



## SPOT-R – ABSTRACT

The beautiful terrain of the Appalachian Mountains is great for the exploration of nature, but the area can cause hikers and other outdoor enthusiasts to become lost or injured. Also, most search and rescue volunteers are scarce or aging, and replacements are needed. In addition, some people, especially children, tend to hide due to fear of the search party. A solution to this challenge is the SPOT-R (Seeking People Over Terrain Remotely) program. The device is a quad-copter designed to help search and rescue operations. It also has enormous potential as a utility for volunteer operations, recruitment, and education. Testing of the apparatus and program design with many individuals who work with search and rescue determined that this innovation could be a very useful asset in rural areas like western North Carolina.

# Mission Folder: View Mission for 'SPOT-R'

**State**

North Carolina

**Grade**

8th

**Mission Challenge**

Technology

**Method**

Engineering Design Process

**Students**

averyscience1

averyscience2

averyscience3

## Team Collaboration

***(1) Describe the plan your team used to complete your Mission Folder. Be sure to explain the role of each team member and how you shared and assigned responsibilities. Describe your team's process to ensure that assignments were completed on time and deadlines were met.***

Each of the team members had essential responsibilities in completing the SPOT-R (Seeking People Over Terrain Remotely) project. While we all worked together on each stage of developing SPOT-R, we also had specific responsibilities that played to our strengths and interests.

averyscience2 was responsible for logo and promotional materials design, legal and literary research, and proofreading.

averyscience3 helped calculate many aspects of the SPOT-R multi-copter by using an online calculator to determine speed, lift, weight, and average flight time. He also researched hobby multi-copters and parts that could be used in our design.

averyscience1 contributed his experience and background with quad-copters, technology, and computer-aided design to create the computer model of SPOT-R and edited the video materials.

We began developing the SPOT-R program in late September 2014. We brainstormed as a team, considering many different problems in our area that could have scientific solutions. We considered issues of cycling safety, fitness, electronics recycling, and repairing appliances in rural areas. The issue that we found to be the most critical and the one that we felt the most optimistic about addressing, however, was the issue of people being lost in our rugged terrain, including visitors unfamiliar with the area.

Once we had decided on the problem of finding lost people, we began researching search and rescue techniques in our area, made contact with professional and volunteer search and rescue workers, and investigated the possibility of using a multi-rotor, equipped with a infrared camera, to find people lost in rugged terrain in the Appalachian Mountains.

Our research revealed that our multi-rotor aircraft would not violate any existing laws, that many search and rescue workers would appreciate the device and could see its usefulness, and also revealed needed improvements and modifications to the initial design, such as a standard camera, additional batteries, and GPS.

We realized that there was more to the problem than just finding lost people. We learned that there are not enough rescue worker volunteers and that many lost people, especially children, may be afraid of the people or machines looking for them. So we expanded our project to include recruitment and education elements. We designed a logo that would appeal to kids and could be used on promotional materials. We surveyed middle school students to see if our device would make them more interested in becoming search and rescue volunteers.

Our SPOT-R device, with its modifications based on our research, was then modeled using Blender so that we could demonstrate to community members how the prototype would be built and what elements it would include. We developed a promotional piece to show rescue volunteers, and surveyed them about the project. Finally, we used the

feedback from our responses to upgrade the project's design, and created a video explaining how we designed the SPOT-R program and demonstrating how it could be used.

## Engineering Design

### Uploaded Files:

- [ [View](#) ] **Bibliography** (By: Advisor, 02/13/2015, .pdf)  
*This is the bibliography of sources used to create the SPOT-R project.*
- [ [View](#) ] **SPOT-R Schematic (Side)** (By: averyscience1, 02/13/2015, .jpg)  
*An Image showing the different components of the SPOT-R utility.*
- [ [View](#) ] **SPOT-R Schematic (Top)** (By: averyscience1, 02/13/2015, .jpg)  
*An Image showing the different components of the SPOT-R utility.*
- [ [View](#) ] **SPOT-R Visual 1** (By: averyscience1, 02/13/2015, .jpg)  
*An image depicting how the SPOT-R device could look if constructed.*
- [ [View](#) ] **SPOT-R Visual 2** (By: averyscience1, 02/13/2015, .jpg)  
*An image depicting how the SPOT-R device could look if constructed.*
- [ [View](#) ] **SPOT-R Visual 3** (By: averyscience1, 02/13/2015, .jpg)  
*An image depicting how the SPOT-R device could look if constructed.*
- [ [View](#) ] **SPOT-R Educational Materials** (By: averyscience1, 02/13/2015, .jpg)  
*An image showing what educational materials could be used to educate children about SPOT-R.*
- [ [View](#) ] **SPOT-R Sample Webpages** (By: averyscience1, 02/13/2015, .pdf)  
*A PDF showing sample webpage images.*
- [ [View](#) ] **SPOT-R Map** (By: averyscience1, 02/27/2015, .jpg)  
*A map showing the rugged terrain in our local area*
- [ [View](#) ] **SPOT-R Video Link** (By: Advisor, 03/01/2015, .pdf)  
*Link to the SPOT-R presentation video on YouTube.*
- [ [View](#) ] **SPOT-R Chart** (By: averyscience1, 03/01/2015, .jpg)  
*A chart showing the responses from our survey of middle school students.*

### Problem Statement

#### **(1) What problem in your community did your team try to solve? Why is this problem important to your community?**

Western North Carolina is a region with great natural beauty because of its rugged mountains, abundant wildlife, and rocky streams and waterfalls. There are many advantages and disadvantages to Western North Carolina's rural terrain. While there are great opportunities to explore nature, it is very easy to get lost in this area. The dense trees that make the geography so attractive to visitors can also make the region difficult to navigate for individuals and the search teams seeking them when they become lost or confused. The mountainous terrain that draws hikers can also lead to a variety of injuries that make it difficult for people to get home. The lovely waterfalls and streams can also cause travelers to become stranded, lost, injured, or cold and wet.

