Design and Fabrication of Obstacle Detection and Warning Unmanned Aerial Vehicle

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***Abstract*: We are going to demonstrate an innovative and simple solution for obstacle detection and warning system to avoid collision of unnamed aerial vehicle (UAV) optimized for and evaluated with quad copters .The sensors we are going to use are low cost ultrasonic and infrared range finders .There are also more expensive sensors such as laser sensors. This needs to be taken into consideration for the design, implementation, and parameterization of the signal processing and control algorithm for such a system. As a result, a UAV is capable of distance-controlled collision avoidance, which is more complex and powerful than comparable simple solutions. Thus, memory and time-consuming simultaneous localization and mapping is not required for collision avoidance. Some of the major problem in flying a UAV are air safety, insurance and crowed skies which give disadvantages for a UAV to fly in air, it is a simple and innovative solution by designing and fabricating an obstacle detection and warning UAV. while using less power this makes them well suited for long distance missions, such as mapping, surveillance and defense, where long endurance can be an important factor this system can be used in military and civil purpose**

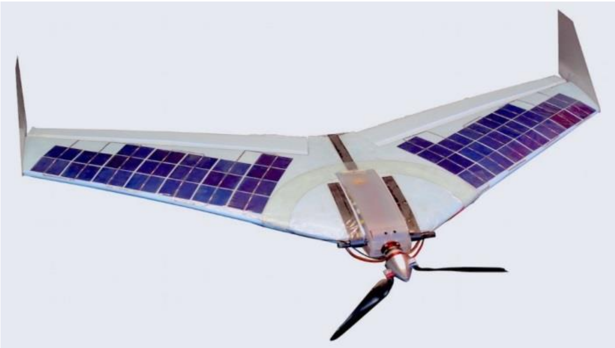
INTRODUCTION

1.1 Background of Project

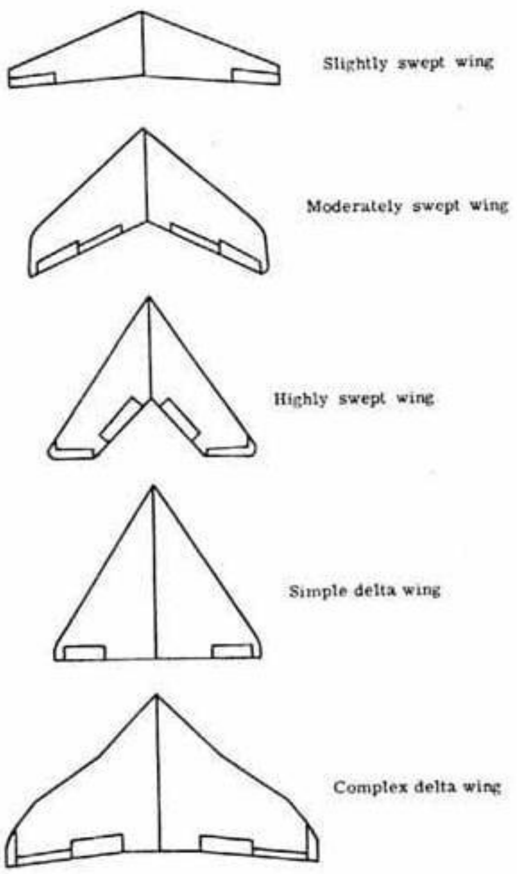
Developing an unmanned aerial vehicle has been one of the main points of concern by many counties all the world; about 70 different counties have some sort of UAV technology. UAV expenditures reached more than US$ 3 billion and constituted a growth of more than 12% in 2010.Approximately 70% of global growth and market share is in the US. UAVs are used to gather information from the air in hostile areas. they can also be used in devastated areas where may support may not be available. These types of UAVs must be portable by ground and very reliable for recurrent use. with these types of uses by the military the UAVs designed are very costly and have very specific uses designed for each. The goal for the UAV design is to provide a cheaper alternative to these very costly military products.

