the mobile unit before they can be Sent to the master server.

In order to obtain visual content, the university channel makes use of recording cameras that are managed by the department's staff. In order to capture the images, the cameras must be placed on a firm surface.

Another way in which they obtain visual content on some occasions is through the use of an unmanned aerial vehicle belonging to Engineer Christian Enríquez who performs the functions of master operator, cameraman and editor within the university channel. The frames that are obtained are stored in a Micro SD memory that is located in the unmanned aerial

vehicle, for that reason to make use of the frames it is required that the drone lands to be able to extract the memory Micro SD and through a adapter of Memory to send the frames to a computer to finally be able to carry out the transmission of the data by means of the use of an analog converter that is connected to the computer (VGA ports, USB) and later video switch that is part of the transmission equipments of the unit mobile.

Although currently available applications in the market that allow the control of certain models of drones in addition to the viewing of the frames using tablets or smart phones their application in the Department of Communication would not be the most indicated because they are devices Which do not have VGA and USB inputs that are necessary for the connection with the analog converter the same as the means to connect with the transmission equipment.

The transmission of information obtained outdoors from the university house is done by means of a terrestrial microwave link. The reception antenna is located on the terrace of the main building of the institution and the information is received by the master server located in the facilities of the communication department, while the transmission is made by means of a mobile unit that counts in its Inside the equipment to carry out the microwave transmission. In order for the transmission of the frames to be successful, the microwave transmitting and receiving antenna must be aligned. Finally, it is concluded that the best way to use unmanned aerial vehicles together with microwave data transmission technology is that the airborne frames are sent wirelessly to a computer, which supports the development of this project.

For the realization of the microwave connections, a certain number of equipment must be used, which will be mentioned below the equipment with which a mobile microwave unit consists.

- Portable Microwave Link G. With Bl 200m 2.4ghz S / N 08060052t / 08060052r Complete Sintetized Portable Tv Link Composed By: 8w Nom Transmiter, Receiver; 2x0.6mt Parabolics, 2 Outdoor Waterproof Boxes, Capacity 1 Video, 1 Audio.
- Datavideo Se 800 video switch
- Sony Lmd 4420-4-Monitor Lcd Module
- Yamaha audio console
- Power source Pyramid
- Frame for Analog Cards Audio and Video Link
- Electronics Pfm 210
- Vda Video Cards
- Kenwood Mobile Radio
- Kenwood Portable Radio
- Player recorder on Dvd
- TV monitor with Av input

IV. HARDWARE DESIGN

The hardware design of the image capture system focused on the interconnection with the different electronic components that make it up, as well as other important aspects to consider in the design requirements, such as:

- Drone with extra weight load capacity.
- Electronic elements of small dimensions, light weight and low energy consumption.
- JPG image format.
- 800x600 pixels or higher image resolution.
- Modules of wireless communication with high speed of transference.

A. Design Perspective

The electronic system will consist of three main operating blocks, User Interface (IU), Control Center (CCT) and Capture Center (CC) which in turn is subdivided into four sections: capture, storage, Communication and food, with which the electronic system will meet the previously established objectives.

The first operating block is the Capture Center (CC), which will be embedded in the support of an unmanned aerial vehicle, will consist of three sections, the first is the camera type module and the Arduino processing plate that will jointly As a function of image capture in the format that is established within Chapter I, the second section refers to the requirements of the same energy supply that is of vital importance for the operation of the project and the last section will be in charge of the communication Wireless and sent data to the user interface.

The second operation block is the User Interface (UI), it will have the functionality of receiving data sent from the Capture Center (CC). This block is constituted by two sections, the first section corresponds to the wireless reception module together with an Arduino processing plate that fulfill the function of receiving the frames and the second section corresponds to the use of the software for the storage of the frames In the PC for its later sent via microwaves to the server located in the central building of the university, this will be realized by means of the equipment used by the communication department of the institution.