When someone gets lost in our area, it can be a very complex process to locate that person, especially since the quality and quantity of rescue efforts are decreasing. Most search and rescue efforts are conducted by unpaid volunteers whose time is also taken up with other responsibilities. In fact, there are so many cases of lost people that the local canine search and rescue co-ordinator has taken part in approximately 150 rescue searches with dogs over a span of fourteen years.

There is also a real lack of new, energetic volunteers to help in search and rescue efforts, and searches can be challenging because children may be scared and may not want to be found. In order to conserve our community's rescue resources, protect our residents and visitors, and promote education about the need for quality rescue volunteers, this problem must be addressed.

To resolve all aspects of this problem, we have designed the SPOT-R (Seeking People Over Terrain Remotely) program, which includes a search and rescue utility; an educational program to help children understand that searchers can help them; and a recruitment system to recruit future search and rescue volunteers.

**(2) List at least 10 resources you used to complete your research (e.g., websites, professional journals, periodicals, subject matter experts).**

Bibliography is posted as a pdf.

**(3) Describe what you learned in your research.**

In our many interviews with a variety of individuals who work closely with different aspects of search and rescue, we learned about search and rescue techniques and the problems presented by the current lack of resources. We discovered that more people are injured than just lost in the outdoors, and that many people who are lost may not want to be found because they are confused, like Alzheimer's patients, or, like children, think they will be in trouble. We also interviewed the Chairman of the Board of the Crossnore Fire Department, who helped us learn about how fires can produce heat and how the fire department engages in search and rescue, including the scope of a potential search area.

Another interview we conducted was with Sue McBean, director of Grandfather Mountain State Park, who helped us understand how the Park Service is incorporated in the search effort as well. Because Grandfather Mountain is a rugged environment, Ms. McBean is familiar with the problem of lost individuals.

In our search for information about volunteer interest in technology-driven search and rescue, we surveyed 182 middle school students. In the survey, 49 percent of students expressed interest in technology, and 54 percent said they would be interested in working as search and rescue volunteers if they were using technology.

We also each learned much more than we expected in the process of researching, designing, and testing the SPOT-R Program.

averyscience2: I learned about science, search procedures, and teamwork. I know now that multi-rotor devices have become more popular and cheaper in the last few years, that infrared also senses the heat of fire and other living animals, and dead people/animals don't release heat. I also discovered that search and rescue squads mostly consist of volunteers, that there are many factors of people becoming lost, and that there are many resources to search and rescue. Also, I was informed that being on a team can be a little unexpected, that teams work separately and together, and that sometimes your skills can help others' skills.

averyscience3.: Through my research, I learned how to make calculations using the scientific method, learned to use teamwork to brainstorm an amazing solution to a community problem, and to communicate with other science enthusiasts to refine and resolve this project.

averyscience1: Though this project I was able to improve my Blender skills and learn more about the Blender software as a whole. I was also able to learn more about quad copters and remote controlled aircraft. I also learned more about talking to different individuals and explaining scientific principles to them.

#### Experimental Design

**(4) Develop a design statement. Be sure to describe what exactly your device should be able to do. Do not describe HOW it's going to do what it needs to do.**

Our device should be able to find lost people in rugged terrain, assist search and rescue operations, and conserve resources while encouraging education and recruitment.

**(5) Determine the criteria for a successful solution and identify constraints for your design. Discuss what the device must have in order to accomplish its job and the restrictions of the device (i.e. the size, the cost, the weight, etc.).**

The device must be able to fly under calm to moderate weather conditions and be able to operate in remote areas. Also, the apparatus must be economical enough for local rescue squads to afford, as well as still being suitably durable to go on many flights. It also requires both infrared, standard, and FPV (First Person View) cameras on board the machine. The model we have designed meets these criteria as indicated in the chart we have attached showing the components.

**(6) Identify the relevant variables you will use to test your prototype or model and explain how you will measure your variables.**

The relevant variables are how high and far the device can fly in different types of weather, wind resistance, how effective the cameras are in varying assets, actual battery life, flying conditions, how well it can land in different areas, if there are any errors in transmission, and the quality of the GPS. Search and Rescue volunteer responses, survey circumstances, number of students and volunteers, and navigation efficiency are other variables to consider. These variables were measured by constructing a rough model that meets the needs for achieving the goals of the design under a wide range of circumstances, and by surveying potential users about the SPOT-R device.

Build Prototype or Model

**(7) Develop a design and list the materials you used in your design. Include technologies you used (e.g., scientific equipment, internet resources, computer programs, multimedia, etc.).**

One of the most important types of tools we used were the many interviews with a variety of individuals who work closely with different aspects of search and rescue. In order to learn about possible solutions to the problem of lost people, we also used articles, websites, and other resources to help us understand how we could build a device to assist with search and rescue operations. We learned that while hobby multi-rotors are growing in popularity, there is no ready-made, low-cost device that meets the needs of our area.

We conducted extensive research on possible parts for our quad-copter design using RC hobby websites, retail sites, and online forums. Through this research, we discovered the critical components that we would need to create a fully functioning, multi-rotor search and rescue device. Over the five months of our research, we saw that the quality of many available parts was increasing, while the prices were decreasing. We selected parts for our prototype based on the research we conducted. We also expect that improved technology will help make even better parts available, including a ready-made frame that meets our specifications. For our prototype, we have included a frame that would have to be custom made, but all the other components are readily available from hobby websites. We selected brushless motors because our research showed them to be longer-lasting and more reliable than brushed ones. We determined that this configuration of components would allow us to construct the initial device for a reasonable cost while allowing for modifications and improvements.

Due to the fact that it was not feasible to build an actual, functioning SPOT-R device for testing with the resources we currently have available, we used many other forms of design to discover if the device could be constructed so that it would be a practical tool for search and rescue in our area.

The resources for SPOT-R were designed using Adobe Photoshop Elements 6.0, Adobe Premiere Pro CC 2014, Adobe After Effects CC 2014, Blender 3D, and Microsoft Office 2013.

