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RESEARCH ARTICLE

Solar-Based Hand Gesture Surveillance Controlled Drone

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ABSTRACT

This paper introduces a novel approach to surveillance, utilizing a solar-powered infrared (IR) surveillance drone controlled by hand gestures. By harnessing solar energy, the drone achieves prolonged flight time, enabling extended surveillance missions. Hand gesture control enhances usability, allowing operators to navigate the drone effortlessly, whereas IR technology provides enhanced night vision capabilities. This integration offers a cost-effective, eco-friendly solution for aerial surveillance in various environments, from urban to remote areas, enhancing security and monitoring capabilities.

Key words: Drone, flight control, global positioning system, hand gesture, solar power

INTRODUCTION

The hand gesture-controlled drone is an innovative and intuitive advancement in the field of unmanned surveillance and in drone technology. This cutting-edge technology enables users to control drones using simple hand gestures, eliminating the need for traditional remote controllers and making the flight experience more natural and interactive. The system operates by leveraging a combination of sensors, cameras, and computer vision algorithms to detect and interpret hand movements in real time. These advanced sensors capture. The data related to hand position, orientation, gestures, and enabling the drone to understand and respond according to user commands.

METHODOLOGY AND WORKING PRINCIPLE

The working principle of a hand gesture control drone involves a combination of sensors, cameras, and computer vision algorithms with solar-based energy utilization when in need.

Sensors and Cameras

The drone is equipped with various sensors, including accelerometers, gyroscopes, and ultrasonic sensors. These sensors provide information about the drone's position, orientation, and movement. In addition, the drone may have one or more cameras that capture video or images.

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Hand Gesture Recognition

When the user interacts with the drone, the onboard cameras capture the user's hand movements, and the captured video or image data are then processed using Arduino Nano. These algorithms analyze the hand position, gestures, and motion to recognize specific gestures made by the user.

Flight Control Execution

The translated flight commands are sent to the drone's flight control system. The flight control system, which consists of onboard processors and controllers, receives the commands and adjusts the drone's motors and propellers accordingly. This allows the drone to perform the desired flight maneuvers based on the user.

RF Transmitter and RF Receiver

The basic principle involves using hand gestures to send a specific command through RF signals to control the drone's movements. The RF transmitter translates the gestures into RF signals, which are then transmitted to the drone's RF receiver. The receiver interprets these signals and translates them into corresponding flight commands, such as moving forward, backward, up, down, left, or right. This allows users to control the drone's movements by simply gesturing with their hands. The specific gestures and their corresponding commands are usually predefined in the drone's software.

Global Positioning System (GPS)

GPS is a satellite-based navigation system that provides precise geographic location and time information to users anywhere on Earth. It consists of a constellation of satellites orbiting the planet, ground-based control stations, and GPS receivers that individuals and devices use to calculate their exact position, velocity, and time. The system enables a wide range of applications, including navigation, mapping, surveying, emergency response, and scientific research.

Solar Panel Charging

Solar panels are devices designed to capture sunlight and convert it into electricity through a process called Photovoltaic conversion. Solar panels are a sustainable and eco-friendly way to generate electricity, harnessing the power of sunlight to charge batteries and power devices.

CALIBRATION, TESTING, AND RESULT ANALYSIS

Hand Gesture Controlled Drone Testing

The testing of hand gesture-controlled drone is mainly with the gesture by hand movement. It indicates this availability through the light-emitting diode (LED), as shown in Figure 1.

Arduino Nano Testing

The testing of Arduino is mainly with the gesture of hand movement. It indicates this availability through the LED. Figure 3 shows the testing of hand gesture sensors in the Arduino Nano Module.

