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Trends of ADS

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Abstract: There are different techniques for detecting the altitude. The measurement of altitude plays a vital role for hikers, mountain climbers, skydivers and aircrafts. In applications like aircraft this measurement is vital and the error in this measurement can smash the aircraft and cause disasters. For the hikers and mountain climbers altitude detection is vital for determining one's location and to manage their safety. Various techniques can be used for determining the altitude but an accurate detection has to be used. For analysing this we compare the three most widely used systems that is a laser altitude detection system, a barometric altitude detection system and an ultrasonic altitude detection system.

Keywords: Ultrasonic, Barometric, Laser.

I. INTRODUCTION

An altitude detection system is an instrument used to measure the altitude of an object above a fixed level. There are different types of altitude detection systems namely pressure altitude detection system , sonic altitude detection system, laser altitude detection system, radar altitude detection system, radio altitude detection system etc. Here we compare the three most commonly used altitude detection system: barometric, ultrasonic and laser altitude detection system.

Barometric altitude detection system determines the altitude based on measurement of atmospheric pressure. Ultrasonic altitude detection system determines the altitude using the ultrasonic sound waves. Laser altitude detection system is operated from a plane, a helicopter or a satellite. It determines the distance to earth's surface by measuring the time of flight of laser radiation.

II. ULTRASONIC ALTITUDE DETECTION SYSTEM

It is an instrument for measuring the height of an aircraft above the earth. It includes an ultrasonic sensor which is used to measure the altitude of an object by using the ultrasonic sound waves. It determines the altitude by measuring the time taken for sound waves to travel from the air craft to the earth's surface and back to the aircraft again. It is considered more reliable and accurate in the region where heavy fog or rain is present.

In aircrafts, the new altitude detection system uses a series of high-pitched sounds from air craft to earth's surface and the sound waves travel back to the aircraft again. It is then converted to feet shown on a gauge inside the aircraft cockpit.

It is known that sound wave travels through air at about 344m/s (1129ft/s). The round trip distance of the sound wave can be calculated by taking the time for the sound wave to return air craft from the earth's surface and multiply it by the speed of the sound. Then to find the altitude of the object, simply divide the round trip distance in half. The accuracy of ultra-sonic sensor used in ultrasonic altitude detection system can be affected the temperature and humidity of the air

In aircrafts, barometric altitude detection systems are very useful but they are not accurate near terrains or water. So, pilots must learn to use visual clues for finding the altitude of aircraft. Unfortunately, they are not always available and can be dangerous. Flare assist offers a simple, accurate and economical ultrasonic solution. It uses ultra-high frequency sound waves, and then announces the computer-filtered results in the pilot's headsets. By knowing the actual height of the hull above the surface allows the pilot to devote attention for flying the aircraft.

Some object may not be detected by ultrasonic sensor. This may occur if the object is are shaped or positioned such that the sound wave bounces off the object, but are deflected away from the sensor. This may also occur if the object is too small to reflect enough of the sound wave back to the sensor.

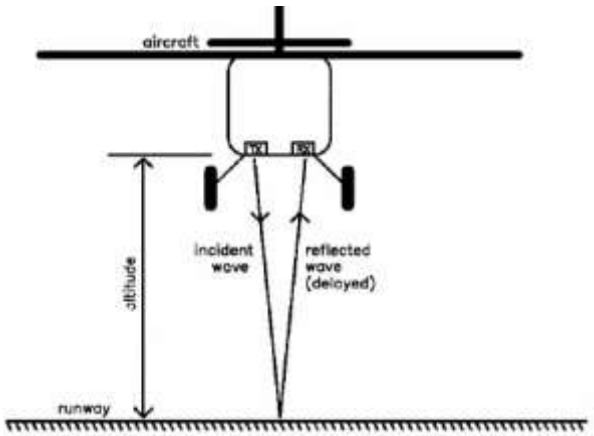

Fig1: Altitude detection using ultrasonic altitude detection system.

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III. LASER ALTITUDE DETECTION SYSTEM

Altitude measurement by laser beam has a wide variety of application like GPS, informational and satellites, industry, military and navigation. Laser altitude detection systems are used in planes, helicopters to measure altitude of the aircraft from the ground. It is most important to identify obstacles, and to maintain accurate flights and landings. In unmanned aerial surveillance vehicle this can be used from low-flying crop spraying to integrated system for assisted take-off and landing (ATOL). A laser altitude detection system is more accurate than a radio or radar altitude detection system. It measures and indicates absolute altitude. The elevation of surface can be determine by comparing how long it takes to be reflected off the target and return back to original position.

To determine the altitude using laser beam a Pulse or direct time of flight measurement method is used. It is a process of sending a laser pulse in a narrow beam towards the object and measuring the time taken by the pulse to be reflected off the target and returned to the sender. This time is the round trip time of laser pulse. The distance of the object can be determine by multiplying the round trip pulse time by the speed of the light and dividing by two. According to the time measured, the altitude can be calculated. Speed of the laser light is more. Laser light returns faster from the top of the volcano than from lowlands because it is closer to the satellite. This can be used to map large surface features like slopes, hills, areas flatness or mountains. GLAS is a laser altitude detection system is used to measure the topography of ice sheets. It is the first laser ranging instrument for continuous global observation of earth.