The third operation block is the Control Center (CCT), will be in charge of the operation, monitoring and mobility of the unmanned aerial vehicle where the first operating block will be installed.

B. System Requirements

The system requirements analysis is performed using the ISO / IEC / IEEE29148: 2011 standard, which contains provisions for processes and products related to requirements engineering, has been developed with the aim of being implemented in the Systems and software products and services throughout the life cycle. (ISO / IEC / IEEE, 2011)

The standard gives guidelines for the format of the required and related information elements allowing to define the construction of a good requirement that provides attributes and characteristics that must be met by the system taking into account the repetitive application throughout the life cycle of the system.

C. Hardware Selection

The choice of hardware was made based on the requirements of the system, in addition to taking into account the weight factor that is determining value in the selection of components. The order in which the components were determined is as follows: firstly, the unmanned aerial vehicle (Hubsan X4 PRO) was chosen because, depending on this, the maximum weight that the system can have is determined, then continued with The camera module (OV2640), this allows to determine the number of pins and other features required for its operation, then proceed to make the choice of the processing board (Arduino Mega 2560 and Arduino Leonardo) in which all the Components corresponding to the CC and UI respectively and finally the choice of the wireless communication module (Bluetooth RN-41) is made.

- Drone Hubsan X4 PRO

The unmanned aerial vehicle is an important element in the development of the system because it has at the bottom of its frame or frame with several connecting pins that are used to feed both the DC and the shaft. Within the main characteristics of the unmanned aerial vehicle the following can be cited in Table 1:

Table 1. Technical Specifications of the Hubsan X4 PRO Drone

Features	Parameters
Flight time	20 minutes
Li-Po Battery	11.1 V-7000mA (3 cells)
Diagonal dimension	370mm
Weight without accessories	1.06kg
Maximum weight	1.46kg
Navigation Systems	GPS, Barometer, orientation
Modes of operation	Manual and altitude maintenance
Return to home	Yes
Removable gimbal shaft	Yes

- OV2640 camera module

Currently some models of this type of cameras that vary depending on the resolution and application are on the market, these cameras can be omnivisión or aptina. The main characteristics of this Arducam module are mentioned in Table 2.

Table 2. Technical specifications of the OV2640 module

Features	Parameters
Capture Mode	Omnivisión
Optical size	1/4 inches
Resolution	Hasta 2Mp
Energy supply	3.3 volts
Weight	20 grams
Compression format	JPG
Arducam Shield	Yes
Auto Image Control Functions	Yes
Voltage Level	Low

- Arducam Shield Rev.C+

It is a control board for Arduino compatible camera modules. It provides an easy-to-use interface as well as a list of software libraries. Table 3 lists the main features of this Arducam module.

Table 3. Arducam Shield Technical Specifications

Features	Parameters
Measurement	99x59mm
Weight	50 grams
Camera modules	De 0,3 MP ha 5MP
Types of Cameras	Omnivisión y aptina
Operating Voltage	5-3 volts
Compatibility	Arduino Mega 2560

- Arduino Mega 2560 and Arduino Leonardo

The function that the Arduino development board fulfills in the system is the interconnection with the other electronic elements, the processing of the data obtained from the IU and CC, interprets the data received and executes a programmed order almost instantaneously. Table 4 lists the main characteristics of the Arduino Mega 2560 board (for the CC) and the Arduino Leonardo (for the UI).

Table 4. Technical specifications Arduino Mega and Leonardo

	Arduino Mega 2560	Arduino Leonardo
Features	**Parameters**	
Electronic board	Atmega1280	Atmega32u4
Number of pins	54	20
Weight	37 gramos	20 gramos
Analog pins	16	12
PWM pins	14	7
Crystal Oscillator	16MHz	16MHz
Flash memory	256Kb	32Kb
SRAM memory	8Kb	2.5Kb
EEPROM memory	4Kb	1Kb
UART pins	4	2
Operating Voltage	5 V	5 V
Recommended Voltage	7-12V	7-12V
Limit Voltage	6-20V	6-20 V
Connection	USB	micro USB

- Bluetooth module RN-41

It is characterized by being used in embedded systems, home automation, telemetry among other applications due to its low weight, low current consumption and low economic cost. Next, Table 5 shows the main features of this wireless communication module that allows the transmission of the frames from the CC to the IU.

