Remote Sensing through Stratospheric Balloons

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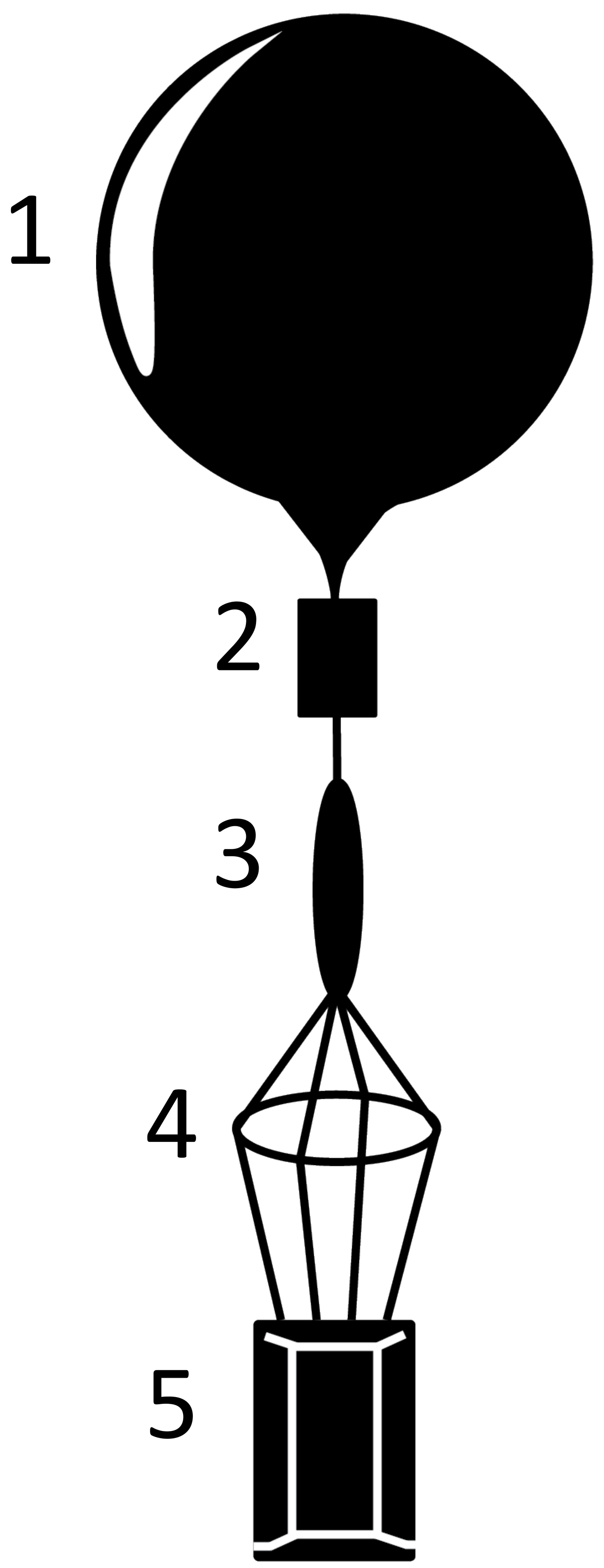
Abstract

Austin Peay State University has been working with stratospheric balloons for a few years. With these balloons we have proven that our platform is a good method for remote sensing. Our development of an integrated flight computer makes our payload an intelligent systems that tracks various conditions throughout a flight. The flight computer serves as the brains for other scientific experiments we choose to fly. In specific we have developed a remote sensing application that takes stable images in specific wavelengths. These images can be handled similarly to satellite images with information such as orientation and GPS location from our flight computer. These images come with better quality, lower investment, and more free range on timing making this a more suitable platform for smaller studies. This platform can be used for endless amounts of applications. At APSU we are focusing this platform on studying the solar eclipse that will pass through our area in August of 2017. We are presenting on the developed system as well as results from launches, where we study things such as cloud structure, and coronal observation.

