THE USE OF A DRONE AS A TOOL FOR THE COLLECTION OF BOTANICAL MATERIALS AT DIFFERENT ALTITUDES

Gustavo Henrique Sanches – Student
Fábio Luiz Ferreira Bruschi – Advisor
Raul Ambrozio Valente – Advisor
André Caseiro– Advisor
Escola Interativa de Londrina
Londrina, Brazil

Abstract:

The botanical study has evolved over the years, as a source to meet growing human needs, both in food and in medical, industrial applications, and even as a source of renewable energy. Today, numerous researchers around the world dedicate their work to find new sources of energy, through the botanical studies, however it can be said that a major problem for these studies is related to the hard practicality of the tools currently used to perform these botanical collections of materials to be analyzed.

The botanical material collections are made through simple and traditional methods tools, thus it can be said that with the use of simple tools botanical collection activity becomes difficult, thereby making the phytological study harder to develop consistently.

The air trimmer is a tool used to perform collection of botanical materials in high regions, but used in small trees. It is made up of a medium-sized bat with a blade at one end and a trigger in the other.

Some collectors use climbing ropes and ladders to reach the material. But in closed forests such facilities are virtually unportable and difficult to handle, besides it can be risky. It is also used two methods that require great precision, which are: linhada, in which something heavy is attached to a line and is thrown in order to cut a brunch to be analyzed, and the use of the sling. In order to facilitate, the process uses up crushed rocks.

According to forest engineers it is recommended the use of this method only in the absence of any other person.

With this design it will be used a multirotor to collect and store various botanical materials in only one flight, that by means of a cutting device where it will be compressed to a mechanism which is coupled under the drone.

After the material is collected, there will be a storage container opposite to the cutting device, placed under it.

The motion of the cutting device will be done with the help of a sensor, which is found therein. So when the sensor identify the presence of some material, it will send the information to a programmer board, that will trigger two engines on which will perform the closing of cutting. Thus, another engine will fire causing the mower to move into the storage container, so when you are on it will open again to deposit the collected material in the container.

After that the engine responsible for making the device locomotion, will do the biting get around in the opposite direction to the storage container, positioning for a new collection.

Currently the assembling of the UAV has been completed, and it is working perfectly. And the developing of the cutter device's systems is in final stage.

1. Introduction:

The drone is a technology that has been drawing the attentions in previous years (GARRET, 2013), which were projected to heavy works and hostile environments.

Originally, the drones were used by soldiers to watch or even attack less dangerously a certain region. Thus, when the aerial device is destroyed, there will not be any human death.

The Unmanned Aerial Vehicles (UAVs) has also been used for peaceful purposes, like the ability to shoot pictures, useful for photographers and cinematographers. These aerial devices can also be used in some business to make deliveries.

Currently, the UAVs has many utilities. Some researchers are using them to scientific purpose, as in photograph data collection. A possible use of this device would be to collect botanical materials.

The botanical study has as main objective to characterize the plants physically. This study is a way to: subsidize taxonomic studies; assist in elaboration of scientific projects about the flora of a certain region; facilitate the knowledge of medicinal and toxic plants with the objective of using and controlling them in a better way; and gather

all possible species to identify others ((FERREIRA, 2006); *op. Cit. in* WIGGERS; STANGE, 2008).

The phytology has evolved over the years with the purpose to comply with the increasing human's necessities. Currently, researchers around the world are dedicated to resolve problems that reach the humanity through botany. Although, it can be affirmed that the difficulty to handle the tools used nowadays to collect the specimens is the biggest problem to the progressive development of the botanicals studies.

Though the activity of botanical collection looks like a simple task, there are often complications that intervene in a precision collection, and consequently, in the acquisition of a material appropriated for a research. On the other hand, is fundamental to get precise information of species in a certain region, as a way to subsidize the analysis, thus associating to the forestry management (ROTTA, *et al*, 2008).

The taxonomy, science related to the appointment and identification of the species, it is essential to recognize species, and consequently, serve as base to strategies of conservations.

2. Methods:

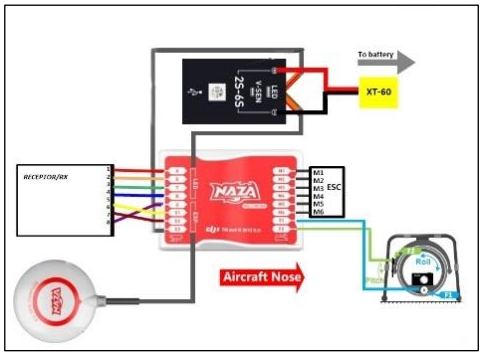
To the assembly of the drone multirotor were utilized: one frame hexacopter F550; one flight controller Naza Lite with a LED V-SEN and a GPS; six engines of 920kv; six speed controllers (ESC), E300 of 15A with the capability to support 11.1v to 14.8v; one battery Li-Po of 5000mAh, 4s (14.8v) 25-50C; one radio transmitter Turnigy 9xr PRO mode 2 and 9 channels; one module FrSky DJT of 2.4Ghz, with telemetry; and a receiver FrSky D8R-II.