**(8) Explain how you built your prototype(s) or model(s)? Include each of the steps in your process.**

We designed the SPOT-R utility to help with the searches using two kinds of cameras. The SPOT-R machine itself would be a quad-copter that has a GPS, a standard color camera, an infrared camera, a Fat-Shark for ground control, and a Raspberry Pi to control the cameras. SPOT-R will work by flying above the ground, high enough to look for lost people and animals and avoiding obstacles. SPOT-R's cameras show both images from the infrared camera and the conventional color camera using the Fat Shark. The standard camera can also help determine if what the infrared camera detects is actually a person or an animal.

We built a computer-aided design (CAD) model using an application called Blender. Because it is a free, open-source program, it allows its users to construct many different types of animations, including a quad-copter. We created this model using the items that we selected through our research. We used many of Blender's virtues, such as the Cycles rendering engine, to replicate many of the substances used on the apparatus. This program also allowed us to emulate the actual movement of SPOT-R as well as confirming that all of the parts would fit well together inside the device. This also allowed us to manipulate the components inside in different configurations; for example we placed the batteries in the center of the device to maintain the center of gravity.

The model was digitally constructed by finding online images of the components and using them to build the rough shape of the item. Then the images were applied to the mesh itself. Afterwards, the meshes were smoothed and finalized by using object modifiers, and were then placed inside the digital casing.

The components for the model were built by first saving an image of the component, then modeling the mesh to fit the shape. Then we added the image to the mesh itself. Following that the mesh was finished by using object modifiers and then placed inside the digital shell.

This model was also used in a promotional video, shown to firefighters, search and rescue volunteers, search professionals, and wilderness guides.

### Test Prototype

**(9) Describe the data you collected and observed in your prototype testing (use of data tables, charts, and/or graphs are encouraged).**

By building the digital model of the quad-copter, we were able to determine that all of the selected components (see file attached) would easily fit on-board the SPOT-R machine. Also, by interviewing multiple people involved with search and rescue we were able to determine that this device could become a useful asset in our area. Interviewing these individuals also allowed us to see the new potential in the early versions of the apparatus.

**(10) Analyze the data you collected and observed in your prototype testing. Does your data support or refute your design statement? Do not answer with yes or no. Explain your answer using 'Our data supports/refutes the design statement because...'**

Our data supports the design statement because our testing proved the three points of the program to be true. The device itself was tested through interviewing multiple individuals and showing them the 3D model. By doing this, the search and rescue experts were able to confirm the device's usefulness and to suggest ideas for long-term improvement and updates. The educational part of SPOT-R was tested by displaying the proposed educational materials to search and rescue volunteers and determining that the materials would work in the events hosted by Search and Rescue volunteers. The last point of the program, the recruitment part, was tested by surveying middle school students in our area about how they could use SPOT-R. Their interest, along with the responses of those who work in search and rescue, confirmed that the program has enormous potential to address all three aspects of the problem.

**(11) Explain any sources of error and how these could have affected your results**

There are several possible sources of error: inability of building and testing an actual prototype, not knowing how accurate the sources were, possible errors in our estimates and calculations, and variations in rugged terrain and actual performance of materials. However, our designs can be modified to account for all of these, none of which will completely negate the program's potential or projected uses.

### Drawing Conclusions

**(12) Interpret and evaluate your results and write a conclusion statement that includes the following: Describe what you would do if you wanted to retest or further test your design. Evaluate the usefulness of your prototype or model. What changes would you make to your prototype or model for the future, if any?**

If we could further research our project, we would keep finding lighter, longer lasting batteries, more wind resistant structures, and better range-providing technology. Search and rescue volunteers were very attentive and provided suggestions for the design based on our model and designs, and their enthusiasm about the project's potential is extremely encouraging.

If we were able to proceed with the program, we would work with Linville Search and Rescue to refine our plans for the first SPOT-R prototype. The members would provide critical information from their experiences to tweak the device to make it the most effective tool possible. We expect that, at current prices, our first prototype could be constructed for under \$800 and could be ready for testing in six months. Based on the results of field testing and feedback from members of the rescue squad and other community volunteers, we would modify the device for demonstration and exhibition.

There will, of course, be challenges to overcome to bring SPOT-R to life. Technical challenges can be overcome with further testing and research. Some of the challenges we have faced so far have been due to the newness of the technology, and as materials become more common and more thoroughly tested, many of those challenges may be resolved. Challenges based on the terrain and the environment can be overcome with practice, testing, and improved technology.

Over time, the program could be continually improved with several SPOT-R devices, making them lighter and faster, with longer-lasting, renewable energy batteries, range, and improved efficiency. Eventually, an entire "pack" of SPOT-R devices could be created. The "pack" would include a variety of "breeds," with different specialties to use in specific search and rescue situations.

The first "breed" of SPOT-R would be based on our first prototype design. This is a camera vehicle that helps with searches in two ways. This SPOT-R machine itself would be a quad-copter that has a GPS, a standard color camera, an infrared camera, a Fat-Shark for ground control, and a Raspberry Pi to control the cameras. SPOT-R will work by flying above the ground, high enough to look for lost people and animals and avoiding obstacles. SPOT-R's cameras show the images from the infrared camera using the Fat-Shark at night and the images for the color camera in the day. The standard camera can also help determine if what the infrared camera detects is actually a person or animal. As technology improves, this "breed" will travel farther, faster, and longer, becoming even more useful in search

efforts.

A second "breed" would be the SPOT-R device that carries a radio and cell phone signal booster. No matter how advanced radio and cell technologies become, in rugged, rural areas, it is often difficult to get reliable radio communications for searchers or cell phone reception. Based on the same basic template as the original model, this "breed" would be lighter and smaller, a tri-copter that could hover and provide radio and cellphone support. This small device could "ride" on the larger one to a search area, conserving battery life and allowing the small SPOT-R to use its energy to hover and provide signal boosting for cell phones and radios.