Introduction



1. Helium filled balloon to 12-15 pounds of pulling pressure.
2. Cut down mechanism.
3. Parachute attached to the balloon and payload.
4. Plastic ring to help guide the air into the parachute. For safe landing and protection of the equipment.
5. Payload consisting of all the electronics and tracking system. Weight of 4-6 pounds, which is under FAA regulation rules.

Figure 1: Balloon Launch, Helium Filled Balloon, Parachute, Payload

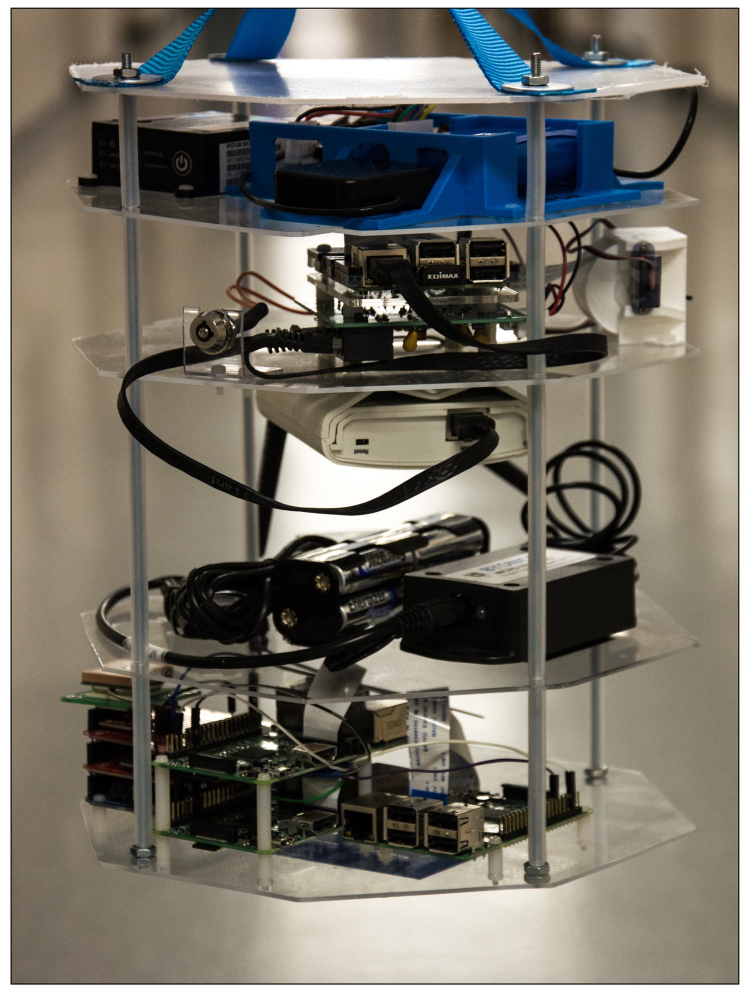
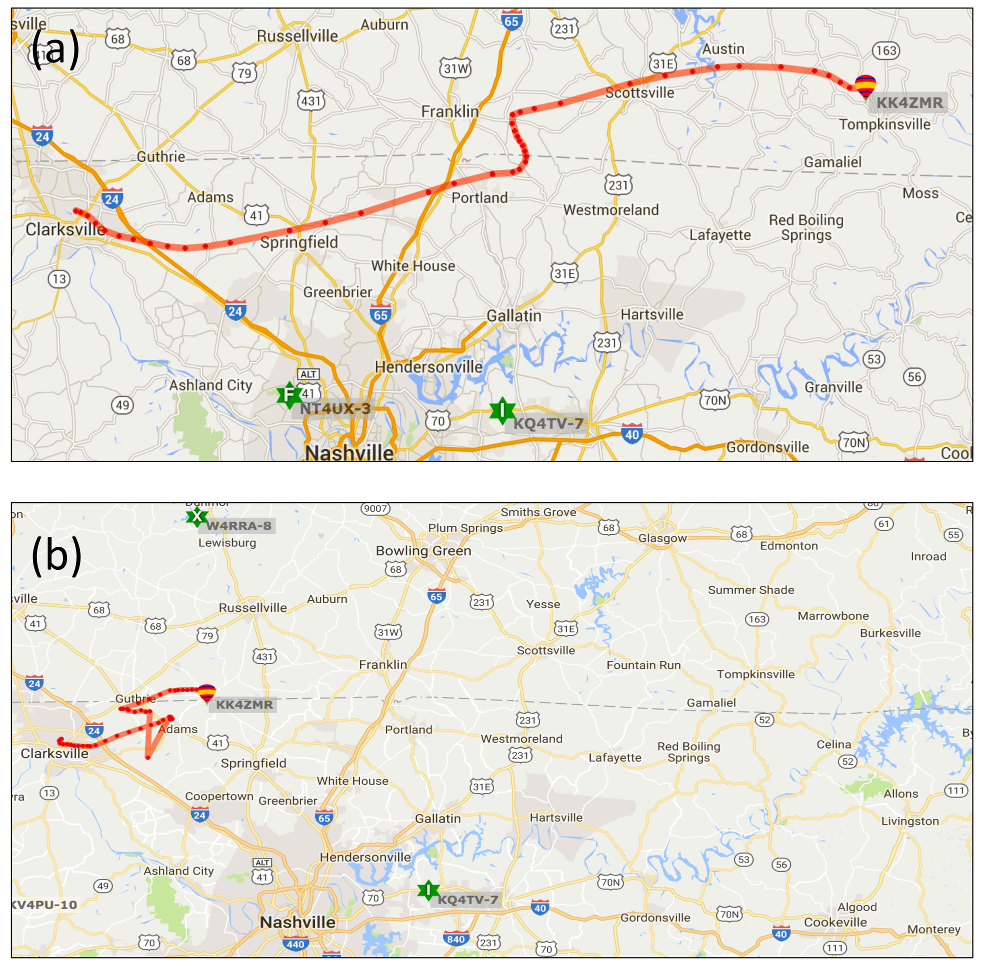