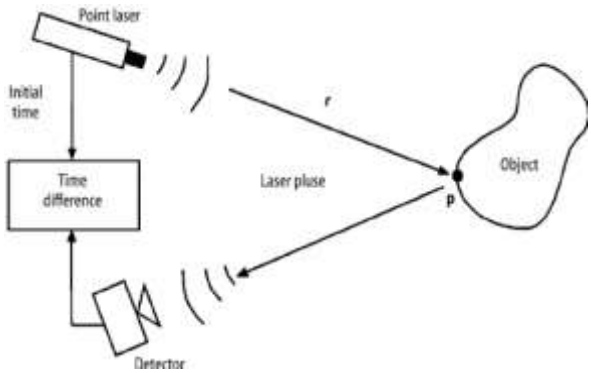

Fig2: Range detection using lasers

Normally 600-1000nm wavelength lasers are most commonly used since they are inexpensive. But they can be easily focused by the human eyes, so the maximum power has to be limited to make them eye-safe. An alternative for this is 1550nm wavelengths can be used since they are eye-safe even at highest power level. But the technology for detection is less advanced. These wavelengths can be used for long ranges but are less accurate.

IV. BAROMETRIC ALTITUDE DETECTION SYSTEM

The barometric altitude detection system is used to measure the altitude based on the atmospheric pressure. As the altitude increases the atmospheric pressure decreases. It is supplied with a nonlinear calibration to indicate the altitude. This is most widely used in aircraft, skydivers, hikers and mountain climbers in addition to other navigational tools like maps, magnetic compass or GPS receivers.

The altitude can be calibrated by the following equation

$$z = c*T*\log (Po / P)$$

Where c is a constant, T is the absolute temperature, P is the pressure at altitude z and Po is the pressure at sea level. The hikers and mountain climbers uses the barometric altimeter along with the topographical map to find one's location. As the atmospheric pressure varies with weather the hikers or the mountain climbers will have to re-calibrate when they reach a known altitude like the peak marked on the topographical map or trail junctions. The altitude detection is crucial for skydivers during the jump to maintain safety. So the altitude detection system is important skydiving equipment.

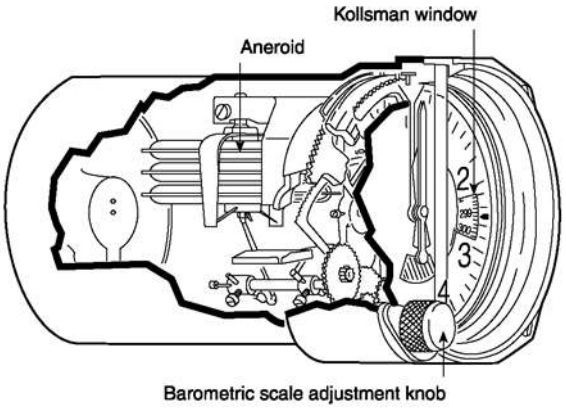

Fig3: Barometric altitude detection system.

The pressure altimeter operates on the principle that average atmospheric pressure decreases linearly with altitude. The barometric altitude detection systems are very useful in aircrafts, but they are not accurate near water or terrains. This error in the altitude can mislead the pilots during the terrain clearance; and to arrest the rate of descent for flare and landing.

V. COMPARITIVE STUDY OF DIFFERENT ALTITUDE DETECTION SYSTEM

- Ultrasonic altitude detection systems are not suitable for detecting large range of altitudes. Since it require very high power to transmit the sound waves to a long distance. Laser altitude detection systems are suitable

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for long range detection with comparatively low power than ultrasonic. But barometric altitude detection system can detect higher altitude by consuming low power in the range of mW.

- Ultrasonic and laser altitude detection system are more reliable and accurate during drastic climatic changes like heavy fog or rain whereas barometric altitude detection systems are less accurate in such cases.
- The Laser waves or ultrasonic waves gets reflected back when they hit other airborne objects or tall buildings from a long height. This can make the measurement of altitude erroneous. Since the barometric altitude detection system just depends upon the atmospheric pressure, they are more accurate in such cases.

TABLE I COMPARISON TABLE

PARAMETERS	DIFFERENT ALTITUDE DETECTION SYSTEMS		
	Laser Altitude Detection System	**Ultrasonic Altitude Detection System**	**Barometric Altitude Detection System**
Types of signal	Uses optical signal	Uses ultrasonic signals	Uses no signals
Effects of Obstacles	Altitude measurement is effected by smaller obstacles	Altitude measurement is effected by larger obstacles	Altitude measurement is not effected by any obstacles
Power consumption	High	High	Low
Accuracy	Accurate than ultrasonic altitude detection system	Least accurate	Highly accurate

VI. CONCLUSION

Barometric altitude detection systems are comparatively more accurate and reliable than laser and ultrasonic altitude detection systems. It consumes less power and it is not affected by obstacles. So, barometric altitude detection systems are more preferable for the detection of altitude.

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BIOGRAPHIES

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