The methodological procedures used for construction of the hexacopter were based in the instructions guide Naza – M Quick Start Guide V1.24.

Figure 1 – Electrical part of the multicopter finished.

Source: Author (2015).

Figure 2 – Electrical system of the drone F550.



Source: http://www.dji.com (2014).

2.1 Device for collection and storage

With the conclusion of the drone's construction, it was diagrammed in the software Solid Edge, a model of the mechanical system in three-dimensional form to the cutting device, which will collect different botanical materials in a flight.

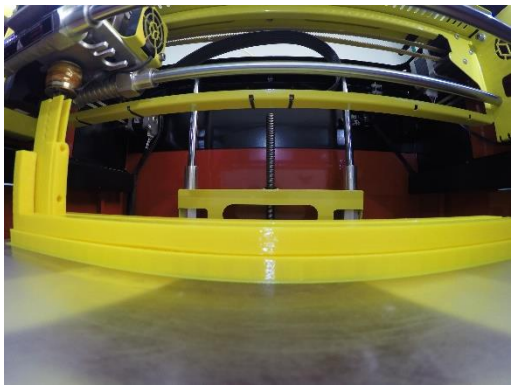
After the elaboration of the first draft, it was discussed with engineers some improvements in the structure and in the electrical components, that will be used in the collection device.

2.1.1 Mechanical system

The mechanical system of this prototype is constituted for: two threaded spindles; two supports to these spindles; two hinges; a cutting device composed of two halves of a cylinder; tension springs; a container to storage the botanical material; a part with a threaded hole to carry the mass that will balance the weight; two long parts with the profile in the form of the letter "L"; two reels; two chains; one basis to support the motors and the reels; three gears; two blades; and a base to all this system.

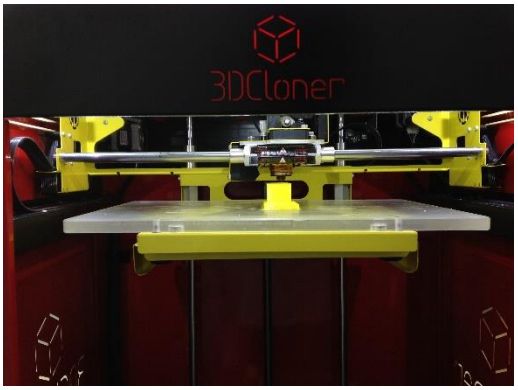
Most of these parts were printed three-dimensionally, in a 3D printer (Figure 3 and 4).

Figure 3 – 3D Printer, printing a piece of the main base.



Source: Author (2016).

Figure 4 - 3D Printer (3D CLONER DH) provided by the company *LabMaker*.



Source: Author (2016).

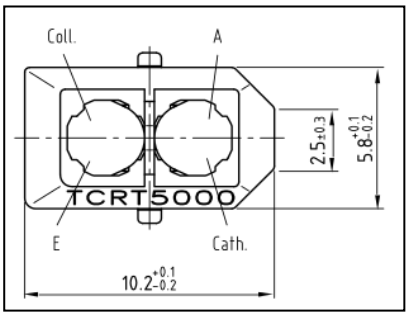
2.1.2 Electrical system

It will used to the electrical system: one Arduino Nano; two servomotors (*Futaba 3003*); four resistors (*2K2*); one electrical motor (*EMAX Cf2822 1200kv*), one optical sensor (*TCRT5000*); one Electronic Speed Control (ESC) with 30 amps; jumper wires; one Li-Po battery (*11.1v, 2200 milliamps*); and one potentiometer (10K).

