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HighBall

High Altitude Balloon Altitude Control and Steering

High altitude balloons are mostly used as weather balloons to obtain information about the atmosphere which helps meteorologists to predict the weather. These balloons are relatively cheap to make which can potentially make them extremely useful in other situations. When natural disasters occur there needs to be constant surveillance of the area and high-altitude balloons would be perfect for this. The balloons used for this task must have an altitude control system that can be used to control the altitude of the balloon. Many high-altitude balloons use varying wind currents at high altitudes to steer them in certain directions. This allows them to be where they need to be and facilitates the process of getting back the payload after it completes its journey. It is important to understand the different ways in which balloons are able to navigate through wind currents at high altitudes.

Wind Steering and Altitude Control

Unlike other kinds of aircraft, hot air balloons can only move up and down by themselves and don't have any type of propulsion to move them in other directions. This is why they rely on wind currents to navigate to their destination. Hot air balloons are initially inflated with cold air before taking off. It has burners that are meant to heat the air inside the balloon. When the density of the air is low enough in relation to the density of the air outside the necessary lift is achieved and the balloon rises. The burner is used to control the altitude of the balloon. If the balloon needs to go down the intensity of the flame is decreased and increased when it needs to go up. Wind speeds and directions vary depending on the altitude so the direction in which hot air balloons can be somewhat steered by just increasing and decreasing the altitude. Even with a good pilot it is difficult to go exactly where it is desired because the pilot does not have direct control over the steering which should be considered when building small unmanned balloons. It would be impractical to use the same altitude control technique for smaller high-altitude balloons but the idea of using the wind for steering seems to work fairly well for balloons of other sizes and purposes.

Project Loon

Project Loon consists of using high altitude balloons to bring internet connection to rural areas. They plan to use several balloons which together can provide coverage to areas where it would be impractical to build communication towers like in big cities. These balloons would need to go wherever

they are needed to be so they need to be able to be steered. The balloons used for this project use helium to provide the necessary lift. Helium is non-flammable and not-toxic which makes it a good choice. The payload that the balloon carries must be light enough so that the balloon is able to rise along with it. Loon balloons use a high-pressured storage chamber in which air is transferred to and from the balloon. If the altitude needs to increase air is transferred from the chamber to the balloon and if it needs to decrease then air is transferred from the balloon to the chamber. This process is powered by solar energy and it would be too expensive and complex for a small project.

Weather Balloons

The payload of weather balloons contains tools to measure temperature, humidity and other information. Some weather balloons don't have an altitude control system so after they are released they keep going up until they reach an altitude of approximately 35km. After the balloon bursts the payload falls back down at high speeds which means that there needs to be a parachute that deploys and leads to a safe return to the ground. Some weather balloons are designed with a valve that releases helium into the air rather than storing it somewhere else. This is done to lower the altitude of the balloons and prevent it from bursting. Since the balloon cannot recover the helium that it has already released it has no other way to increase its height again. Since most of the data that weather balloons are meant to collect is acquired as the balloons goes up there is no need for a mechanism that increases its height again. If there was a need to increase its height there are cheaper ways in which it can be done.

Simple Altitude Control and Steering for Small High Altitude Balloons

Releasing helium from the balloon seems to be the best way to decrease the altitude but having a mechanism similar to the one used for the Loon project to increase altitude would be very expensive. The altitude control of hot air balloons would also be expensive and too heavy to include for small balloons and payloads. The best solution is to include something with the payload that can be dropped whenever the weight of the balloon needs to decrease. This ballast can possibly be water than can be dropped to decrease the weight which would increase the altitude. Since temperatures can drop to -90°C at high altitudes it would be better to use alcohol instead of water. After having implemented a good altitude control system the high-altitude balloon has to have a GPS to track its location and altitude. Based on this data the balloon needs decide if some helium should be released or some of the ballast has to be dropped in order to be steered in the right direction. A simple high-altitude balloon like this should be relatively inexpensive. Balloons that can lift a payload of five pounds cost about \$200. These larger balloons can reach an altitude of 115,000 feet before they burst. There doesn't not seem to be an altitude control system widely available online so the price of building one could vary.

References

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