Another "breed" would be specialized to carry supplies to stranded or injured individuals. Current search and rescue volunteers are already enthusiastic about the potential of a quad-copter to deliver a small, needed tool, like a flashlight, to someone who is lost in the dark, or an epi-pen to a person who is experiencing a severe allergic reaction. Advances in technology will allow the SPOT-R to carry these and heavier supplies to those who need them. This "breed" will have a larger frame and greater payload capacity.

The SPOT-R pack would also include a connected GPS wristband for the search teams so that SPOT-R can keep track of them. These devices, or "Whistles," would allow SPOT-R to distinguish between searchers and possible lost people and could be activated or deactivated as needed.

In addition, in the long term there would be promotional materials to use with the educational aspect of SPOT-R. We created a "kid-friendly" logo that encourages children not to be fearful of the machine, and this could continue to be developed as a tool. Resources, including bookmarks, stickers, brochures, coloring books, toys, and T-shirts, could be produced to distribute to young children and their parents to help educate the public about SPOT-R's mission and the importance of rescue operations.

One of the biggest challenges we foresee is an image problem. Because of television and movies, there are many stereotypes and misconceptions about aerial vehicles. People fear that multi-rotors and drone devices are there to spy on them or invade their privacy. Rural people, particularly in our Appalachian region, are often resistant to change and suspicious of anything that might intrude on their privacy. By creating a program that shows the public the benefits of SPOT-R and takes the mystery out of the device, we hope to remove this stereotype and build positive relationships. We hope that soon SPOT-R will be looking out for lost people, children, and volunteers in our area.

## Community Benefit

### Uploaded Files:

- [ [View](#) ] **SPOT-R Coloring Book** (By: [averyscience1](#), 03/01/2015, .jpg)

*An example of an educational resource for use with SPOT-R*

- [ [View](#) ] **SPOT-R Recruitment Poster** (By: [averyscience1](#), 03/01/2015, .jpg)

*A poster showing the recruitment potential of SPOT-R.*

### ***(1) How could your design help solve your problem and benefit your community? Describe next steps for further research/design and how you have or how you could implement your solution in the future.***

Our community problem has three sections, and so does the solution we have created. The SPOT-R (Seeking People Over Terrain Remotely) program revolves around the SPOT-R device which we have designed using scientific principles. The device will find lost people more efficiently than traditional search methods, but it also will help recruit volunteers for the search and rescue and fire departments to help offset the diminishing numbers of volunteers as individuals drop out or age: "Someone has to replace us old guys" (Oliver, qtd. in Wukman 4). Technology attracts younger recruits who will be excited about working with this device and developing skills and experiences that they can use in their future careers.

Even younger children will be included in the SPOT-R program, as the device can be used in educational occasions. By seeing the unit in action, children will know that search and rescue personnel and tools, including SPOT-R, are not scary, but there to help.

With unlimited resources and time, we would be able to continually improve the program with several SPOT-R devices, making them lighter and faster, with longer battery life, range, and improved efficiency. Since we have noticed a steady decline in the cost of quad-copter materials and an increase in the reliability of available components, just in the last year, we expect that future SPOT-R devices can be economically feasible. However, it would still be a significant investment for our local search and rescue and fire departments to have access to this resource. We could also continue to improve the design of SPOT-R if we had abundant time and funding. In time, we would like to add a supplemental, small tri-copter that would work with SPOT-R as a radio and cellphone booster. We are also considering the possibility of adding a connected GPS wristband for the search teams so that SPOT-R can keep track of them.

In addition, additional resources would allow us to produce promotional materials to use with the educational aspect of SPOT-R. We created a "kid-friendly" logo that encourages children not to be fearful of the machine. Resources,

including bookmarks, stickers, brochures, coloring books, toys, and T-shirts, could be produced to distribute to young children and their parents to help educate the public about SPOT-R's mission and the importance of rescue operations. Our SPOT-R mascot could become as friendly and recognizable as Smokey the Bear, or other icons. These promotional items could be used in educational events that would demonstrate the device. Monthly events at different local schools could be a great venue for SPOT-R promotions, and educational days, festivals, and fairs, could feature SPOT-R. Field trips to the fire department could include SPOT-R demonstrations for the students. For older students, the SPOT-R events would be recruitment fairs, by allowing them to see the vehicle in action and learn how it works and how they could become involved. Interested students could get more information about volunteering with SPOT-R, and older high school students could begin training for the SPOT-R program themselves. Other volunteer opportunities in rescue and fire departments can also be explored by interested students. If we receive funding for the project, we would work with Linville Search and Rescue to refine our plans for the first SPOT-R prototype. The members of the search and rescue department would be able give us important information from their experiences as we tweak the device to make it the most effective tool it can be. Based on the results of field testing and feedback from members of the rescue squad and other community volunteers, we would modify the device for demonstrations and exhibitions. We would also produce promotional materials and plan events that will feature SPOT-R.

The benefits to our community include recruiting more volunteers for search and rescue, creating a useful technological asset for local search and rescue operations, and instructing children about the device and about search methods. Clearly this program, including the SPOT-R instrument, can have an exceedingly positive impact on our community.

## Mission Verification

### Uploaded Files:

- [ [View](#) ] **Survey Approval Form** (By: Advisor, 03/01/2015, .pdf)

*Form approving survey administration*

**(1) Does your Mission Folder project involve vertebrate testing, defined as animals with backbones and spinal columns (which includes humans)? If yes, team must complete and attach an IRB.**

No

**(2) Did your team use a survey for any part of your project? If yes, team must complete and attach a survey approval form.**

Yes

**(3) You will need to include an abstract of 250 words or less. As part of the abstract you will need to describe your project and explain how you used STEM (Science, Technology, Engineering and Mathematics) to improve your community**

The beautiful terrain of the Appalachian Mountains is great for the exploration of nature, but the area can cause hikers and other outdoor enthusiasts to become lost or injured. Also, most search and rescue volunteers are scarce or aging, and replacements are needed. In addition, some people, especially children, tend to hide due to fear of the search party. A solution to this challenge is the SPOT-R (Seeking People Over Terrain Remotely) program. The device is a quad-copter designed to help search and rescue operations. It also has enormous potential as a utility for volunteer operations, recruitment, and education. Testing of the apparatus and program design with many individuals who work with search and rescue determined that this innovation could be a very useful asset in rural areas like western North Carolina.



