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Micro Drone with Proximity Sensor

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Abstract: *The Lidar Micro Drone is an innovative unmanned aerial vehicle equipped with advanced sensors for proximity sensing and environmental data collection. This drone incorporates a VL53L0X sensor for precise distance measurements, enabling it to navigate and avoid obstacles with exceptional accuracy. Additionally, it integrates a DHT11 sensor to monitor temperature and humidity levels, providing valuable insights into the surrounding conditions.*

The inclusion of a BMP180 sensor enhances its capabilities by measuring atmospheric pressure, further enriching the data collected during flight. All these sensors are seamlessly connected to a Node MCU for data processing and transmission.

The drone communicates its sensor data in real-time to a mobile application developed using Kodular, ensuring that users can access critical information effortlessly. Whether for applications in environmental monitoring, safety, or surveillance, the Lidar Micro Drone offers a versatile and powerful solution for proximity sensing and data collection, bridging the gap between advanced technology and user-friendly mobile interfaces.

Drones are now widely used in a variety of industries in the present era of fast- moving technology. Drones are used for anything from photography and cinematography to thermal examinations. The expense of drones is the most significant concern. Drones are often expensive to buy, and there is a significant risk of harm while flying them, which is why they are still a very uncommon item. Large drones can produce a lot of noise and require a lot of open space to fly. They can't fly indoors, in dense forests, or in locations with a lot of trees. The little drone is made up of four propeller-driven drone motors, an Arduino Pro Mini F3 EVO controller, a lidar sensor, and a buzzer. Infrared is used by the LiDAR sensor..

Keywords*:* Arduino, EVO controller

I. INTRODUCTION

Drones are today widely being used in a number of fields. Applications of drone's ranges from filming and videography to thermal inspections. The major issue associated with drones is the cost. Drones are generally costly purchase and there is a huge risk of damage while flying drone that is why drones are still not a very common gadget. Also, large drones make a lot of noise and need a lot of clear space to fly. They cannot be flown indoors or in dense forests or areas with many trees. So here we build a micro drone with an obstacle detection feature using LIDAR. This drone helps you understand drone flying as well as how obstacle sensing can be done using drones. Also, its small size and lower cost makes it less risky to fly it in dense forest of tricky places.

This Micro drone provides the following advantages:

- Small size and Low Cost
- LIDAR based obstacle sensing
- LED and Buzzer indications as per obstacle distance
- Can Takeoff from one's hand/trees or tight places
- Less Noise and very lightweight design

II. LITERATURE SURVEY

This work presents a concept of intelligent vision-less micro-drones, which are motivated by flying animals such as insects, birds, and bats. The presented micro-drone (named BAT: Blind Autonomous Tiny-drone) can perform bio-inspired complex tasks without the use of cameras. The BAT uses LIDARs and self-emitted optical-flow in order to perform obstacle avoiding and maze-solving. The controlling algorithms were implemented on an onboard micro-controller, allowing the BAT to be fully autonomous.

We further present a method for using the information collected by the drone to generate a detailed mapping of the environment. A complete model of the BAT was implemented and tested using several scenarios both in simulation and field experiments, in which it was able to explore and map complex building autonomously even in total darkness. In this work, Vision-based obstacle size estimation algorithm and distance estimation based on the LIDAR (Light Detection and Ranging) sensor for autonomous navigation of MAV (Micro Aerial Vehicle) were proposed. First, the LIDAR sensor installed on the MAV was used to measure the obstacle distance. When the threshold distance between the MAV and the obstacle is equal to 1.5m, then the obstacle size (width and height) can be measured using the object images acquired using the camera sensor based on the proposed vision-based object size measurement algorithm. The collision can be avoided with the obstacle using the LIDAR sensor which works on time on flight principle, in addition to that based on obstacle's width and height with the tolerance of 0.01m, the MAV can change the flight route by either increase the altitude or roll/yaw.

