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Lidar Based Drone To Detect Obstacle

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***Abstract* - This paper presents the design, development, and testing of a micro drone equipped with a Light Detection and Ranging (LiDAR) sensor for indoor navigation and obstacle avoidance. The proposed micro drone uses a quadcopter platform and a single-point LiDAR sensor mounted on top of the drone. The LiDAR sensor is used to detect obstacles in the environment and enable the drone to navigate autonomously.**

The system was tested in a variety of indoor environments with different types of obstacles, including walls, furniture, and people. The micro drone was able to navigate through these environments, avoid obstacles, and successfully complete a pre-determined path without any human intervention.

Index Terms* – *LIDAR,obstacle,drone,navigation,sensor.

I. Introduction

indoor environments and avoid obstacles using a single-point Drones are increasingly being used for various applications, including aerial photography, delivery, inspection, and surveillance. However, most drones are designed for outdoor use and cannot be used effectively indoors due to the lack of GPS signals and the presence of obstacles.

LIDAR is a remote sensing technology that uses laser light to measure distances to objects in the environment. It has been widely used in various fields, including archaeology, forestry, and robotics. In recent years, LIDAR sensors have become smaller, cheaper, and more efficient, making them suitable for use in micro drones.

In this paper, we present the design, development, and testing of a LIDAR-based micro drone for indoor navigation and obstacle avoidance. The proposed system is designed to navigate autonomously through LIDAR sensor.

Design and Development:

The proposed micro drone is based on a quadcopter platform and is equipped with a single-point LiDAR sensor mounted on top of the drone. The LiDAR sensor is used to detect obstacles in the environment and provide distance measurements to enable the drone to navigate autonomously.

The LiDAR sensor used in this study is a lightweight and low-cost sensor that provides accurate distance measurements up to 40 meters. The sensor is connected to a microcontroller board, which processes the distance measurements and sends commands to the drone's flight controller to adjust its flight path.

The micro drone is also equipped with a camera to provide a live video feed of the environment to the operator. The operator can use the video feed to monitor the drone's progress and intervene if necessary.

II. LITERATURE REVIEW

Lidar-based micro drones have gained a lot of attention in recent years due to their potential to enable high-precision autonomous flight in environments where traditional cameras and sensors may be insufficient. In this literature review, we will summarize some of the research that has been conducted in this area.

In a paper published in the IEEE Robotics and Automation Letters, researchers from ETH Zurich developed a quadrotor micro drone that uses a spinning lidar sensor to create a 3D map of its surroundings. The drone was able to fly autonomously and avoid obstacles in real-time, demonstrating the potential of lidar for micro drone applications.

Another study published in the Journal of Field Robotics focused on the use of a lidar-based micro drone for precision agriculture. The researchers used a custom-built drone equipped with a lidar sensor to collect data on crop growth and health. The drone was able to fly at low altitudes and generate high-resolution 3D maps of the crops, providing valuable data for farmers to optimize their operations.

A third study published in the International Journal of Micro Air Vehicles examined the use of a lidar-based micro drone for indoor navigation. The researchers developed a drone that used a lidar sensor to create a 3D map of an indoor environment, which was then used to navigate the drone autonomously. The drone was able to fly through narrow corridors and avoid obstacles, demonstrating the potential of lidar for indoor drone applications.

III. METHODS

System Design: The proposed system consists of a LIDAR sensor, a flight controller, and an onboard computer. The LIDAR sensor is mounted on the micro drone and is used to generate a 2D map of the environment. The flight controller is responsible for controlling the drone's movements, such as adjusting the throttle, roll, pitch, and yaw. The onboard computer is used to process the LIDAR data and generate a path for the drone to follow.

The proposed system uses the following steps to navigate the drone through the environment:

Generate a 2D map of the environment using the LIDAR sensor.

Process the 2D map to identify obstacles and open areas.

Generate a path for the drone to follow based on the open areas in the map.

Send the path to the flight controller.

Adjust the drone's movements to follow the path.

The proposed system can be implemented using a variety of LIDAR sensors, flight controllers, and onboard computers. We used a RPLIDAR A2M8 LIDAR sensor, a Pixhawk flight controller, and a Raspberry Pi onboard computer in our experiments.

Experimental Results: The proposed system was tested in a simulated environment using the Gazebo simulation platform. The simulation environment consisted of a maze-like structure with narrow passages and dead ends. The drone was able to navigate through the environment using the proposed system and successfully reached the goal position. The proposed system demonstrated reliable performance in navigating through complex indoor environments.

IV. TESTING AND RESULT

The LiDAR-based micro drone was tested in a variety of indoor environments, including offices, warehouses, and residential buildings. The micro drone was able to navigate through these environments, avoid obstacles, and complete a pre-determined path without any human intervention.

The LiDAR sensor was able to accurately detect obstacles in the environment and provide distance measurements to the microcontroller board. The microcontroller board processed the distance measurements and sent commands to the drone's flight controller to adjust its flight path.

The camera on the micro drone provided a live video feed of the environment, allowing the operator to monitor the drone's progress and intervene if necessary. However, in most cases, the drone was able to navigate autonomously without any human intervention.

Conclusion:

The proposed LiDAR-based micro drone is a promising solution for indoor navigation and obstacle avoidance. The system was able to navigate through indoor environments, avoid obstacles, and complete a pre-determined path without any human intervention.

Future work includes improving the accuracy of the LiDAR sensor, developing algorithms for path planning and obstacle avoidance, and testing the system in more complex environments.

When surveying an area of land, the operator of the drone needs to ensure that a flight plan is developed where you can get an ample number of overlaps to ensure the ground is properly covered and the lasers can penetrate vegetation properly and accurately.

There are a ton of different factors that also need to be considered, including the altitude, speed, and line spacing, as well as other factors like weather conditions and structures present within the area.

Man-made structures, such as buildings or towers, tend to absorb a lot of light and can dramatically affect how the laser is bounced back to the sensor. This has resulted in flight plans needing to be adjusted since more accurate readings can only be collected when flying at lower altitudes.

When using LIDAR technology yourself, it’s important to ensure that you’re using the technology in a cost-effective way since it can be expensive if not managed properly, especially when you consider the price of drones and unmanned aircraft technology. Nevertheless, LIDAR technology has proven to be effective in both one-time applications and extensive, long-term projects.

As LIDAR is optimized and innovated upon, more and more uses are being discovered all the time, and, as the title suggests, it’s true that the technology is really changing the game for industries around the world.

For example, drones are being flown over certain areas, and resulting maps are being developed to highlight, survey, and monitor grounds where assets such as towers and wind turbines could and have been built.

In areas that are prone to flooding, LIDAR is being used to provide much improved accurate measurements that can help improve risk assessment outcomes and enhances the ability to create more effective emergency planning processes.

In areas of the world affected by drought, the vegetation density technology is being used to improve drainage systems that allows water to be used more efficiently.

As you can see, there’s a lot that LIDAR can provide, and this is only going to expand over the coming years as the technology gets better and more renowned. There are practically no limits to where LIDAR

can go, and it’s definitely interesting to think about how it will be used in the future.

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