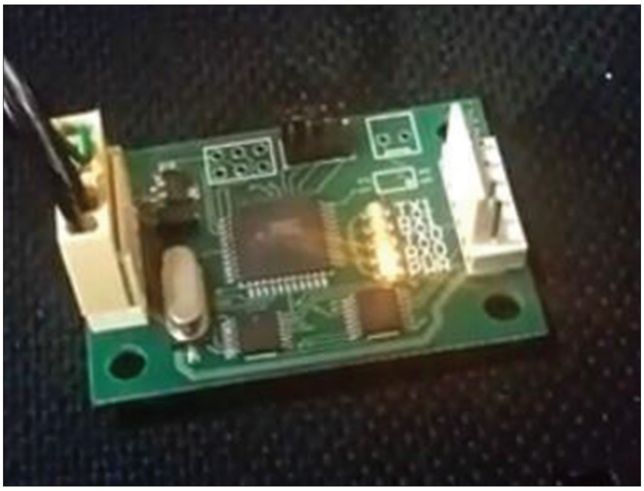

Figure 1: Hand gesture-controlled drone

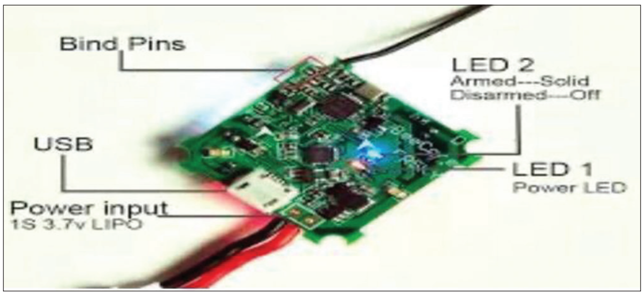

Figure 2: Flight controller

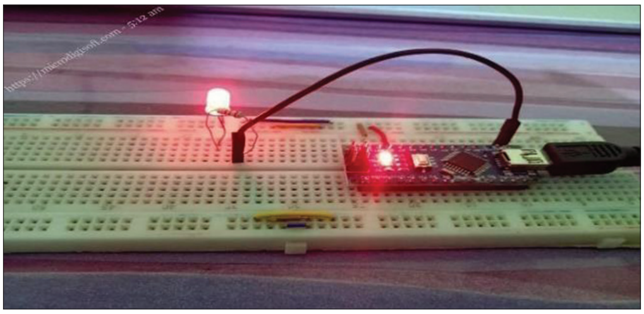

Figure 3: Arduino nano

Solar Panel Testing

The testing of a solar panel for charging involves connecting the solar panel to a charge controller and then linking the controller to the battery or device being charged. Figure 4 shows the testing of the solar panel. Table 1 shows the testing of hand gesture sensors and overall system process.

Flight Controller

The testing of flight control is mainly based on the gesture by hand movement. It indicates this availability through the LED. Figure 2 shows the testing of the flight controller.

Surveillance Camera Testing

The testing of the surveillance camera for infrared mode and normal mode photographs are shown in Figures 4 and 5 shows the testing of solar panels.

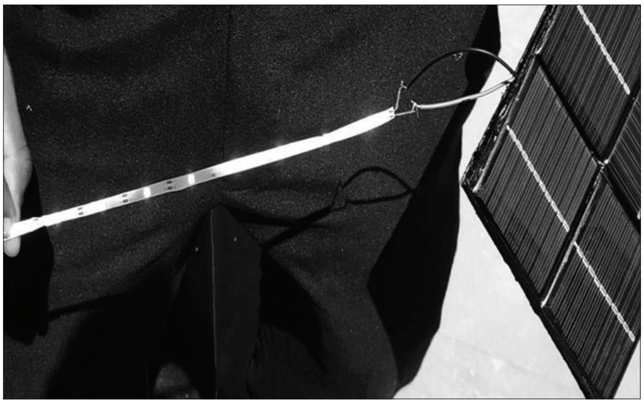

Figure 4: Solar panel

Figure 5: Surveillance camera

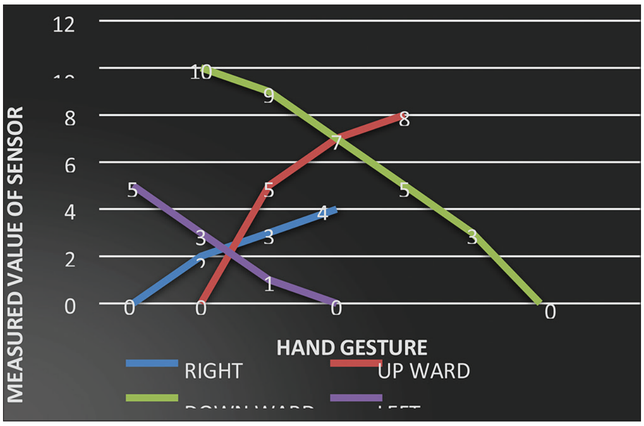

Figure 6: Graphical analysis of drone direction

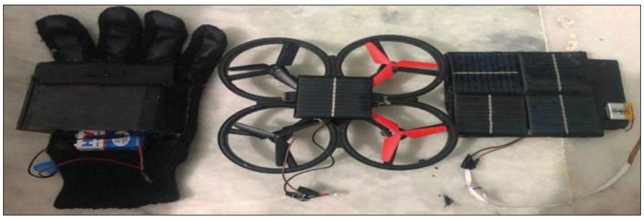

Figure 7: Final prototype hardware

Figure 7 shows the overall prototype hardware model for fabricating the surveillance drone controlled by hand gestures.

Overall System Testing

Table 1 shows a summary of the testing of the overall system and its output parameters.

Table 1: Overall system testing

S. No.	Components	Output
1.	Drone Weight	250 g
2.	Drone Flying Distance	8-10 metres
3.	Motor Thrust Ratio	1:4
4.	Total Thrust per Motor	62.5 g
5.	Motors Voltage	12V
6.	Input Supply	3.7V
7.	Solar Panel Total Voltage	4V
8.	Surveillance Camera	1080P (Photos, Videos)
9.	Propeller Length	65 mm

Graphical Analysis

The graph was plotted between a measured value of the sensor on the y-axis and hand gesture movement on the x-axis, shown in Figure 6.

CONCLUSION

The evolution of hand gesture-controlled drones can be traced back to advancements in both drone technology and gesture recognition systems. With the miniaturization of sensors, including gyroscopes and accelerometers, drones have become more responsive to their environment, enabling real-time gesture interpretation. This synergy has resulted in drones that can accurately interpret a user's hand movements, translating them into precise flight commands.

The applications of hand gesture-controlled drones are diverse and impactful. Moreover, they find utility in industrial sectors for tasks like inspection and monitoring. The paper concludes that hand gesture-controlled drones represent an exciting for kids and surveillance.

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