Figure 2: Inside of the payload. Camera system, tracking system, video stream

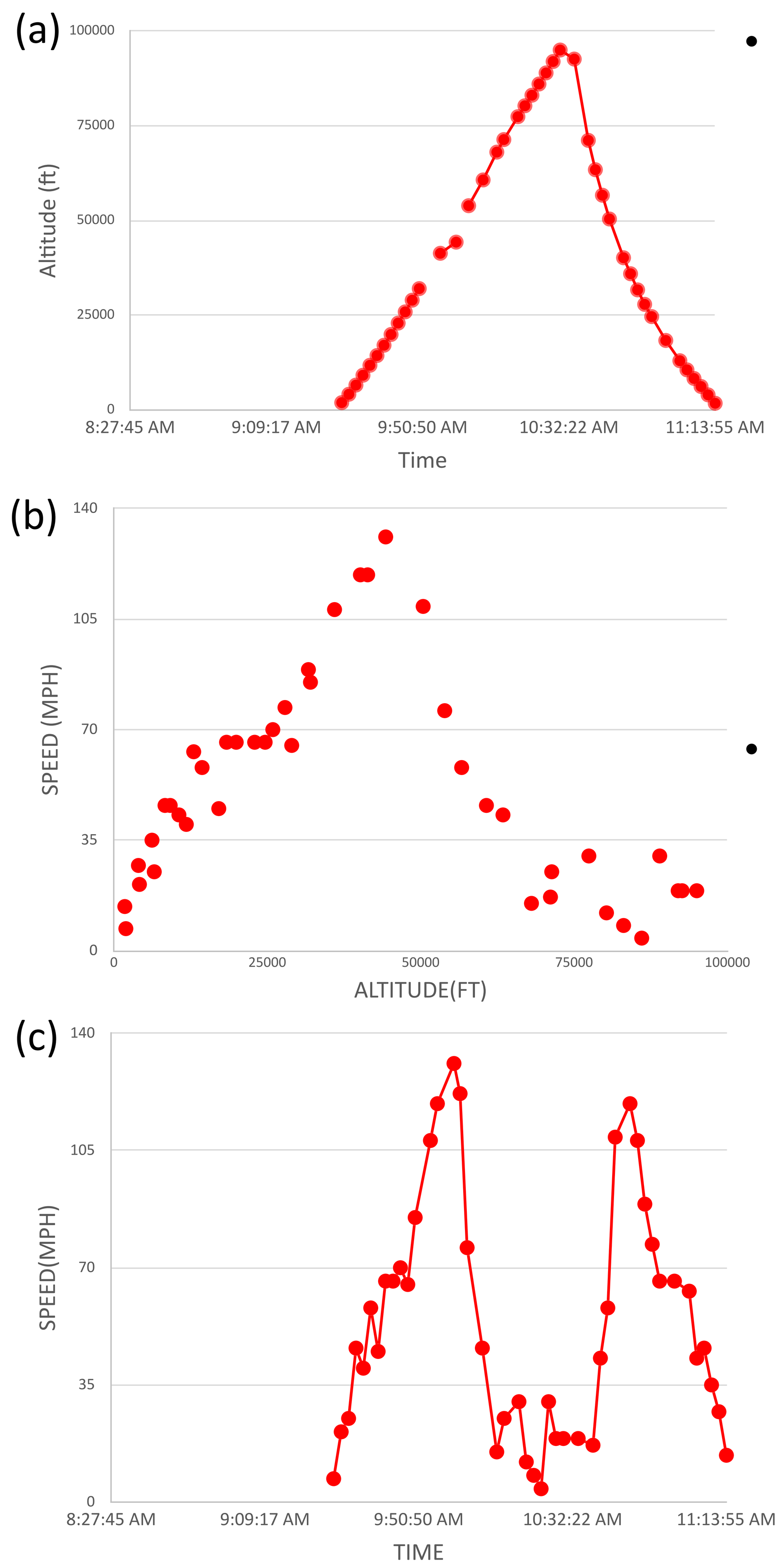
Flight



The flight path across the Tennessee/Kentucky Boarder. The flights took 2 hours, but as visible had very different paths. This describes the difficulties of predicting a flight path and landing sight.

Figure 3: Balloon path with points marked every two minutes. APRS frequencies were used to determine the location of the balloon throughout the flight. (a) Spring Flight (b) Fall Flight

Motion



Graph 1: (a) Altitude vs Time during flight (b) Speed of balloon at different altitudes (c) Speed of balloon through times.

- Graph 1a shows the altitude of the balloon over the flight, which shows that the climb is almost linear and the descent is linear but steeper. The ascent took longer then the descent which was expected due to the parachute size. At the initial point when the balloon burst it can be seen a drop of 20,000ft in 2 min. This can be explained by the low amount of air at those altitudes.
- The wind speed can be directly correlated to speed of the balloon at the different altitudes as can be seen in Graph 1b and Graph 1c. Wind speeds of 140 mph can be seen at 45,000 ft.

Figure 4: Bursting balloon at maximum altitude. Shreds vertically

Results

Determining dirty water that isn't that visible from the normal camera is easily detectable in the infrared range and proves our concept as feasible to use HAB's to acquire remote sensing data.