## Bibliography

*Adafruit*. 25 Jan. 2015. <http://www.adafruit.com>.

"Avery County, North County." *United States Census: State and County QuickFacts*. 8 July 2014. <http://quickfacts.census.gov/qfd/states/37/37011.html>.

"BPH Cheetah A1510 Brushless Outrunner Motor." *BH Hobbies*. 5 Dec. 2014. <http://www.bphobbies.com/View.asp?id=V450327&pid=I0740231>.

Brown, Cole. "History of the National Association of Search and Rescue Coordinators." (NASARC) May 2010. 26 Jan. 2015. <http://www.ssarcc.com/uploadfiles/History%20of%20the%20National%20Association%20Search%20and%20Rescue%20Coordinators%20by%20Cole%20Brown%20May%202010.pdf>.

*Hobby King*. 25 Jan. 2015. <http://hobbyking.com/>

Lonon, Jason. Personal Interview. 21 Jan. 2015.

Johnson, Phillip. Personal interview. 4 Nov. 2014.

McBean, Susan. Personal Interview. 14 Nov. 2014.

"Mitchell County, North Carolina." *United States Census: State and County QuickFacts*. 8 July 2014. <http://quickfacts.census.gov/qfd/states/37/37121.html>

Montgomery, Clem. "Multi-Rotors, First-Person View, And The Hardware You Need." *Tom's*

*Hardware*. 3 June 2014. 1 Dec. 2014. <http://www.tomshardware.com/reviews/multi-rotor-quadcopter-fpv,3828.html>.

Mueller, Harry. "Ares Ethos: Affordable Multirotor Fun." *Robot* November/December 2013: 44-45.

Schaffer, Richard. Personal Interview. 22 Oct. 2014.

"Search and Rescue Unit." *Yuma County Sheriff's Department*. 21 Nov. 2014.

<http://www.yumacountysheriff.org/vol-sar.html>.

*SparkFun Electronics*. 25 Jan. 2015. <https://www.sparkfun.com/>

"Specialty Teams: Search and Rescue Dog Task Group." *Linville Central Rescue Squad*. 15 Oct.

2014. <http://linville-centralrescue.org/search-and-rescue-dog-team-pd-56.php>.

*Spectrum RC*. 25 Jan. 2015. <http://spektrumrc.com/>

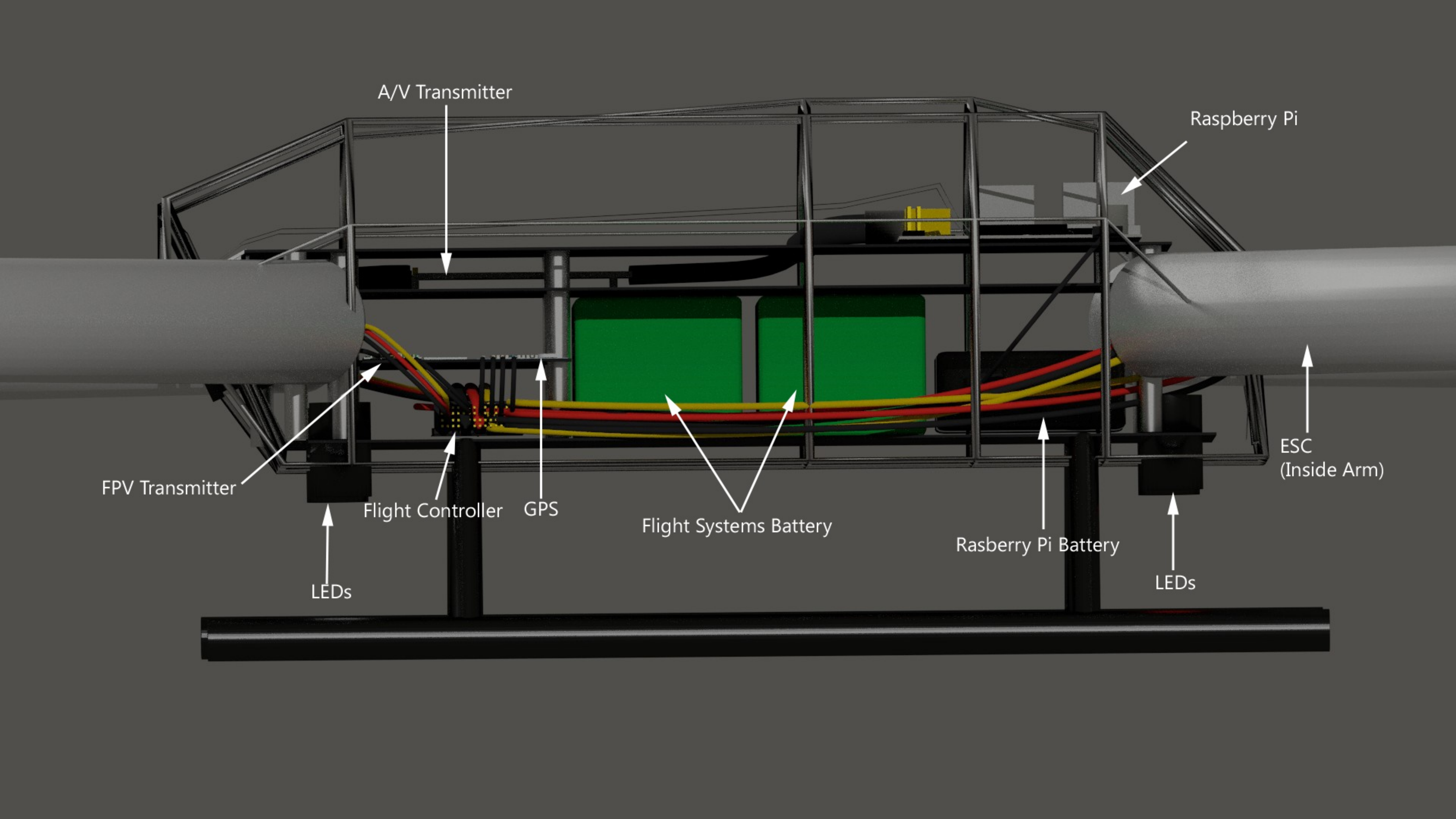
Williams, Rich. "2014 State Unmanned Aircraft Systems (UAS) Legislation." *National*

*Conference of State*. Sep. 16 2014. Nov. 21 2014. [http://www.ncsl.org/research/civil-and-](http://www.ncsl.org/research/civil-and-criminal-justice/2014-state-unmanned-aircraft-systems-uas-legislation.aspx)

[criminal-justice/2014-state-unmanned-aircraft-systems-uas-legislation.aspx](http://www.ncsl.org/research/civil-and-criminal-justice/2014-state-unmanned-aircraft-systems-uas-legislation.aspx).

