Endeavour InvenTeam 2004-2005 Invention Progress and Plans #2

Aerial Imaging Remote Sensing System

Current Status:

We have recently completed our Input Phase and are currently beginning our Output Phase, which means that we are building and testing our prototypes for problems that may be encountered during the commencement of our invention. Each group (Camera, Analysis, Gondola/Gimble, and Launch Station) is performing tests and experiments to determine the appropriate setting, design, and/or equipment for our experiment.

Accomplishments to Date:

We have had a presentation from Kelly Bobbitt of Bobbitt Associates on GIS and GPS for vineyards. He told us a plethora of information about how his company utilizes Geographic Information System (GIS) and Global Positioning System (GPS) to aid viticulturists. His information has been very helpful to our invention process.

We have had a series of budget requests approved by our Advisory Council, and with the money from those requests, have purchased experimental filters, a filter color book, supplies for a model and a prototype for the launch station, and the radio equipment and servos for the gondola.

Our Advisory Council has expanded, and we invited media to come to our last meeting. It was very crucial to involve the media, because they ensured us that they would spread the news of our invention and inform possible benefactors of our need for funding. Now that our name is out to the community, donations will increase. We have a contact to obtain a camera and are currently awaiting this donation.

The Webmaster has updated and changed our InvenTeam website to better fulfill our needs. "www.pasoschools.org/endeavour/General/InvenTeam/InvenTeam.htm" is the address to our new website.

Our invention was given a name, **A**erial **I**maging **R**emote **S**ensing **S**ystem (A.I.R.S.S.), which we voted on and we have also decided on a logo to accompany it, which is a camera lens with a field in its reflection. One of the portions of the field is an NDVI image.

Our attendance and presentation to a Rotary Club Meeting with many members from our community, has resulted in many contacts for us concerning our experiment.

Each group has performed an experiment to aid the invention process and was assigned to turn in a formal report to present our findings at the Advisory Council meeting.

The Camera and Analysis Group did an experiment to see if changes in plant vigor could be detected in a picture. They obtained eight plants, which they split into two groups of four and grew them in two different conditions in cups, sunlight and no sunlight, and they each got some water. The plants were then photographed. Then after these plants "died", and there were apparent changes in the outward appearance (ie: they were wilted and dried out) they were photographed again using numerous filters. The pictures are currently being analyzed right now.

The Camera Group also did a test with LEDs to see if the camera was reading

the correct intensities and to determine the light range of the camera. The LEDs had known intensity values and these were compared to the relative sensitivity of the camera from the photos taken with different filters. Due to the results of these experiments, the requirements for the camera that we want have changed, and we now need one that has infrared sensitivity, video out, adjustable shutter speed and exposure, a resolution of at least three mega pixels and it needs to be lightweight (about eight ounces). Finally, the Camera Group has discovered how to find the area represented in the picture.

The Analysis Group has learned how to use Adobe Photoshop, Multispec Windows Application, Scion Image, and Microsoft Excel well enough to aid them with the analysis process. They have performed an experiment comparing the blackbody radiation graph acquired from Planck's equation with a graph of a photo they took through a spectrometer of the sun. The results showed that with the Canon S400 digital camera the infrared light was being blocked out. It could have been an element in the camera or the air that was blocking the light and further tests are currently being done to find out exactly what is blocking the infrared.

The Gimble/Gondola group has conducted a series of experiments to find whether one, two, or three lines attaching to the balloon would be sufficient. They also conducted another series of experiments to find which of the three gondola designs would suit our purposes best. They found that a modification of Andrew Heafitz's design, a triangle with the two top lines extended to the ground with the gimble at the bottom of the triangle was the most preferable of the designs.

The Launch Station Group has constructed a small model to scale of the launch system. The team has experimented with this model by calculating the force that is applied to it by the wind while it is in air. The angle of the line, causing displacement of the ground station has been tested, which has given them graphs, which show the relations of all the different components of a launch and how it will affect the balloon in flight.

Challenges:

As these experiments have been completed, they have solved and created a variety of questions about our invention. For instance, we must determine whether or not to buy a camera that can already read infrared or attempt to modify the camera we have now. We are having trouble deciding which wavelengths are appropriate for our invention also. During the LED experiment, we had some trouble getting accurate intensity measurements of the LEDs and we are also getting mixed results regarding the infrared intensities while using the same camera.

Lastly, it is imperative to build working designs of our invention because our scheduled flight date is quickly arriving.

Next Steps:

We will maintain our monthly Advisory Council meetings and we will continue inviting more members of the community to join. Another important aspect is to keep asking for donations from the community. The Camera Group will obtain a camera for the invention and will learn the correct settings for the camera. The Analysis Group is going to continue experimenting with the camera and the spectrometer. One test they

will do is repeating the experiment, but use an incandescent light bulb to supply the light instead of the sun. Doing it multiple times to see if the results are repeatable are the advantages of doing the experiment in this manner. They are going to experiment with a program, Scion Image, which calculates NDVI (Normalized Difference Vegetation Index). Finally, they are going to experiment with taking the infrared cutoff filter out of a camera to see if the photos are easier to analyze. The Launch Station and Gimble/Gondola groups are going to build a prototype of their two launch stations; they will be done by February 8, in time for the next advisory council meeting.

Team Function:

At the beginning of every class period we have a class meeting led by the Coordinator. Our teacher and the Coordinator create the agendas to ensure our success. Each Advisory Council meeting is started by the Coordinator and a presentation is given by InvenTeam members to update the Advisory Council. Each student is responsible for contacting a member of the Advisory Council. Maintaining communication between the groups is essential and we have been very successful during our scheduled briefings to each other.

Needs and Questions:

We need more funds to enable us to purchase more supplies, which we hope to acquire with the debut of our invention. Many questions have arisen regarding infrared and because of this, we also need to obtain a camera quickly so we can determine the correct settings. Lastly, it is essential that we assemble our invention and get it ready for flight in April.

Problem Statement:

Existing technologies today allow agriculturalists to use multispectral imaging to analyze the needs of their fields. Unfortunately, it is often expensive and requires from a couple weeks up to three months of time to get the images analyzed. To solve this issue, we will be inventing an easy, way to collect and analyze multispectral images for under $3000, for the first launch, and about $60 for each additional launch. Our invention will have two multispectral cameras mounted on a ten-foot diameter helium filled tethered balloon launched to approximately 900 feet. The balloon will have two lines that will simultaneously launch. This will offer an alternative to expensive existing technology already in use today. What sets our invention apart from existing technologies is that it will be repeatable, inexpensive, portable, and accessible.