III. AIM OF PROJECT

The aim of a Micro Drone with Proximity Sensors project is to develop a compact, autonomous, or semi-autonomous drone that can detect and avoid obstacles in real time using proximity sensors. The main objectives of this project include:

Autonomous Navigation and Obstacle Avoidance

Utilize proximity sensors (e.g., ultrasonic, infrared, LiDAR, or Time-of-Flight sensors) to detect nearby objects.

Enable the drone to change its flight path automatically to avoid collisions.

Compact and Lightweight Design

Build a micro drone that is small, portable, and energy-efficient.

Optimize the design for indoor and confined-space operations.

Scope of Project:

The scope of the project includes the following key areas:

Hardware Development

Selection of a lightweight micro drone frame.

Integration of proximity sensors (e.g., ultrasonic, infrared, LiDAR, or ToF sensors).

Use of a microcontroller or flight controller (e.g., Arduino, Raspberry Pi, or Pixhawk).

Implementation of brushless motors, ESCs, and battery systems for efficient propulsion.

Software & Control System

Programming the sensor data processing for obstacle detection.

Implementing autonomous flight algorithms for real-time navigation.

Communication with a remote controller or mobile application.

Failsafe mechanisms to prevent crashes in case of sensor or signal failure

IV. HARDWARE OVERVIEW

SYSTEM BLOCK DIAGRAM- BLOCK DIAGRAM

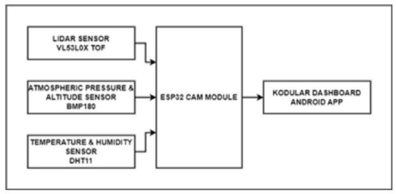

Fig: 3.1.-Block diagram of system

BLOCK DIAGRAM DESCRIPTION

A drone, in technological terms, is an unmanned aircraft. Essentially, a drone is a flying robot that can be remotely controlled or fly autonomously through software- controlled flight plans in their embedded systems, working in conjunction with onboard sensors and GPS.

V. METHODOLOGY

The proposed methodology for a LiDAR micro drone equipped with a VL53L0X sensor, a DHT11 sensor for temperature and humidity, and a BMP180 sensor for atmospheric pressure, reporting data to a mobile application developed using Kodular involves several key steps: Firstly, the hardware setup of the drone is crucial. The LiDAR sensor (VL53L0X), the DHT11, and the BMP180 need to be appropriately integrated into the drone's design, ensuring they are securely attached and connected to a microcontroller, such as a ESP32 Cam or a similar device. The VL53L0X LiDAR sensor will be utilized to provide proximity sensing capabilities, allowing the drone to detect and measure distances from obstacles or the ground. The data collected by the sensor will be communicated to the ESP32 Cam, which will act as the drone's central processing unit.

DRONE COMPONENTS:

Standard Propellers:

The propellers are usually located at the front of the drone/quadcopter. There are very many variations in terms of size and material used in the manufacture of propellers. Most of them are made of plastic especially for the smaller drones but the more expensive ones are made of carbon fiber. Propellers are still being developed and technological research is still ongoing to create more efficient propellers for both small and big drones. Propellers are responsible for the direction and motion of the drone. It is therefore important to ensure that each of the propellers is in good condition before taking your drone out for flight. A faulty propeller means impaired flight for the drone and hence an accident. You can also carry an extra set of propellers just in case you notice some damage that was not there before.

Brushless Motors:

All drones being manufactured lately use the brushless motors that are considered to be more efficient in terms of performance and operation as opposed to the brushed motors. The design of the motor is as important as the drone itself. This is because an efficient motor means you will be able to save on costs of purchase and maintenance costs. In addition to that, you will also save on battery life which contributes to longer flight time when flying your drone.

Landing Gear:

Some drones come with helicopter-style landing gears that help in landing the drone. Drones which require high ground clearance during landing will require a modified landing gear to allow it to land safely on the ground. In addition to that, delivery drones that carry parcels or items may need to have a spacious landing gear due to the space required to hold the items as it touches the ground.