"Yancey County, North Carolina." *United States Census: State and County QuickFacts*. 8 July

2014. <http://quickfacts.census.gov/qfd/states/37/37199.html>.



A/V Transmitter

Raspberry Pi

FPV Transmitter

Flight Controller

GPS

Flight Systems Battery

Raspberry Pi Battery

ESC  
(Inside Arm)

LEDs

LEDs

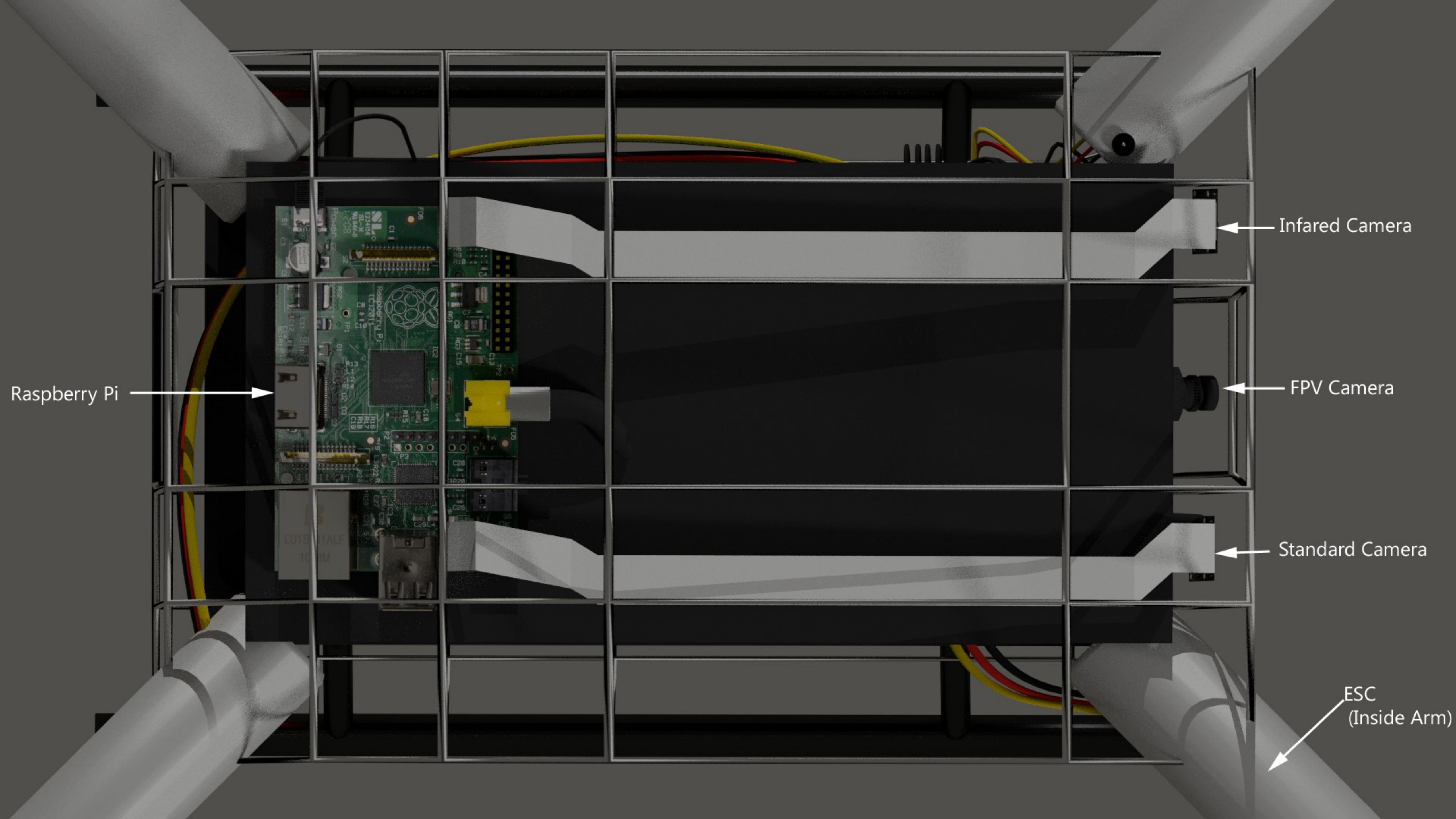
Raspberry Pi

Infrared Camera

FPV Camera

Standard Camera

ESC  
(Inside Arm)





**SPOT-R**

LINVILLE SEARCH &  
RESCUE

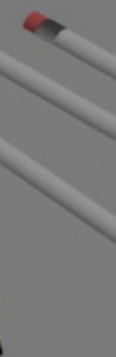
SP-723

CAUTION





LINVILLE SEARCH &  
RESCUE





# ***SPOT-R***

***SEEKING PEOPLE OVER TERRAIN REMOTELY***

[Home](#)

[Past and present](#)

[Our Technology](#)

[Breakthroughs and consequences](#)

[Design Process](#)



## ***SPOT-R***

***BEST FRIEND TO CHILDREN  
BEST FRIEND TO RESCUE PERSONAL  
BEST FRIEND TO LOST PEOPLE***

Though many people have attempted to build multirotor aircraft, it has not been until recently that technology has allowed us to build small, inexpensive multirotor aircraft. Throughout history many people have used multi-rotor aircraft. From the early aviators during the early 20<sup>th</sup> century to the military who attempted to build many different types of aircraft during the 1950s and 60s, it appears that many-bladed flying machines have always fascinated us. However, it seems that these aircraft have become immensely popular during the last ten years, when remote controlled multi-rotors began to become available to the general public.