1.2 Selection of Wing

In this section, six design configuration structures will be considered i.e., basic airframe configuration, wing configuration, straight wing, tail configuration, fuselage material, and propeller location. Three vertical wing positions against the fuselage will be considered. There are four things to consider, namely the ease of manufacturing process, stability, ease of hand launch, and ground clearance. Three types of fuselage materials are presented in this study. There are five things to consider, namely the ease of manufacturing process, structural strength, price, availability, and weight of the structure.



Delta wing is commonly used for high speed application as its advantage can sustain lift force at higher angle of attack. Nonetheless, delta wing configuration also can be applied in micro air vehicle (MAV) and unmanned aerial vehicle (UAV) because its weight effectiveness and the structure of a delta wing that is rigid. Delta wing produced more lift at higher angle of attack because of the vortex formed near the leading edge. Strong vortices generate at higher angle of attack produce high speed flow above the wing, resulting in low pressure region above the wing



1.3 Material Selection

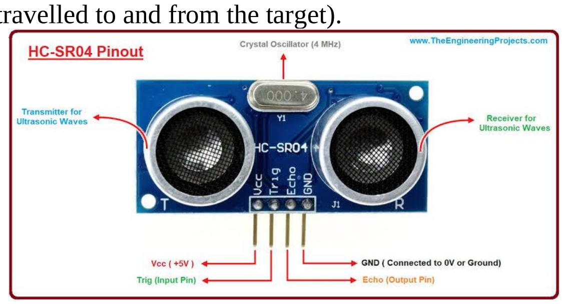
The foam board does not handle the wet grass so we take the coroplast for the aircraft, also the Transportation takes a beating on the foam, and it starts to look ratty, but not on the coroplast.

SPADs are preferred to other materials because they are cheaper and are easy to work with, painting is not required, the plastic can optionally be decorated with vinyl sheets which are available in any signboard making shop at very cheap price. The hinges for the control surfaces can be made by sheering one of the twin walls of the plastic sheet and no special hinging device is required. SPAD Modellers use corrugated plastic sheets of various thickness, such as 2 milli meter (like the flying wings [4] or electric gliders for which 2mm sheet are preferred) and 4 milli meter. These sheets are generally used by signboard makers and many times, when these sheets are discarded, the modellers have a choice to use them to build model airplanes. The choice of propulsion can be either internal combustion engine or electric motors as with balsa counterparts. Corrugated plastic planes are simpler alternative to the traditional balsa wood based R.C. aircraft for a variety of situations. Most of the SPAD airplanes do not use balsa which saves considerable cost. They withstand crashes better than balsa counterparts because of their resilience and hence are a good choice for beginners. Good trainer planes and gliders can be made from SPADs. SPAD modellers make equally good advanced planes that can be made with corrugated plastic. They include: RC Airplane Combat, 3D Flying, and are preferred in places where the flyers would normally not risk a more expensive plane and yet want the same flying characteristics of balsa planes. For making a SPAD plane, the modeller (usually a beginner) can copy the dimensions of a well-known balsa trainer and makes the SPAD plane using the same dimensions and adapting to the building techniques of a SPAD plane. The plane can also be built from plans or can be scratch built (usually, the modeller draws his/her own plans and makes the plane, though this is mostly attempted by experienced modellers)

Corrugated plastic goes by a number of names including corkboard, Pollute, Flute last, Propleg, Cortex, Twin last, Correlate, Corf lute, etc. Above all, Coroplast is the most common brand name for corrugated plastic sheets. Corrugated plastic is a type of plastic cardboard that consists of three layers of polypropylene plastic substrate. The two external layers, which are known as twin-wall plastic sheeting due to their uniform design and parallel positions, hold together an internal layer of honeycomb-shaped plastic. This makes corrugated plastic sheets one of the most lightweight, versatile, and shock-absorbent plastic materials on the market. Polypropylene is an extremely sturdy thermoplastic polymer with a neutral pH that allows it to withstand all kinds of external temperature, weather, and usage conditions for long periods of time with minimal wear and tear.

