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QUADCOPTER VIDEO SURVEILLANCE UAV

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ABSTRACT:

Wireless Sensor Network (WSN) deployed terrestrially to detect and track trespassers, and a set of lightweight unmanned aircraft vehicles (UAVs) in the form of quadcopters that interact with the deployed WSN to improve the border surveillance, the detection and investigation of network failures, the maintenance of the sensor network, the tracking of trespasser, the capture and transmission of real time video of the intrusion scene, and the response to hostage situations. A heuristic-based scheduling algorithm is described to optimize the tracking mission by increasing the rate of detected trespassers spotted by the quadcopters. Together with the design of the electrical, mechanical and software architecture of the proposed VTail quadcopter, we develop in this paper powerless techniques to accurately localize terrestrial sensors using RFID technology, compute the optimal positions of the new sensors to drop, relay data between isolated islands of nodes, and wake up sensors to track intruders. The developed VTail prototype is tested to provide valid and accurate parameters' values to the simulation. The latter is conducted to evaluate the performance of the proposed WSN-based surveillance solution.

INTRODUCTION

The development of unmanned aerial vehicles (UAVs) has been growing significantly over the last decade. UAVs have been expanding from military applications into civilian purposes like aerial photography, field surveillance, and disaster relief. However, most are often found to be expensive and difficult to deploy. To address these issues, this project sought to implement a lightweight drone capable of performing surveillance while communicating in real time to the user. Before the team could establish project specifications, they conducted extensive background research to gain a deeper understanding of the current technological advancements within the drone industry. Though modern-day technology is quickly advancing and improving UAVs and drones, developments in this field began decades ago, even before the first manned airplane flight occurred in 1903. The first and most primitive designs centered on balloons. The first attempts began in France in 1782 by the Montgolfier brothers. These attempts continued through the years, one of which was developed by Charles Perley in February 1863, two years after the Civil War began.Perley attempted to design an aerial bomber, a hot-air balloon that carried explosives in its basket. The explosives were attached to a timing mechanism, and upon the timer going off, the explosives dropped out and a fuse was ignited. However, due to the unpredictability of air currents and weather patterns then, Perley's aerial bomber was never successfully deployed and experimentation into other designs was expanded. Another model reliant upon wind and weather was a surveillance kite.

BLOCKDIAGRAM

Fig:working of Quadcopter

The working of quadcopter by the propulsion system (motors, electronic speed controllers and propellers) are the drone technology, which move the UAV into the air and to fly in any direction or hover. On a quadcopter, the motors and propellers work in pairs with 2 motors / propellers rotating clockwise (CW Propellers) and 2 motors rotating Counter Clockwise (CCW Propellers).

The main objectives of the quadcopter are:

- Localization of terrestrial sensors and detection of sensing and transmission coverage holes
- Detection of several types of nodes failures, such as battery depletion, and routing problems.
- Transporting and dropping of lightweight sensor nodesof coverage holes by dropping sensors at suitable positions.
- Relaying of data between isolated island of BSN nodes, and between isolated DRNs and the NCC.
- Tracking of objects crossing the border by capturing and transmitting real-time video of the intrusion area.
- Waking up of isolated sensors to track mobile trespassers and trace their trajectory.

The use of quadcopters for enhancing the quality of border surveillance offers several advantages. First, it is able to fly over hazardous and risky areas, allowing to prevent the loss of human life. Second, it is an inexpensive platform that can be built from scratch using components available in the market, and easily assembled due to its non-complex mechanical architecture. Third, it does not rise safety and legislative issues thanks to its small dimension and ability to fly at very low altitude. we should mention that such advantage is granted to quadcopter unless some conditions are satisfied including: (i) The quadcopter should not fly over or within 150 meters of a congested area or an organised open-air assembly of more than 1,000 persons; (ii) The quadcopter should not fly within 50 meters of any vessel, vehicle or structure which is not under the control of the person in charge of the aircraft; and (iii) The quadcopter should not fly within 50 meters.DESIGN

To achieve the aforementioned objectives we design a quadcopter that has the following characteristics. First, it represents a mobile sensor that is able to communicate with the WSN deployed on the ground. Second, it is able to perform a long distance communication with the NCC using a packet oriented service connection (such as 3G or rural mobile network) to receive navigation data, transmit the locally collected data, and relay data between isolated nodes. Third, it can be remotely piloted and controlled over thousands of meters, and is able to fly at a tunable altitude (up to several tens of meters). Fourth, it is equipped with a set of on-board sensors for safe flying (e.g., Attitude and Heading Reference System (AHRS), GPS receiver, 2DLIDARobstacle detection, compass, and accelerometer).