Currently, there are many inexpensive remote controlled multi-rotors available; however, these small pre-built machines are not advanced nor durable enough to assist in helping Search and Rescue and Fire departments. There are some search and rescue operations that have multi-rotors for this purpose, but they are far too expensive for most small communities to afford.

To address this problem, we designed SPOT-R, which stands for Seeking People Over Terrain Remotely. SPOT-R is a program that is devoted to building inexpensive multi-rotors that can aid search and rescue and fire departments in rugged areas. The current design features both standard and infrared cameras to observe the terrain both day and night. The apparatus also features a GPS to help guide the machine.

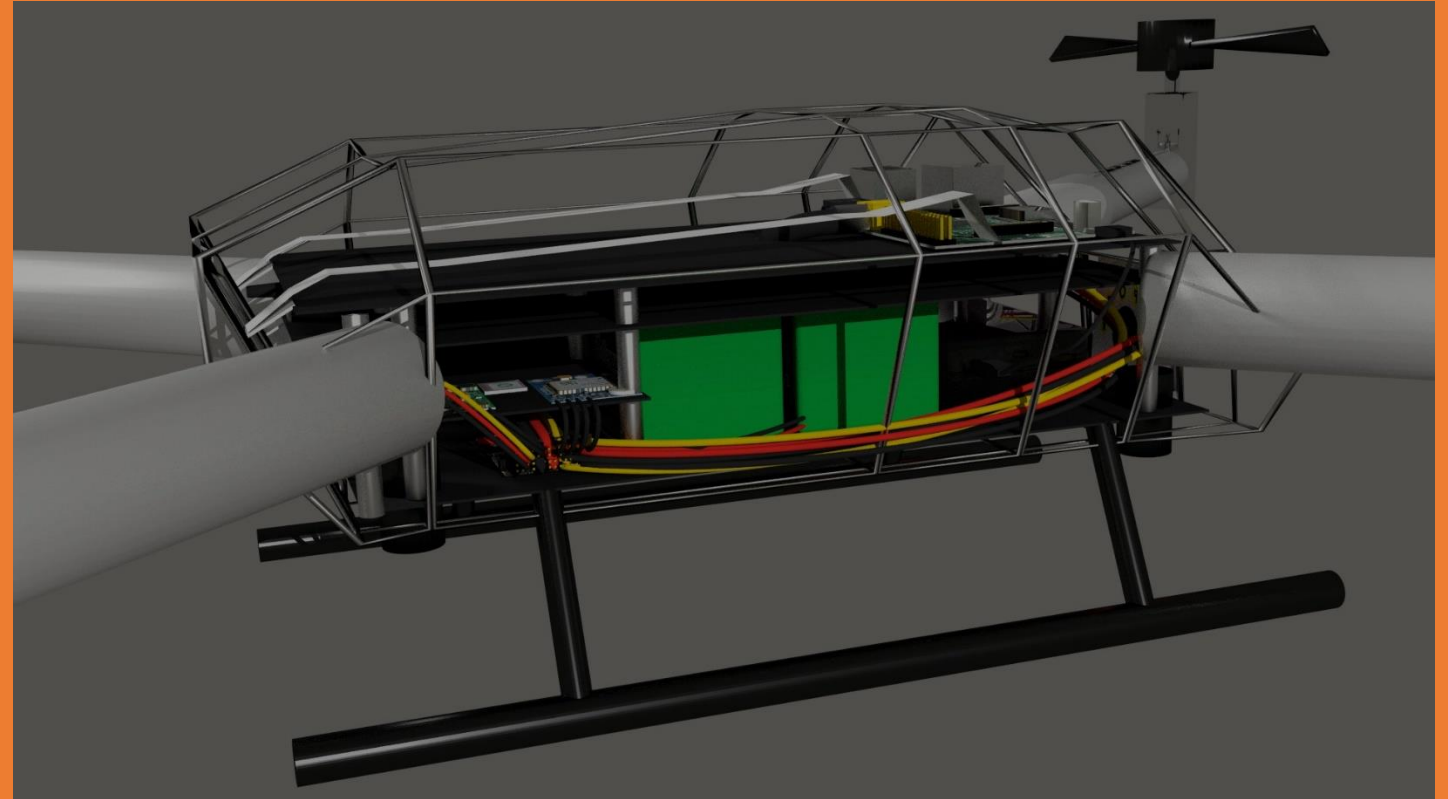


Diagram of the parts needed for the basic SPOT-R device.

This device can already be built for under \$900 but multirotor technology is continuing to decrease in price and increase in performance allowing this device to become more reliable and less expensive as time goes on.

