James Fulford

James Hamblen

Light Emitting Navigational System

Laser Detection and Ranging Technology

Introduction

The virtual awareness of objects or surfaces is necessary for surveying or navigation. Technologies such as radar and ultrasonic have been used for the mapping of landscapes or enabling a robot to travel autonomously through its environment. These two technologies can be easily interfered with and require time for detection. Laser detection and ranging technology, LIDAR for short, is rapidly growing in popularity for its reliability and speed for range sensing. This paper reviews more expensive and less expensive LIDAR products that are currently on the market.

How the LIDAR Works

The LIDAR sends out a pulse of light at a surface and measures the time the pulse takes to return to the sensor. This pulse generally travels at the speed of light which makes this type of range finder the quickest on the market. Once the pulse returns, either the LIDAR or a microcontroller calculates the distance using the value for the speed of light and the time elapsed. These calculations are usually accurate even for the cheapest LIDARs manufactured. A detailed mapping can be produced with a quick enough pulsing. Some LIDARs can operate at rate of 300,000 pulses per second [1]. Pulsing speed and detection distance are the biggest tradeoffs with price among LIDARs.

Implementation of LIDAR Technology

Some LIDAR products such as VLP-16 "PUCK" and LeddarOne contain onboard processors. These onboard processors calculate and retain information such as: time of flight distance measurement, calibrated reflectivity measurement, rotation angles, and synchronized time stamps [1]. This information can be acquired using a cable to relay the LIDAR's data to a microcontroller of a Bluetooth device. The received data will need be converted to useable information using mapping software or microcontroller program language. Usually this data is used to perform mapping of a landscape or control a system for the movement of an autonomous vehicle.

Other LIDARs such as LIDAR-Lite v3 require a microcontroller to pulse the light and read when the pulse returns. These options are more difficult to use because they require the user to program the functionality of the LIDAR and the readings of digital or analog signals from the LIDAR for ranging calculations. Fortunately, there is a preprogrammed library for the LIDAR-Lite v3 to easily use on the

Arduino microcontroller. This library can be found on Github, which provides the LIDAR-Lite v3 owner with functionality [2].

Commercial Applications for Laser Detection and Ranging Technology

Professional

The VLP-16 "PUCK" is made by Velodyne LiDAR which was created to be used by professionals. The PUCK has a retail price of $7999 [1]. This LIDAR has a quicker ranging speed than the LIDAR-Lite v3 which enables it to quickly produce a 3D mapping of an area. Civil Engineers can use these LIDARs to collect geographic information for their next building project. Civil Engineers can mount these LIDARs to remote controlled vehicles to survey tunnels which may be too dangerous for a human to enter. LIDAR's have been used for gaming as well. EA Sports used the Focus3D by FARO to scan several football stadiums for their football games [3]. This option enables game developers to capture places with great detail while reducing the amount of time to put it into the game.

Military

The military finds similar use for LIDARs as professionals do. Targets and points of interest can be scanned using a LIDAR mounted to an air vehicle. This could notify them of dangerous situations such as enemy armored vehicle or a hidden trap. LIDAR technology has also provided the military with the use of autonomous vehicles which can keep troops out of harm's way. In June 2010, a light attack and reconnaissance helicopter performed a fully autonomous flight with obstacles [4].

Hobbyist

The LIDAR-Lite v3, made by Garmin is intended for projects such as small scale surveying or basic autonomous robots. Projects where weight and tight spaces find these cheaper LIDARs as a good choice. The LIDAR-Lite v3 is sold for $150 [5]. These LIDARs are mounted to drones or autonomous robots for 2D or 3D mapping purposes of their home or local areas.

References

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