The components of this current system have already been purchased, but it is still being assembled and programming code with the help of engineers is also been created:

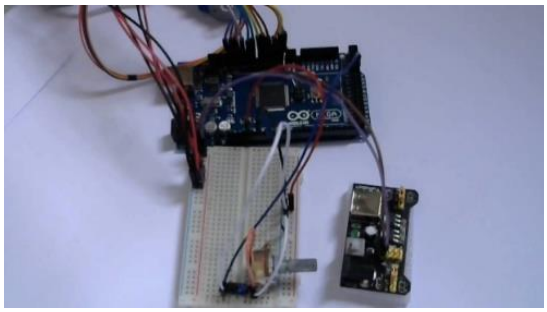
For the operation of the optical sensor, the pin anode was connected to 5 volts through of a potentiometer of 10K and a resistor of 100Ω, thus, it was possible to adjust the sensitivity levels of the sensor by means of the potentiometer variations. The collector pin, which send the electrical pulse to the Arduino, was configured as input in the Arduino. Consequently, the pins cathode and emitter were plugged to the ground of the power board (**Figures 5 e 6**)

Figure 5 – Optical sensor TCRT5000.



Source: www.ferpinheiro.wordpress.com (2012).

Figure 6 – Optical sensor connected to the Arduino.



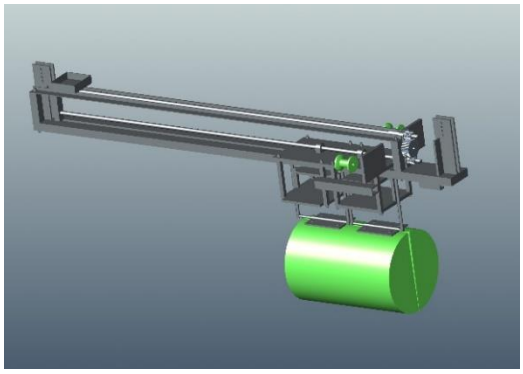
Source: Author (2015).

2.1.3 System Operation

First the sensor inside of the cutting device will identify the botanical material, posteriorly the servomotors and the reel which will be connected to the cutting device through of a stream will be activated (**Figure 7**). With this, the cutting will close because it is tensioned by springs, thus collecting the botanical material.

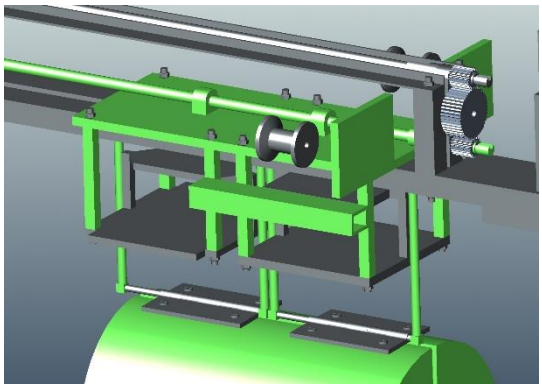
In order to storage the botanical samples, the base that support the cutting device contains two extrusions with a threaded hole, thus, these holes will be threaded to the spindle (**Figure 8**). When the motor which is connect to the spindle through the gears is activated, the threaded holes will move the base of the cutting device toward the storage container.

Figure 7 – The reels connect to the cutting device through the streams.



Fonte: Author (2016).

Figure 8 – Base of the cutter with threaded holes in its extrusion.



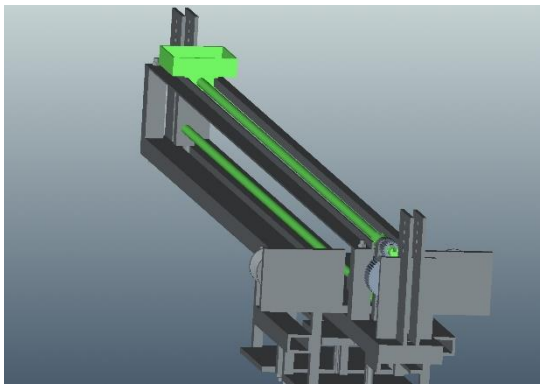
Fonte: Author (2016).

With the mobility of this complex to the other side, there will be a destabilization in the multicopter, due of the bad distribution of weight along of structure. So the screw spindle which moved the cutting device will have other above of the same (**Figure 9**). When the motor, with its axis between the gears is activate one of the spindles will turn in the opposite direction to the other. (**Figure 10**), causing the threaded parts to move in the opposite direction carrying the counterweight.

Therefore, when the cutter reaches the opposite end in relation to which the plant material was collected there will be a storage container.

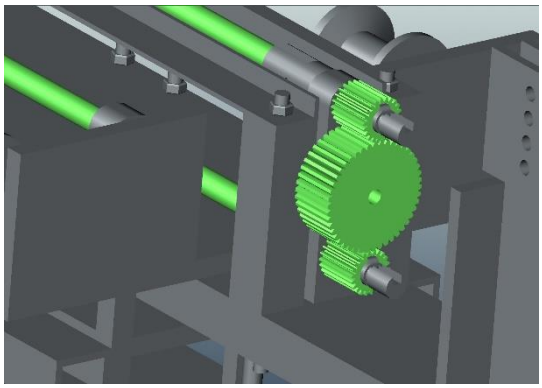
In view of this, the cutter will open, depositing the collected material into the storage container, and this process will return the cutting device to the direction where performed the collection, making the whole complex ready to collect other botanical species.