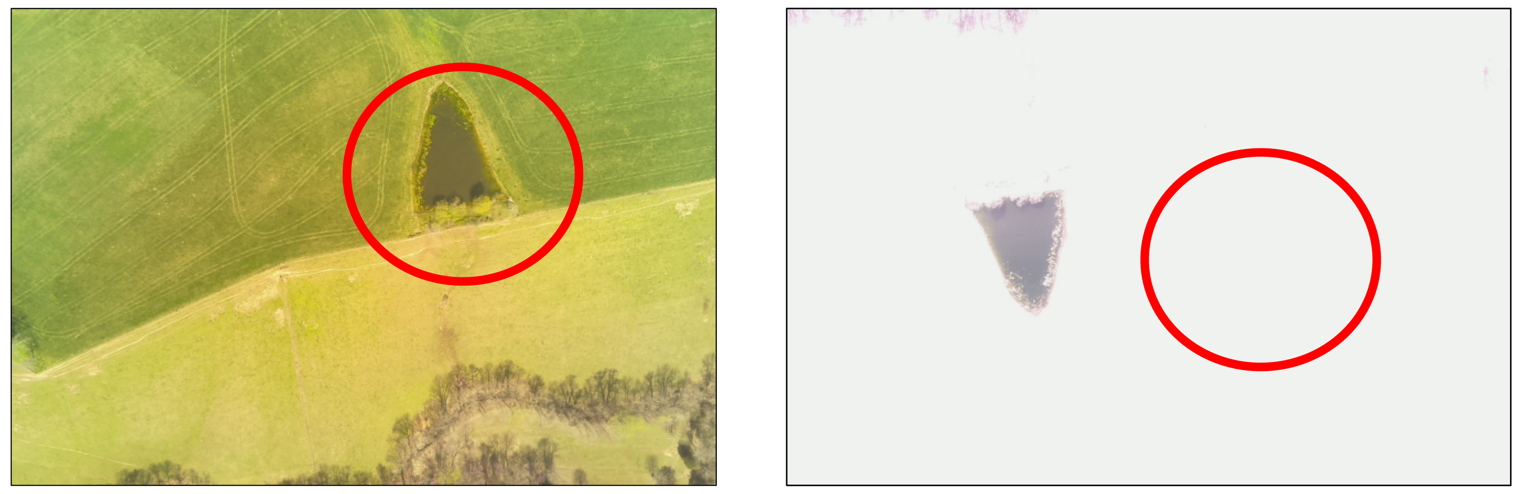


Figure 5: left shows small pond with regular camera, right shows matching infrared image where the water can be clearly seen

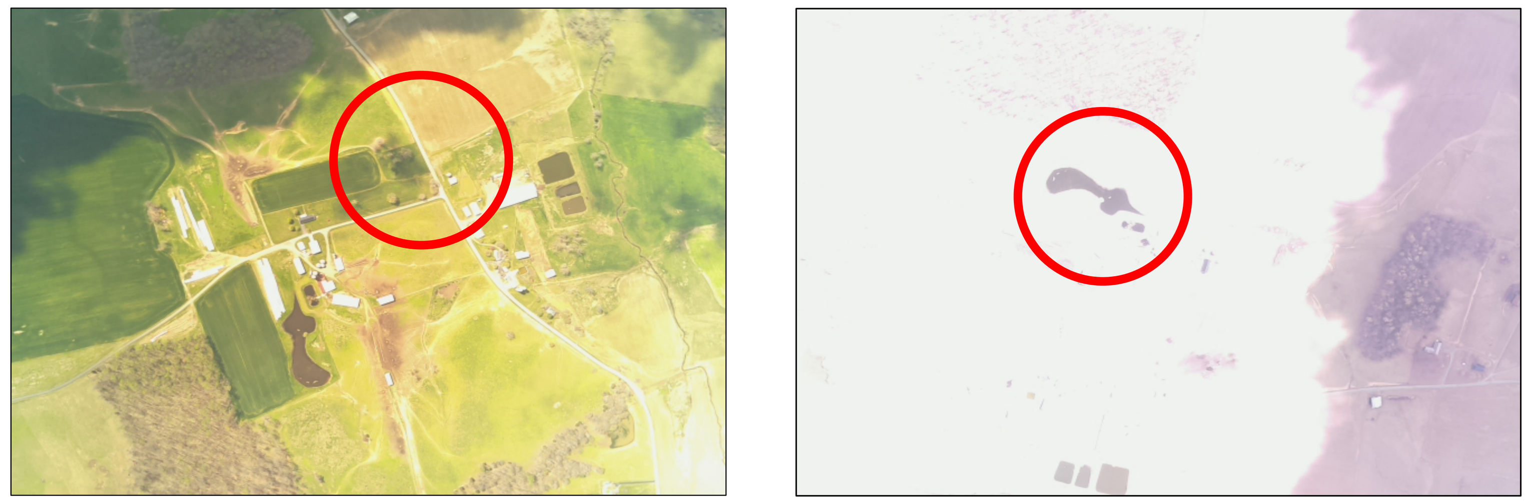


Figure 6: left shows large pond with regular camera, right shows matching infrared image where the water can be clearly seen

