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Drone for Automatic Localization and Counting the Animals

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Abstract: ***This project is concerned with nature conservation by automatically monitoring animal distribution and animal abundance. Typically, such conservation tasks are performed manually on foot or after an aerial recording from a manned aircraft. Such manual approaches are expensive, slow and labor intensive. In this project investigation the combination of small unmanned aerial vehicles (UAVs or \drones") with automatic object recognition techniques as a viable solution to manual animal surveying. Since no controlled data is available, record our own animal conservation dataset with a quad copter drone. This project evaluate two nature conservation tasks: i) animal detection ii) animal counting using three state-of-the-art generic object recognition methods that are particularly well-suited for on-board detection. Results show that object detection techniques for human-scale photographs do not directly translate to a drone perspective, but that light-weight automatic object detection techniques are promising for nature conservation tasks.***

Keywords: Arduino Uno Board, Radio Transmitter, Bldc Motor, Propeller, Web Camera

1. Introduction

A quad copter or a quad rotor helicopter is a multi rotor copter that is lifted and propelled by four rotors. All the four arms have a motor and a propeller at their ends each. The lift is generated by a set of rotors and vertically oriented propellers, hence quad copters are classified to rotorcrafts. They are also referred to as pre-programmed missions. A quad copter uses 2 sets of identical fixed pitched propellers; 2 clockwise (CW) or in one direction and 2 counter-clockwise (CCW) or opposite direction. This helps the machine to hover in a stable formation. This is unlike most helicopters. Control of vehicle motion is achieved by altering the rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics. These use variation of RPM unit (revolutions per minute) to control lift and torque.

Quad copters are known by different names, including: quad rocopter, quad rotor, quad-copter, UAV (Unmanned Aerial Vehicle), UAS, or drone. There are series of bi copters (two blades), tri-copters (three blades), quad copters (four blades), hexa-copters (six blades), and octocopters (eight blades). The multi rotors with a high number of blades are designed to carry a heavier payload, for efficient yaw smoothness and for efficient lift capacity. According to the efficiency needed for a particular task, respective series may be used.

A helicopter has one big rotor to provide all the lifting power and a little tail rotor to offset the aerodynamic torque generated by the big rotor. Without it the helicopter would spin almost as fast as the propeller. But a quad rotor's all four rotors work together to produce upward thrust and only 1/4 of the weight is lifted by each rotor. So less powerful motors are used, making it cost efficient. The quad rotor's movements are controlled by varying the relative thrusts of each rotor. The quad copter allows a more stable platform, making it ideal for tasks such as surveillance and aerial photography, attributing to its unique design

2. Block Diagram

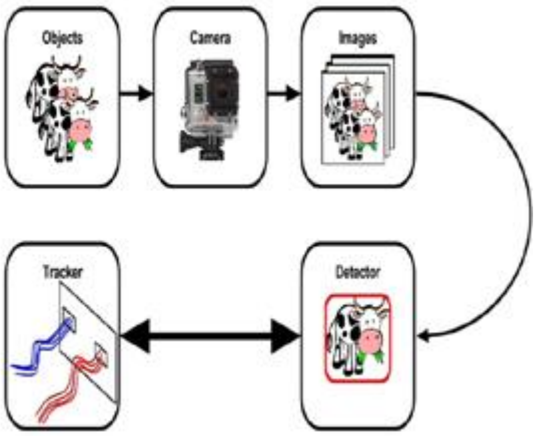


Figure 1: Block diagram of proposed system.

The ESC controls the speed of an AC motor with frequency, not voltage. If you plug an 11.1 volt battery into your power system, you have 11.1 volts going to the motor with the full amperage potential of the battery backing that voltage. The AC brushless motors we use are true 3-phase AC motors. The motors DO run on AC current. The ESC is a trapezoidal wave generator. It produces 3 separate waves (one for each wire to the motor). The speed of the motor has nothing to do with voltage or amps, but instead the timing of the current fed into it. By increasing and decreasing the wave length (frequency) of the trapezoidal wave on the 3 phases, the ESC causes the motor to spin faster and slower.