# ***SPOT-R***

## ***SEEKING PEOPLE OVER TERRAIN REMOTELY***

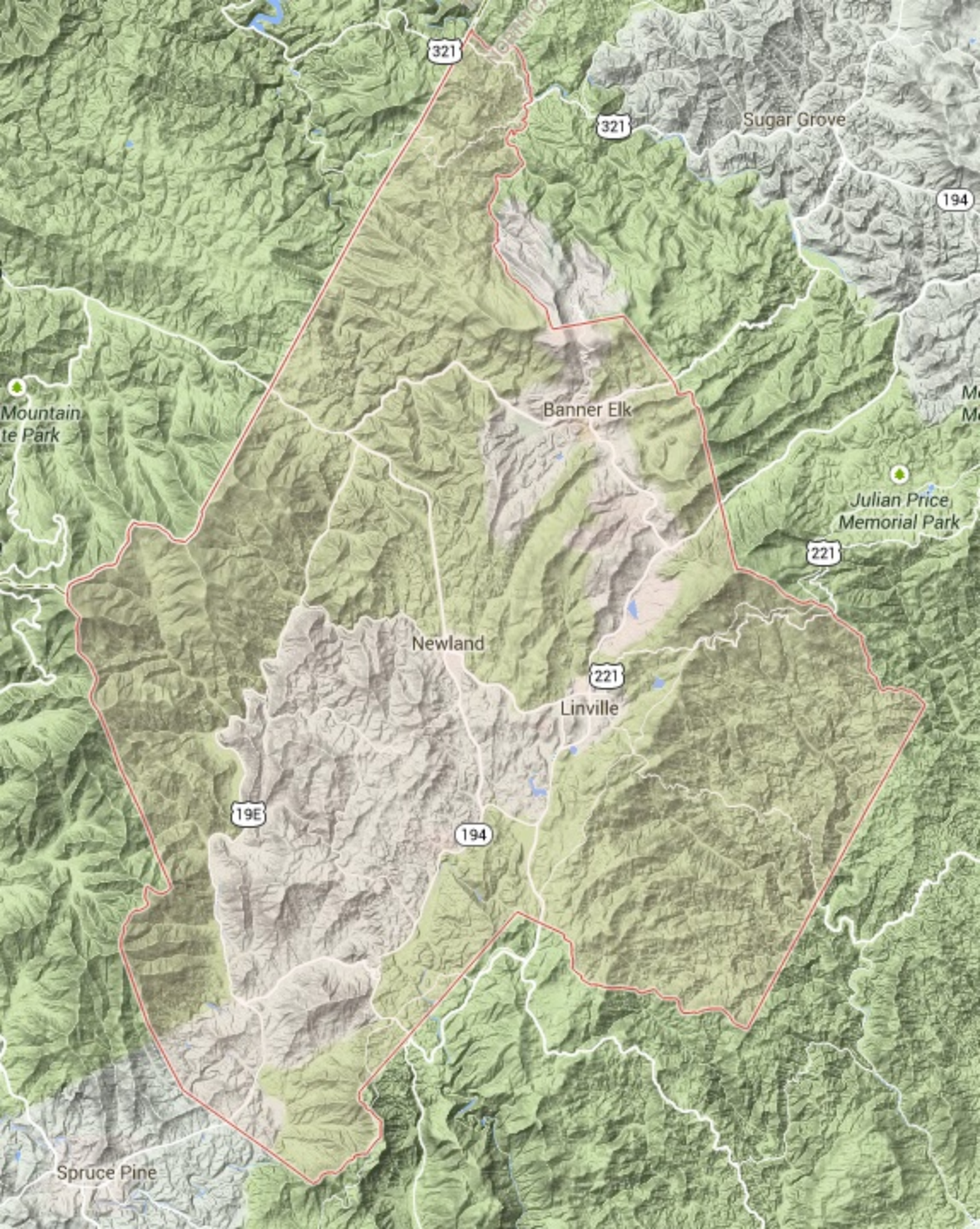
[Home](#)

[Past and present](#)

[Our Technology](#)

[Breakthroughs and consequences](#)

[Design Process](#)



321

321

194

Sugar Grove

Mountain  
Lake Park

Banner Elk

Julian Price  
Memorial Park

221

Newland

221

Linville

19E

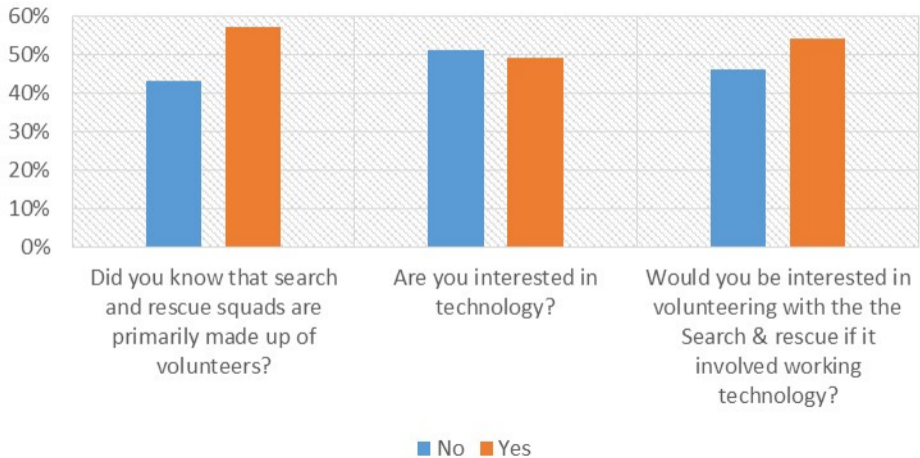
194

Spruce Pine

**SPOT-R YOUTUBE PRESENTATION VIDEO LINK:**

[HTTPS://WWW.YOUTUBE.COM/WATCH?V=MVOXYKTZFM4](https://www.youtube.com/watch?v=MVOXYKTZFM4)

# Survey Results





# ***SPOT-R***



***ACTIVITY BOOK***

***YOU COULD  
PILOT***



***SPOT-R***

**eCYBERMISSION Survey Approval Form**

eCYBERMISSION team name: SPOT-R

Team Advisor name: Elizabeth Hardy

Team Advisor email: elihardy@hotmail.com

Team Advisor phone: (828)737-0305

Student usernames: averyscience1, averyscience2, averyscience3

School name: Gryphon Academy, Avery M.

School address: PO Box 393 Crossnore, NC 28616

**Describe the survey your team will conduct:**

Two surveys: 1 for students to determine interest in using technology as search and rescue volunteers and one to current volunteers to determine their reactions to the program after seeing materials.

**Describe the participants you plan to distribute your survey to:**

1. Middle school students
2. Rescue volunteers in the community

**Project approved by school administration?**

Yes

No

**Approved by: Michael Hardy**

**Title: Homeschool Administrator**

**Date approved: 02/10/15**

**Signature, School Administrator:**



\*Please save form and upload to your team's Mission Folder.