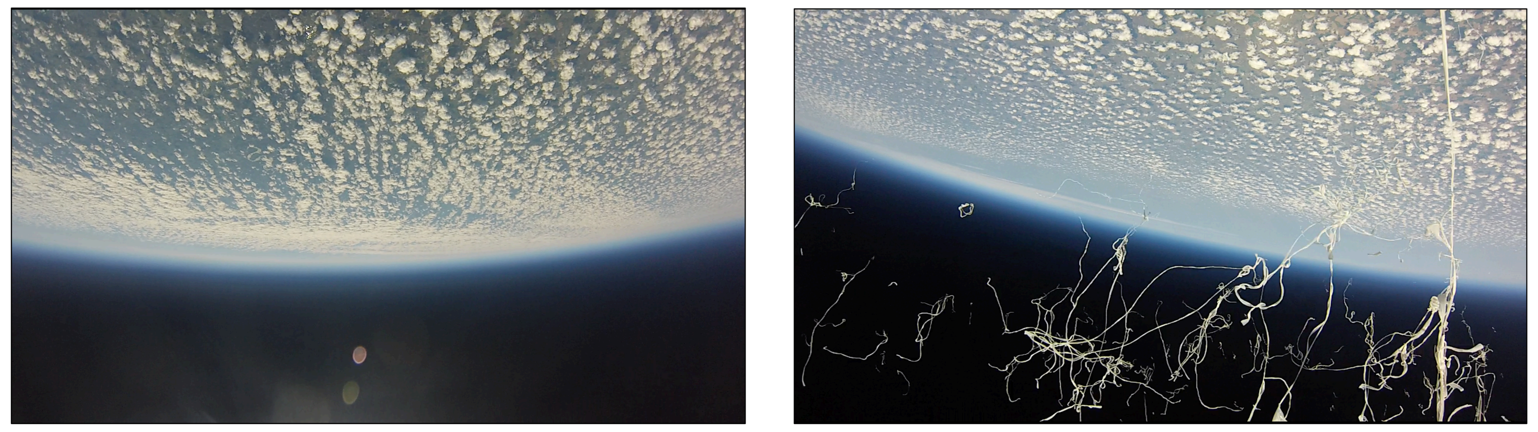


Figure 7: Images taken at maximum altitude 94,000+, left shortly before balloon burst, right at balloon burst

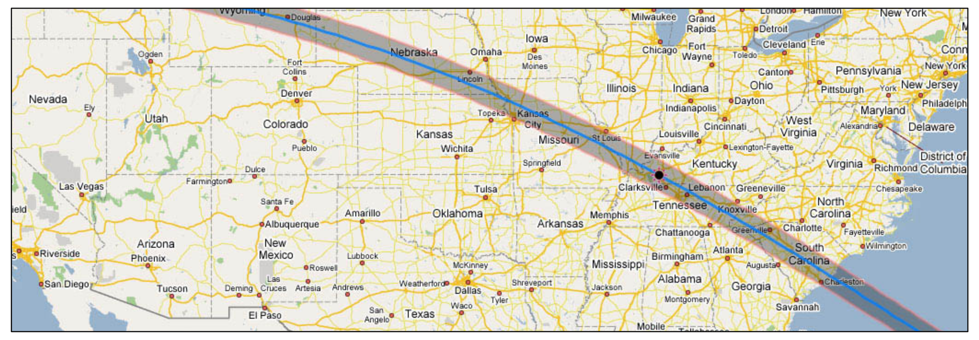


Figure 8: 2017 Eclipse Path. Nashville marked with most time of totality of 2 minutes and 40 seconds. Nashville is the best place to view the Eclipse.

Future Work

- Preparation for 2017 Solar Eclipse
- Improvement on camera timing to have simultaneous images
- Simplify electronics preparation for launches
- Secure electronics in payload better

Acknowledgements

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