Electronic Speed Controllers:

An electronic sped controller (ESC) is an electric circuit whose main responsibility is to monitor and vary the speed of the drone during flight. It is also responsible for the direction of flight and variations in brakes of the drone. The ESC is also responsible for the conversion of DC battery power to AC power to propel the brushless motors. Modern drones

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depend entirely on the ESC for all their flight needs and for performance. More and more companies are coming up with better performing ESC that reduce power needs and increase performance, the latest one being the DJI Inspire 1 ESC.

The Receiver:

The receiver is the unit responsible for the reception of the radio signals sent to the drone through the controller. The minimum number of channels that are needed to control a drone are usually 4. However, it is recommended that a provision of 5 channels be made available.

The Transmitter:

The transmitter is the unit responsible for the transmission of the radio signals from the controller to the drone to issue commands of flight and directions. Just like the receiver, the transmitter needs to have 4 channels for a drone but 5 is usually recommended. Different types of receivers are available in the market for drone manufacturers to choose from.

GPS Module:

The GPS module is responsible for the provision of the drone longitude, latitude and elevation points. It is a very important component of the drone. Without the GPS module, drones would not be as important as they are today. The modules helps drone navigate longer distances and capture details of specific locations on land

Battery:

The battery is the part of the drone that makes all actions and reactions possible. Without the battery, the drone would have no power and would therefore not be able to fly. Different drones have different battery requirements. Smaller drones may need smaller batteries due to the limited power needs. Bigger drones, on the other hand, may require a bigger battery with a larger capacity to allow it to power all the functions of the drone.

Camera:

Some drones come with an inbuilt camera while others have a detachable camera. The camera helps in taking photos and images from above which forms an important use of drones. There are different camera types and qualities in the market and a variety to choose from. These are basically the main component of a drone.

VI. ADVANTAGES:

1. Collision Avoidance & Safety

The proximity sensor helps the drone detect obstacles and avoid collisions.
Ensures safer flight in indoor and outdoor environments.
Reduces the risk of damage to the drone and surroundings.

2. Autonomous Navigation

Enables autonomous flight by adjusting its path based on detected obstacles.
Useful for environments where GPS signals are weak, like indoors or underground.

3. Enhanced Control & Stability

Improves flight precision, especially in tight or cluttered spaces.
Helps maintain steady flight by adjusting altitude and direction based on nearby objects.

4. Surveillance & Monitoring

Can be used for security and monitoring in restricted or hard-to-reach areas.
Useful in search and rescue operations, inspecting hazardous environments, or spying applications.

VII. APPLICATIONS

- **Military & Defense**: Surveillance and reconnaissance in risky zones.
- **Industrial Inspection**: Checking machinery, pipelines, or power lines in factories.
- **Healthcare & Emergency Services**: Delivering small medical supplies or monitoring disaster-hit areas.
- **Agriculture**: Monitoring crops and detecting plant health

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VIII. CONCLUSION

Drones can be used to optimize a farm based on a large range of image data about the condition of crops, fields and livestock as well as applying pesticides. In our project we use drones for real time adaptive monitoring to check the condition of the crops from time to time with the use of drones. This methodology can provide good crop yield, decrease farmers burden of checking the crop field daily. It might also predict beforehand if the crop is going to be damaged. Furthermore, it can provide security to the agriculture fields from animals as well as from thievery. The future of micro drones with proximity sensors is bright, with potential advancements in AI, IoT, and automation. As technology improves, these drones will become smarter, safer, and more efficient, expanding their applications across various fields.

RESULT

The micro drone with proximity sensors was successfully designed, built, and tested. The integration of ultrasonic (or IR) sensors enabled the drone to detect and avoid nearby obstacles during flight. This enhanced the drone's safety, especially in indoor or cluttered environments.

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