Remote Controlled Prototype Model for Live Video Surveillance and Leakage Detection

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Abstract

Unmanned Aerial Systems are integral in base defence plans and the protection of key infrastructure. They enable commanders to monitor activity throughout their area of responsibility and direct action, when required. Many policymakers see Unmanned Aircraft Systems as a cost effective alternative to manned aircraft and a way to prevent risking a pilot's life. These systems have a number of advantages over manned aircraft. They are unbound by human limitations.

Keywords: *Unmanned Aerial Systems (UAS), Manned aircraft, Commanders, Cost effective*

1. Introduction

Since as early as 1920, multicopter vehicles have been designed, built, and used to experiment with aerial vehicle designs. The quadrotor or quadcopter design is one example of the many prototypes produced. This particular design uses four identical rotors mounted symmetrically; the result is a very stable flight platform. The video received will be transmitted by digital or analog signals. If the captured video is an analog format it must be converted to digital video after transmission. With a digital signal, the video can be easily processed for analysis and storage. The quadcopter chassis and controller system consists of everything needed to build and control the flying platform in which the camera will be mounted. This includes a frame, DC motors, power supply, rotors, flight control circuit board, flight control software, and an RC controller.

The video transmission system consists of the components that record, transmit, and display the live video to the controller. Included are the camera, transmitter, receiver, and display. The digital video analysis system will take the raw video data, convert it to digital if necessary, and load it into a program. This system will need a video capture card, a computer receiver, and video processing software.

2. Related Works

The history of unmanned aerial flight is long and diverse, reaching back to the early years of military aviation. In [1], Model-based diagnosis and fault-detection systems have been proposed to recognize failures. In this paper it proposed a novel, model-free, approach for detecting anomalies in unmanned autonomous vehicles, based on their sensor readings (internal and external).

In [2], present a new INS/GPS sensor fusion scheme, based on state-dependent Riccati equation (SDRE) nonlinear filtering, for unmanned aerial vehicle (UAV) localization problem. SDRE navigation filter is proposed as an alternative to extended Kalman filter (EKF), which has been largely used in the literature. Results obtained by SDRE navigation filter were compared to EKF navigation filter results.

In [3], A novel hyperspectral measurement system for unmanned aerial vehicles (UAVs) in the visible to near infrared (VIS/NIR) range (350-800 nm) was developed based on the Ocean Optics STS microspectrometer. The ultralight device relies on small open source electronics and weighs a ready-to-fly 216 g.

In [4], an embedded hardware/software architecture specially designed to be applied on mini/micro unmanned aerial vehicles (UAV). A UAV is a low-cost non-piloted airplane designed to operate in D-cube (Dangerous-Dirty-Dull) situations. UAV shares limitations with most computer embedded systems.

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3. Motivation

3.1 Real life Motivation

The fact that the vehicles are unmanned (whether autonomous or not), can lead to greater difficulties in identifying failure and anomalous states, since the operator cannot rely on its own body perceptions to identify failures [1] Moreover, as the autonomy of unmanned vehicles increases, it becomes more difficult for operators to monitor them closely, and this further exacerbates the difficulty of identifying anomalous states, in a timely manner.

3.2 Technical Motivation

In addition to the military uses of the small UAV, we were interested in evaluating applications in the commercial and industrial sector. Our premise was that if smaller and cheaper UAVs become readily available, new markets and uses will emerge. Disaster relief or crop assessment seems also to be likely areas where small UAVs could be useful. [2]We were also motivated by on-campus uses such as monitoring parking or quick-look video of an incident, or monitoring hard to reach locations, or exploration of a collapsed building or other dangerous location.

4. Problem Domain

Quadcopter itself as a system –in this layer- does not aware of anything external including its orientation and angles. Position-Balancing is the act of resisting changing the absolute position of quadcopter. Using Position-Restoring we can achieve the ultimate “Stand-Still” performance, using the correct set of sensors we can reverse actions to keep our quadcopter in the same X-Y-Z position and facing a certain object.

5. Problem Definition and Statement

Live video capturing can be done using a video camera. The videos captured can be seen in a ground system with the required software installed. Gas sensor leakage detection is done with the help of a gas sensor that equipped in the UAV system.

6. Problem Issues

Live videos can be captured with the help of a video camera and it can be saved in a ground system provided. But the videos can be captured only upto a particular height. The leakage detection can be performed only for a particular quantity. The battery equipped in the UAV is need to get charged for the proper flight.

7. Problem Capture

Atmega32 is used as the microcontroller. RF input is given to microcontroller. Electronic speed controller (ESC) controls the speed of the motor by the sequence given. Four ESC’s are there to control the speed of four motors. Accelerometer and gyroscope is connected using the I^2C bus and is connected to the microcontroller. This combination is there to calculate the error cause and to obtain the value. 6 channel receiver receives the signal from joystick and is given to controller.