Fifth it has an attached camera to capture high-resolution images and real-time videos of the intrusion scene. The images and video will be processed by a computer vision algorithm to minimize the rate of false alerts. Sixth, it can transport and drop tiny sensor nodes. In order to reduce to the maximum possible the overhead of the energy required by terrestrial sensors to respond to the requests generated by the quadcopter, we introduce the use of Radio Frequency energy harvesting techniques to powerlessly localize sensors and collect and modify configuration data

Electrical Architecture

The electrical architecture shown in Figure 2, is centred around the use of a well-known flight controller called the KK2 Board made by RC store HobbyKing. This board uses the Atmega324 PA, an 8-bit microcontroller operating at 20MHz with 32 general purpose input/output pins, I2C communication protocol, Universal Asynchronous Receiver/Transmitter (UART) serial communication line, and analog to digital conversion (ADC) channels.

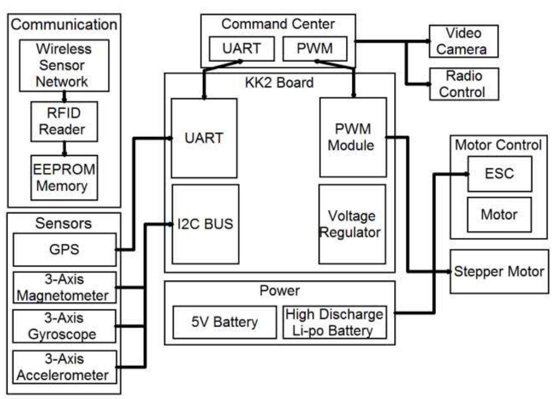

Fig 2: Electrical Architecture

The KK2 Board has a library of preinstalled software to compute and set the different orientations of quadcopters, which is especially useful since the VTail form is rarely supported. This board is responsible for sending pulse width modulated (PWM) signals ranging from 1.5ms to 2.0ms every 20ms to four electric speed controllers (ESCs).

Hardware And Software Architecture

In the case where a sensor is damaged or is malfunctioning in the field, the UAV will need to be able to retrieve the data from the broken sensor and replace it with a working one. A workable solution is to attach a magnetic locking mechanism to the base of the quadcopter. In there is a permanent magnetic ring on the bottom of the structure. That ring will hold the top of the sensor to be deployed on the ground. The way that the UAV drops the sensor is by a stepper motor-driven threaded turning rod that passes through a hole in the base of the structure, making the platform able to move upwards. The rod will physically push the top of the sensor down to create enough to separate the sensor from the magnetic ring, dropping the sensor on the ground in its designated location. The stepper motor is controlled by a channel on the KK2 board as seen in Figure 2.

Simulation

Each BSN or DRN is able to estimate the remaining lifetime by calculating the average energy consumption in J/S over a history period. Before its lifetime reaches a threshold value T h, a node forwards a notification to the NCC which intervenes by sending a quadcopter to replace that node and consequently extend the network lifetime. We suppose that the time of intervention of the quadcopter is constant and defined as the total time required to:

- fly to the suitable zone.
- compute the position of the new BSN to drop.
- drop the new BSN.
- wait for the new BSN to attach itself to the network.
- read the BSN's WISP to check whether the routing table of the BSN has a new route to the DRN.

ADVANTAGES

- Small-scale quadcopters have frames that enclose the rotors, permitting flights through more challenging environments, with lower risk of damaging the vehicle or its surroundings.
- Small-scale UAV's make the vehicles safer for close interaction.
- Quadcopters do not require mechanical linkages to vary the rotor blade pitch angle as spin. This simplifies the design and maintenance of the vehicle.
- Lightweight, easy takeoff and landing.
- **Quality Aerial Imaging**: Drones are excellent for taking high-quality aerial photographs and video, and collecting vast amounts of imaging data. These high-resolution images can be used to create 3D maps and interactive 3D models, which have many beneficial uses. For example, 3D mapping of disaster areas can enable rescue teams to be better prepared before entering hazardous situations.
- **Easily Deployable**: With advances in control technology, most drones can be deployed and operated with relatively minimal experience. Combined with the relatively low cost of most models, drones are becoming accessible to a wide range of operators. UAVs also have a greater range of movement than manned aircraft. They are able to fly lower and more directions, allowing them to easily navigate traditionally hard-to-access areas.

APPLICATIONS

- Inspection.
- Broadcasting.
- Border Security.
- Traffic analysis.
- Environmental protection.
- War Reporting.
- Filming Movies.

CONCLUSION

Though this was an ambitious project, a lot of preliminary designs were considered during the research in order to develop a versatile quadcopter that would serve as a tool to undertake Aerial Security Surveillance System. The anticipated results from the design of the quadcopter were as follows:

1. The designed quadcopter should weigh at least 1.5Kgs.
2. The quadcopter should take off and land safely.
3. The quadcopter should take all commands given and interpret them effectively
4. The quadcopter should hover laterally and vertically with ease.

The prototype designed is user friendly and can be easily used to satisfy the specific goals outlined in chapter one, among all the above anticipated results the designed Quadcopter was able to take off and landing safely was achieved. 46 The quadcopter had a problem with constant lateral motion thus making control an issue that after doing the test analysis, the control and flying the quadcopter was a big challenge, lastly the quadcopter crashed several times before learning proper control and flying

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