The ESC switches the polarity of the phases to create the waves. This means that the voltage through any given winding flows 'Alternately' one direction then the other. This creates a push-pull effect in the magnetic field of each winding, making the motor more powerful for its size and weight. The motor and the load that is placed on it, is what determines the 11 amp draw from the ESC and the battery. In the below picture, we have 2 motors with 3 poles each. Their windings are labelled as poles “A”, “B”, and “C”. The graph (under the 2 motors) shows the 3 separate waves that the

ESC generates to drive a motor. The graph shows the signals time to voltage relationships.

The black wave on the graph is the signal that is sent to winding “A”. The red signal goes to winding “B”, and the blue signal goes to winding “C”. If you look at "AC Motor 1" and "AC Motor 2", and the signals shown on the graph that are sent to the windings; it is easy to see that when we swop any two motor connections, we change the order that the waves hit the windings, and that changes the direction of the motor.

3. Circuit Diagram

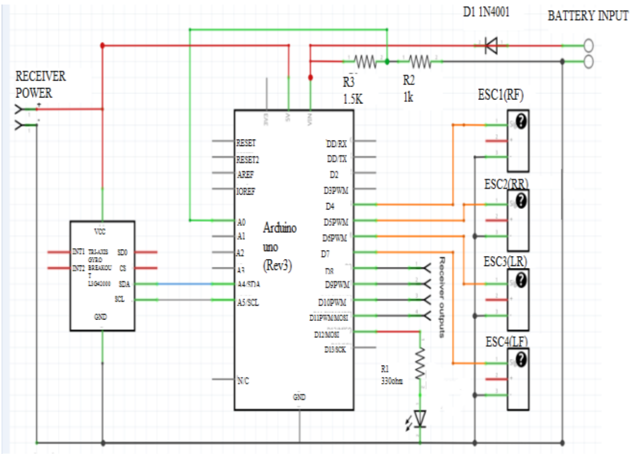


Figure 2: Circuit Diagram

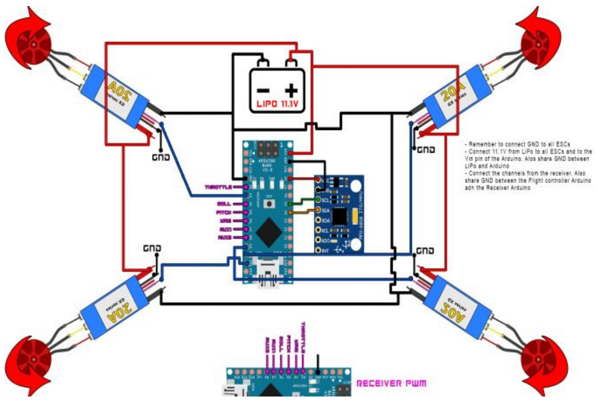


Figure 3: Hardware Framework

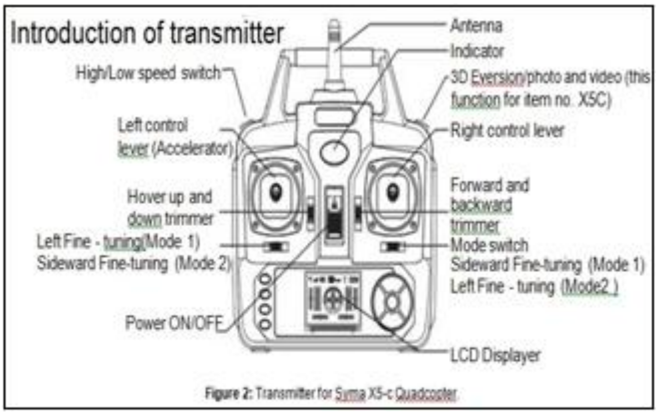


Figure 4: Transmitter

Transmitter/remote controller

The drone is accompanied with a remote controller (Figure 2). The remote controller interfaces with an on-board receiver that in turn controls the motion of the rotors and the speed of rotation as the case may be. It works with a radio frequency with a range of 2.4 GHz.

High/low speed switch

This button regulates the speed of directional transit of the drone. Basically it throttles the speed of sideways transition of the drone.