2. CONCEPT OF ULTRASONIC SENSOR

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

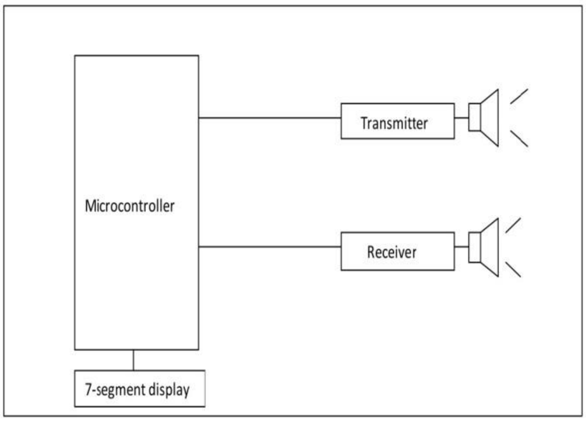


Ultrasonic sensors are also used as level sensors to detect, monitor, and regulate liquid levels in closed containers (such as vats in chemical factories). Most notably, ultrasonic technology has enabled the medical industry to produce images of internal organs, identify tumours, and ensure the health of babies in the womb. This is the HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.

There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). You will find this sensor very easy to set up and use for your next range-finding project. This sensor has additional control circuitry that can prevent inconsistent "bouncy" data depending on the application.

The ultrasonic distance meter account the amount of time taken by measures the distance by taking into account the amount of time taken by the pulse to travel to a target and return as reflected echo and also the speed of the pulse. The device calculates the distance up to 2.5m and at a temperature of 25*C and displayed on a seven-segment display. Here two ultrasonic transducers are used one each ai transmitting and receiving end. A microcontroller AT89C205 is used which act as the brain of the device which carries out all the major functioning. The system consists of a transmitter circuit and a receiver circuit, the details of which are described below. Fig shows the principle of ultrasonic distance meter.

The transmitter section consists of a transistor which amplifies the 40KHz pulse generated by the microcontroller. The ultrasonic transducer which is used as a transmitter is driven by an inverting buffer. A set of three parallel inverter are used to increase the transmitted power. The output of this set of parallel inverters are given as input to the another set of parallel inverters. Then the output of both these parallel inverters is given as input to the two terminals of the ultrasonic transducer at the transmitting end. One of the inputs given to the terminal of the transducer is the positive going pulse and the other terminal is given 180 phase shifts of the same input. This is done in order to increase the transmitted power. Thus, the ultrasonic transducer at the transmitting end generates a 40 KHz pulse which hits the target and return back as reflected echo.



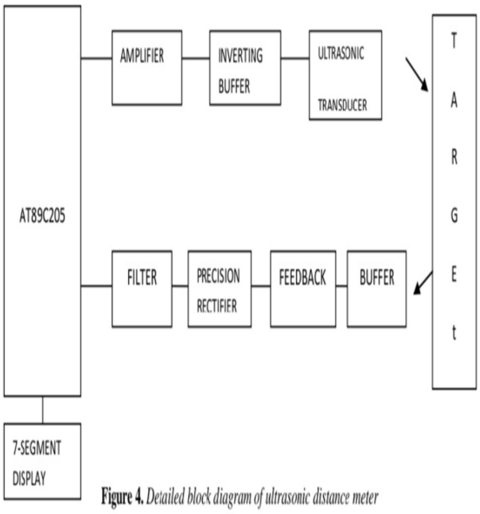


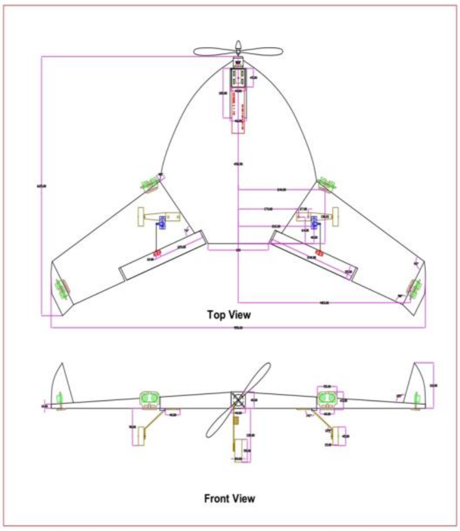
Figure 4. Detailed block diagram of ultrasonic distance meter