Table 5. Technical specifications of the RN-41 module

Features	Parameters
Transfer Speed	To 3Mbps
Scope	To 100 metros
IEEE Standard	802.15.1
Energy supply	3.3V
Certificate	By the FCC
Configuration	Way UART
Weight	0,0016kg
Dimensions	13.4mm x 25.8mm x 2mm
Frequency	2.402 - 2.480 GHz
Cost	25,95$

D. General Operation Diagram

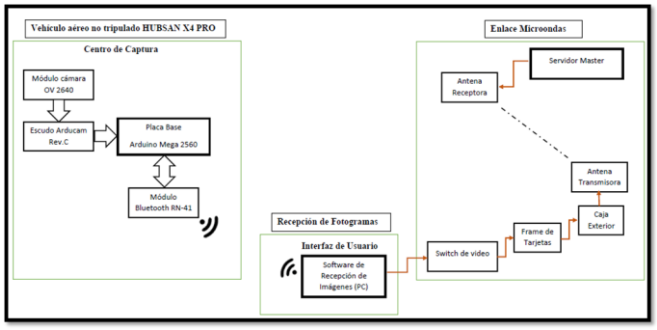

Fig. 5 System Block Diagram

In Fig. 5 the general functioning of the system is represented, the sections that comprise it are represented by numerical characters which will be explained next:

1. This section corresponds to the manipulation of the unmanned aerial vehicle by the pilot and the communication that takes place between the CC that is located in the cardan shaft belonging to drone Hubsan X4 PRO and IU which are responsible for the Transmission of images to the PC which is manipulated by the operator.

2. The second section corresponds to the transmission of the frames that were captured and stored in the first section, the transmission of the images will be carried out by means of the mobile equipment with the university channel, in particular with the analog converter that is Connects directly to the PC and also to the transmission equipment of the channel.

3. The third section corresponds to the transmission of the images to the master server located in the installations of the university channel by means of the equipment with which it counts, the antennas of reception and transmission are the most relevant components because they form in bond terrestrial transmission.

V. Software Design

In order for the system to work properly all its components must be properly configured, and the interconnection between them must be done correctly. Specifically, the following requirements must be met:

- Two-way communication over the wireless network.
- Display of information and capture messages.
- Send the frame to the User Interface.

The programming software that was used belongs to the Arduino platform because it complies with the characteristics for the programming of all the electronic elements, this programming environment is called Arduino ID.

The system requires the operation of two programs one for the Capture Center and another for the User Interface. In what corresponds to the program that belongs to the CC was considered the use of some libraries that allow the use of different devices and modules that are integrated into the system. The following are the libraries used:

- SPI Library (#include <SPI.h>)
- Wire Library (#include <Wire.h>)
- Arducam Library (#include <Arducam.h>)

The use of these libraries allows the OV2640 module to interact properly with other devices, based on the functionality and programming to be performed, in addition to setting the system's transmission rate to 57600.

The program corresponding to the User Interface does not require the use of any particular library, however, the same transmission speed established in the Capture Center is established, allowing to establish the wireless communication channel between the CC and IU.

VI. Funcionality Test

A. Operation of the OV2640 Module

In this section we proceeded to check the quality of the images obtained by the module OV2640 in daytime in the range of 6 in the morning to 6 in the afternoon, in order to check if the quality of the frames is equal. In the Figures presented below, three frames can be observed which were captured in the morning, midday and afternoon hours.