4. Results

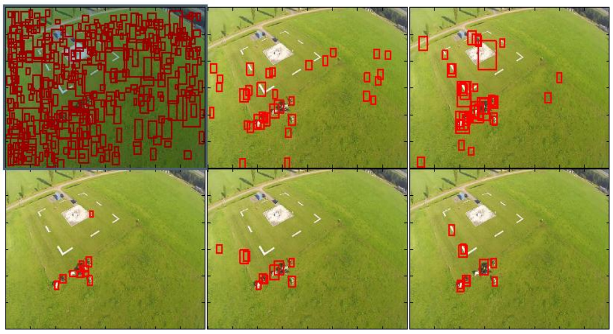
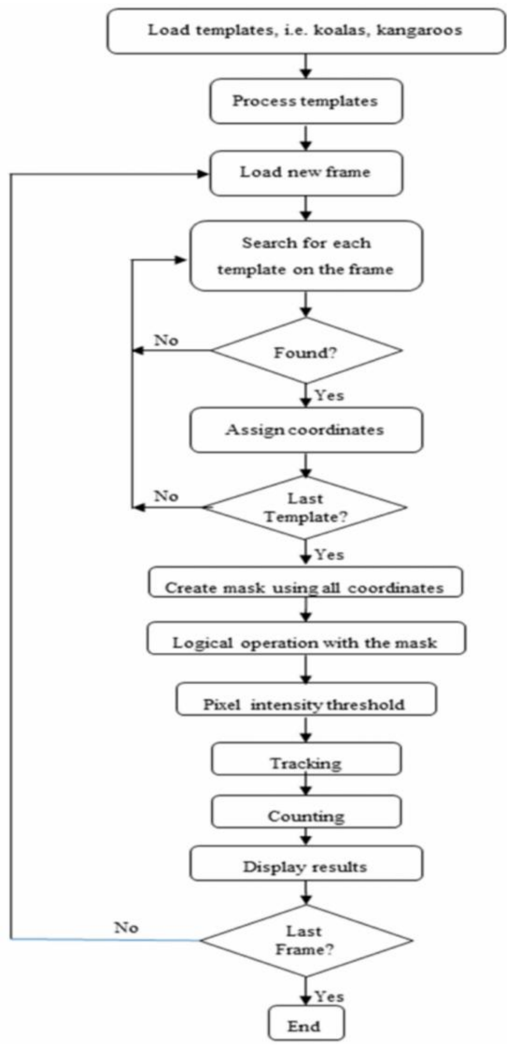


Figure 5: Result

Frame principle: Frame is the structure that holds all the components together. The Frame should be rigid, and be able to minimize the vibrations coming from the motors. Quad copter frame consists of two to three parts which don’t necessarily have to be of the same material;

- The center plate where the electronics are mounted
- Four arms mounted to the center plate
- Four motor brackets connecting the motors to the end of the arms Most available materials for the frame are
- Carbon Fiber
- Aluminum

Wood, such as Plywood or MDF (Medium-density fiberboard) Carbon fiber is most rigid and vibration absorbent out of the three materials but also the most expensive. Hollow aluminum square rails are the most popular for the Quad copters’ arms due to its relatively light weight, rigidness and affordability. However aluminum could suffer from motor vibrations, as the damping effect is not as good as carbon fiber. In cases of severe vibration problem, it could mess up sensor readings. Wood board such as MDF plates could be cut out for the arms as they are better at absorbing the vibrations than aluminum. Unfortunately the wood is not a very rigid material and can break easily in Quad copter crashes. As for arm length, the term “motor-to-motor distance” is sometimes used, meaning the distance between the centers of one motor to that of another motor of the same arm in the Quad copter terminology.



Flow Chart

Scope of Project

- Animal detection
- Automatic object detection
- Animal Counting

5. Conclusion

In this thesis, the suitability of current automatic object detection methods as designed for human-centred objects for nature conservation on a drone is investigated. Imagery taken from a conservation drone is typically much smaller and has a viewpoint from above. Two tasks: (i) animal detection and (ii) animal counting are defined, which are both important for monitoring animal distribution and animal abundance as typically required for successful cattle farming.

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