Figure 9 – Part of the counterweight system, threaded in the top spindle screw.



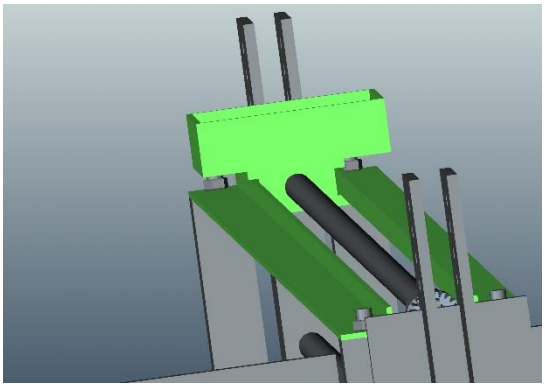
Source: Author (2016).

Figure 10 – Gears between of the threaded bars.



Source: Author (2016).

Figure 11 – Structure supporting the counterweight system holder on the spindle.



Source: Author (2016).

3. Results and discussion:

Currently, the construction of the multicopter F550 hexacopter was finished, and the parts of the mechanical system are printed in three dimensions. Now, the electrical system it is being developed, and the mechanical structure is in final phase of the assembly. So, it will be possible to examine the operation of the electrical system and make the necessary adjustments.

4. References

AERIAL MEDIA. **DJI F550 FLAMEWHEEL NAZA HEXACOPTER ARF STEP BY STEP COMPLETE BUILD**. Available in:<https://www.youtube.com/watch ?v=r4M95kRo_AM>. Accessed on April 15, 2014.

ALL ELETRONICS**. Curso ARDUINO Iniciantes**. Avaiable in:< https://www.youtube.com/playlist?list=PLQ4bYmp0mquJMgHLfEmgMT_SrmfP Al6I7>. Accessed on September 08, 2015.

BRUN, Eleandro. et al. **Técnicas de Coleta e Herborização de Material Botânico**. Avaiable in: < http://pt.slideshare.net/fagneroliveira7771/herborizaao-aterial-botanico >. Accessed on February 11, 2015.

DJI, Innovations. **Naza – M Quick Start Guide V1.24**. Avaiable in:< http://download.dji-innovations.com/downloads/nazam-v2/en/NAZA-M_Quick_Start_Guide_v1.24_en.pdf >. Accessed on December 28, 2014.

GARRET. Felipe. **Oque é Drone? Para que serve? Tecnologia invade espaço aéreo**. Avaiable in:<http://www.techtudo.com.br/noticias/noticia/2013/10/o-que-sao-e-para-que-servem-os-drones-tecnologia-invade-o-espaco-aereo.html>. Accessed on October 06, 2014.

GOMES, Joaquim. et al. **Colete e preparação de material botânico**. Avaiable in:< http://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/373944/1/fd430001.pdf >. Accessed on February 11, 2015.

LAFLOUFA. Jacqueline. **Tudo sobre drones, os robozinhos voadores que fazem mais parte da sua vida do que você imagina.** Available in:<https://tecnoblog.net/135789/tudo-sobre-drones/>. Accessed on October 06, 2014.

PINHEIRO, Fernando. **Arduino e sensor óptico reflexivo TCRT5000**. Available in:< https://ferpinheiro .wordpress.com/2012/01/25/arduino-e-sensor-optico-reflexivo-tcrt5000/ >. Accessed on September 10, 2015.

ROTTA, Emilio. et al. **Manual de Prática de Coleta e Herborização de Material Botânico**. Available in:< http://www.infoteca.cnptia.embrapa.br/bitstream/doc/315636/1/Doc173.pdf >. Accessed on September 22, 2015.

SILVA, Luiz. **TÓPICOS SOBRE TÉCNICAS DE COLETA DE MATERIAL BOTÂNICO E MANEJO DE HERBÁRIO**. Available in:< http http://nead.uesc.br/arquivos/Biologia/modulo_7_bloco_1/1_unidade/material_apoio/4_herbario_texto_da_apresent.doc >. Accessed on September 21, 2015.

WIGGERS, Ivonei; STANGE, Carlos. **Manual de instruções para coleta, identificação e Herborização de material botânico**. Available in:< www.diaadiaeducacao.pr.gov.br/portals/pde/arquivos/733-2.pdf >. Accessed on February 11, 2015.