Fig. 6 Photogram captured in the morning

The frame that can be seen in Figure 6 was captured in the morning with a lot of sunlight, as you can see the image quality is very good.

Fig. 7 Photogram captured at noon

Figure 7 shows a frame captured at half a day, in this case the frame was made under normal conditions or natural light, therefore, it can be evidenced that the camera type module can perform the capture of frames in these climatic conditions Without any inconvenience.

Fig. 8 Photogram captured in the afternoon

Figure 8 shows a photogram captured in hours of the afternoon, without high concentration of natural light, however, the captured image is of very good quality as you can see the color balance and the image are very good, they do not present Distortion are also not opaque.

As can be seen in the previous Figures, the quality of the frames is maintained because the OV2640 camera module has automatic image control functions and quality controls. In this way, the selected camera module complies with the system's requirement to be able to capture frames at different times of the day.

B. Wireless Communication

In this section we proceeded to check the communication with the bluetooth communication modules RN-41 in order to carry out the transmission of the frames. The modules are configured in such a way that the authentication with the UI is made through a COM communication port, in addition its connection is made automatically changing from red to green as shown in the following figure.

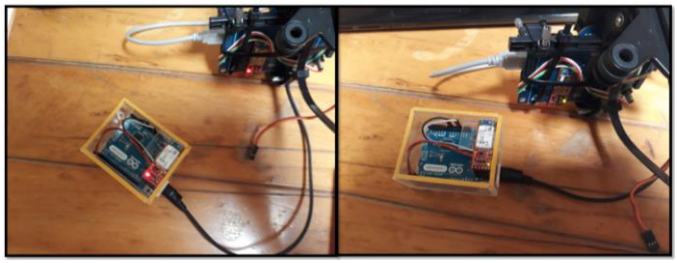

Fig. 9 Establishment of connection between the CC and IU

The test of operation of the modules is done in order to verify that there is the transmission of images between the CC and the UI, in addition to verifying that the modules meet the requirements of the system and that the frames are transmitted in an average time of 5 seconds and its quality is maintained.

In Figure 10 it can be seen how the program is responsible for receiving, displaying and saving the frame sent from the CC, with a transmission rate of 57600 and through the communication port COM 4 allows communication with the CC.

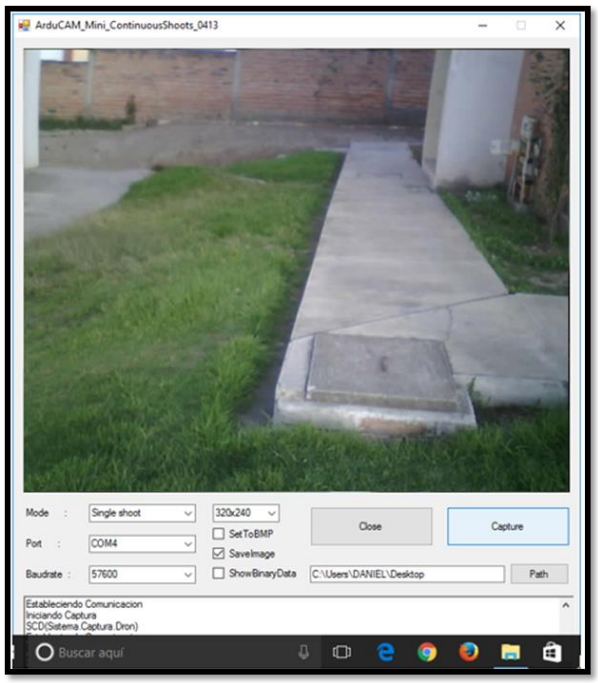

Fig. 10 Display of the frame transmitted from the CC to the UI

As can be compared between the Figures captured and sent directly to the PC in section 1 and Figure 10 in which the frame is sent wirelessly from the CC to the UI, the image quality is maintained, the bitmap is transmitted Successfully without loss of data that translate into badly pixelated images. In this way fulfilling the objectives planned within this section.