Video camera captures the live video and produces composite signals. It is then given to the transmitter. We can obtain live videos in the ground system. Combustible gas sensor senses the leakage and amplifies the signal. It is then given to buzzer to produce sound. Both video and audio can be obtained in the laptop.

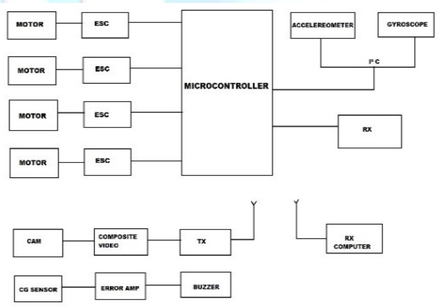

Fig .1. Block diagram of working of UAV

8. Algorithm

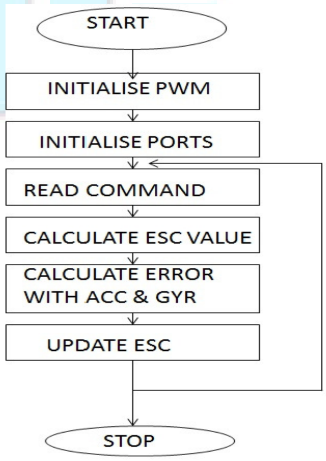

Fig .2. Algorithm of Microcontroller

9. Circuit Diagram

Microcontroller ATMEGA32 is used as the microcontroller. RF signal is given as the input to the controller. Four motors are present for the motion. Electronic speed controller (ESC) is used to control the speed of the four motors. A sequence is generated to control the speed. ADXL335 is used as the accelerometer and IDG-650 is used as the gyroscope. Both are connected by using I^2C bus and is connected to the controller. Error caused by the movement can be calculated by using accelerometer and gyroscope combination and value can be obtained. 6 channel receiver is there to receive the output from the joystick and given to controller.

Video camera is there to capture live videos. Thus it produce a composite signal and given to the transmitter. Receiver connected to the laptop receives the video and it can be viewed and saved. Combustible gas sensor used is MQ135. It senses the gas leakage and amplifies the signal. The amplified signal is given to buzzer to produce sound. Thus live video surveillance and leakage detection is achieved.

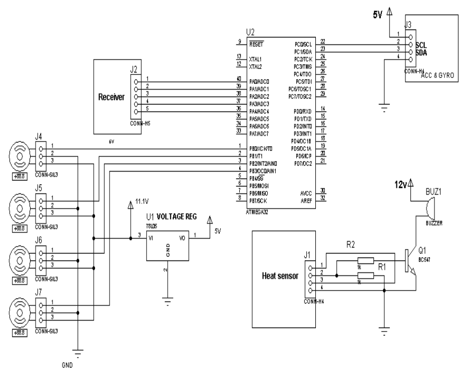

Fig .3. Circuit diagram of working of UAV

10. Input-Output Model

1. ATmega32

Input: 1) DC voltage
2) Battery charge level
Process: Monitoring RF and battery charge levels and convert the output to a signal that turns on the MOSFET driver circuit.
Output: Control Signal

2. Battery

Input: DC voltage
Process: The input DC voltage is stored as charge in the battery.
Output: Charge storage

3. LCD

Input: 1) DC voltage
2) Battery charge level
Process: The RF availability and the battery charge level are displayed in terms of their percentage.
Output: Percentage display of levels

4. ADXL335

Input: Sensor input
Process: It contains a polysilicon surface-micromachined sensor and signal conditioning circuitry to implement an open-loop acceleration measurement architecture.
Output: Analog voltage.

5. IDG-650

Input: Vibration occurs due to rotation
Process: When the sensor is rotated about the X- or Y axis, the Corolis effect causes a vibration that can be detected by a capacitive pickoff. The resulting signal is amplified, demodulated, and filtered to produce an analog voltage that is proportional to the angular rate.
Output: Sensitivity output

11. Results

Model-based diagnosis and fault-detection systems have been proposed to recognize failures. However, these rely on the capabilities of the underlying model, which necessarily abstracts away from the physical reality of the robot [1]. Video surveillance system is working properly and live videos can be viewed and saved. Buzzer produces sound when it exceeds the set value.

Fig .4. Prototype model of quadcopter

12. Comparison of Results

The comparison between the UAV- and the Laser-DSM showed slightly better results as the comparison of the UAV and Laser-DSM with manual measurements. Furthermore, the manual measurements are more time consuming with respect to the automated methods. Therefore, the automated methods are preferred instead of the manual ones.

13. Future Works and Conclusion

A dynamic model of the quadcopter is derived. Deriving this model requires knowledge of rotation matrices which converts forces between different reference systems. Voltage and current sensors are also doing good job and is a vital part of the controller board which needs a certain volt in order to operate. There is also room for even more sensors and maybe a IP-camera for visual recognition. It is relatively easy to program and to expand to more advanced tasks.

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