C. Components on the shaft

Its verification is made in function of the mobility that the cardan shaft continues to maintain with the inclusion of the components that make up the CC. Next, you can see the sequence of images that are in Figure 11.

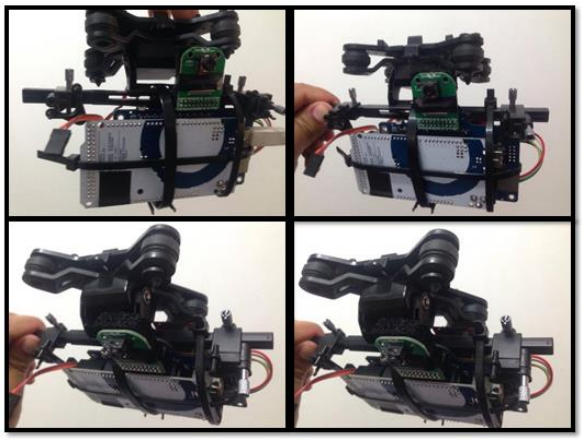

Fig. 11 Cardan shaft movement seen from the front

As can be seen in Figure 11, it corresponds to a sequence of images of cardan shaft mobility once the elements comprising the CC are included, in the sequence of images it can be seen that the external elements that have been included on the axis do not intervene in Its mobility which is 0 ° to 90 ° in the y-axis.

D. Inclusion of the system in the drone

In this section we performed the final tests of system operation. The unmanned aerial vehicle is equipped with the cardan shaft and the components of the CC also through the UI will be transmitted the images to the computer.

Fig. 12 Hubsan X4 PRO unmanned aerial vehicle equipped with CC and ready to perform flight test

In Figure 12 it can be seen that the engines of the Hubsan X4 PRO unmanned aerial vehicle are on and is equipped with the cardan shaft in which the CC is located, which is responsible for the capture and transmission of the frames.

This section allows to determine if the system is ready to continue with the next stage that consists of the implementation of the system with the transmission equipment that the university channel has.

Fig. 13 Hubsan X4 PRO unmanned aerial vehicle equipped with DC during flight

In Figure 13 it can be seen that the unmanned aerial vehicle Hubsan X4 PRO is equipped with the CC and in period of flight, in addition it can be established by this test that the flight time is of approximately 10 minutes. In order to reach this stage of the test, the preliminary tests established in the previous sections were carried out.

The wireless communication and transmission of the frames between the CC located in the Hubsan X4 PRO unmanned aerial vehicle and the UI were successfully performed as shown in Figure 14, allowing to determine that the image capture system is in Good conditions to proceed to the implementation with the microwave equipment that owns the university channel belonging to the Universidad Tecnica del Norte.

Fig. 14 Frame captured and transmitted from the CC to the UI by wireless communication

E. Implementation of microwave link

The implementation of the image capture system was carried out with the help of the pilot and operator who belong to the university channel. The following figure shows the unmanned aerial vehicle in its flight phase.

Fig. 15 . Hubsan X4 PRO unmanned aerial vehicle equipped with DC during flight

As can be seen in Figure 15, the system is in operation, therefore, the images are taken by means of the CC that is located in the unmanned aerial vehicle, the software located in the PC being in charge of the reception and storage of the images as can be seen in Figure 16.

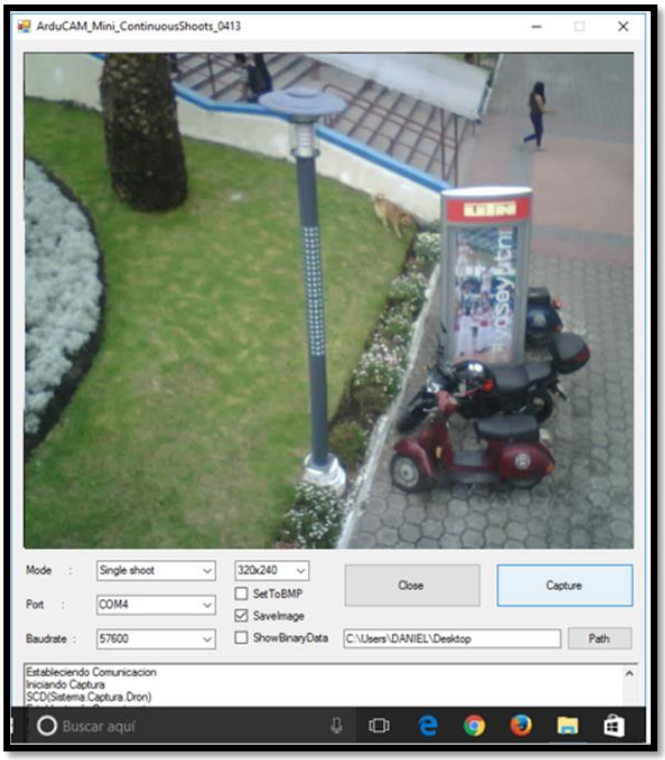

Fig. 16 Picture received in the image receiving software

The PC used by the operator is connected to the equipment that allows the transmission of the images by means of the microwave link, for that reason the images that are received and stored in the PC will be visualized in the monitors located in the switch Video that is located in the premises of the central building and are immediately transmitted to the master server. It can be seen more clearly in the following figures.

Fig. 17 Photogram sent from the IU to the monitors located in the premises of the central building

Figure 17 shows the frame that was captured with the image capture system in the exteriors of the central building being transmitted to the monitors that are connected to the switch and other equipment located in the facilities of the central building.

Fig. 18 Image captured by the image capture system and received on the master server

Figure 18 shows in the same way the frame that was captured in the exteriors of the central building with the image capture system this time being transmitted to the communication offices where the master server is located which is the final destination of the Frame where the staff that corresponds to this area will give the corresponding use of the image for the creation of new content for the university channel.

VII. CONCLUSIONS

- It was concluded that a large variety of unmanned aerial vehicles are currently on the market and are designed to comply with certain applications including unmanned aerial vehicles designed for training, initiation, military

applications or civil applications, in addition to being characterized by its architectural designs which allows them to have a wide field of application.

- It was concluded that in the case of an image capture system, the modules that have a direct relationship with the camera must have technical characteristics that include greater processing capacity, program memory (flash) and data memory (SRAM) for storage of the image before its transmission.

- During the design of the wireless transmission system, it was concluded that the location of the receiver and transmitter module is a very important factor to take into account, because it is a point-to-point (P2P) network that establishes a coverage area in which It is possible to carry out the transmission of the data, in addition it was evidenced that the technical specifications established in the datasheets of the modules vary drastically in what corresponds to distance.

- It was concluded that when unmanned aerial vehicles are used in a system, the external elements must comply with certain technical and design characteristics, such as weight, dimensions and energy consumption, because these factors directly affect the Time of flight of the drone, in addition they must be well insured because it could suffer an abrupt fall that as consequence will have the damage of the element.

- During the development of the project it was possible to conclude that the management of the unmanned aerial vehicle is facilitated for people who have skill in the handling of joystick because it is similar to the control of the unmanned aerial vehicle.

- During the transmission of the frames by means of the microwave link, preliminary tests must be carried out to determine that the transmit and receive antenna are correctly aligned, otherwise the interference will occur at the time of reception of the images.

- At the moment of the implementation of the image capture system with the equipment of the microwave link, it was observed that the images that are received by the PC in the UI are simultaneously displayed on the monitors that are connected to the video switch and the Master server.

- Being the captured frames in the format of 800x600 the university channel can make use of these images complying with the technical parameters that the channel requires for its use in the development of informative content that they create pertinent.

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