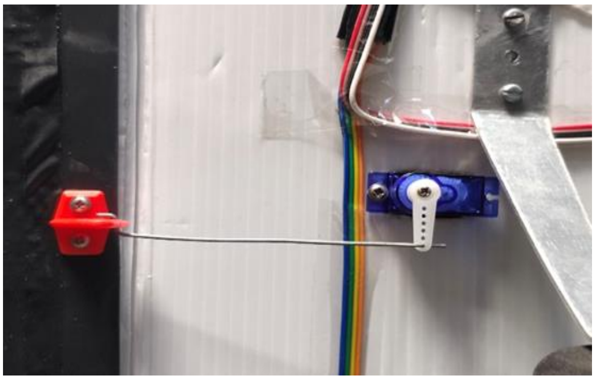
3. DESIGN CONFIGURATION

The plans are usually laid out using the values from the real models and scaling it down to a higher scaling factor. This at the end gives us a layout with different dimensions but regulated by a common factor of orientation. For example, may be the length of the wing may be considered as a common factor and all other dimensions are given as a multiplier of the length of the wing. This enables easy construction and improved adaptability to changes. We choose a Russian Biplane model and an already available scale down model plan is adapted for guidance and the flight is built over it. The flight plan is shown in the figure. The weight of the flight is given importance and the whole flight is built using chore sheet, the properties of which are discussed latter in the report. The main frame is constructed in the balsa wood and then the chore sheet is used to surface the body and the wings. The high resistivity and toughness of the sheet helps in withstanding the air forces encountered on the flight course. The materials are to be cut with precision and the uncut edges, corner chips and sanding problems are to be eliminated by filing smooth, laser cut and the adhesive bonding. To keep sanding minimum, try to cut all parts as accurate as possible including spars, longerons, wing leading edge sheeting etc. This will save time of replacing broken parts. It is advised not to cut the plan over as it will lead to formation of ribbons and hence reducing the aero – properties of the structure.

3. CONSTRUCTION OF MODEL

The basic understanding of the aerodynamic concepts and the correct scaling down methods can enable a designer to build a successful RC flight. This construction has an advantage of understanding the properties of the materials used, mechanisms design, concept creation and grading the components. The quality of the materials has to be given consideration for long life of the flight and better functionality.





3. COMPONENTS OF MODEL

Scorpion 2208-1100 V2 Brushless Outrunner Motor

Specifications	
Stator Diameter	22.0 mm (0.866 in)
Stator Thickness	8.0 mm (0.315 in)
No. of Stator Arms	12
No. of Magnet Poles	14
Motor Wind	28 Turn Delta
Motor Wire	3-Strand 0.21mm (31 AWG)
Motor Kv	1100 RPM / Volt
No-Load Current (Io)	0.41 Amps @ 10 Volts
Motor Resistance (Rm)	0.170 Ohms
Max Continuous Current	12 Amps
Max Continuous Power	130 Watts
Weight	45.0 Grams (1.59 oz)
Outside Diameter	27.9 mm (1.098 in)
Shaft Diameter	2.98 mm (0.117 in)
Body Length	26.0 mm (1.024 in)
Overall Shaft Length	45.0 mm (1.772 in)

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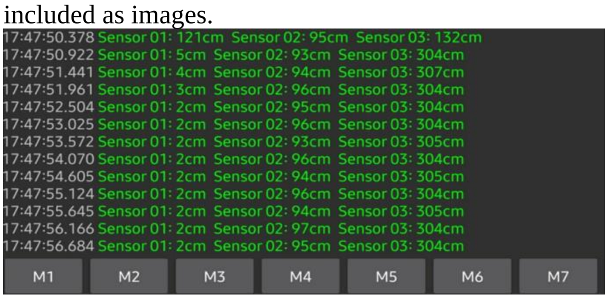
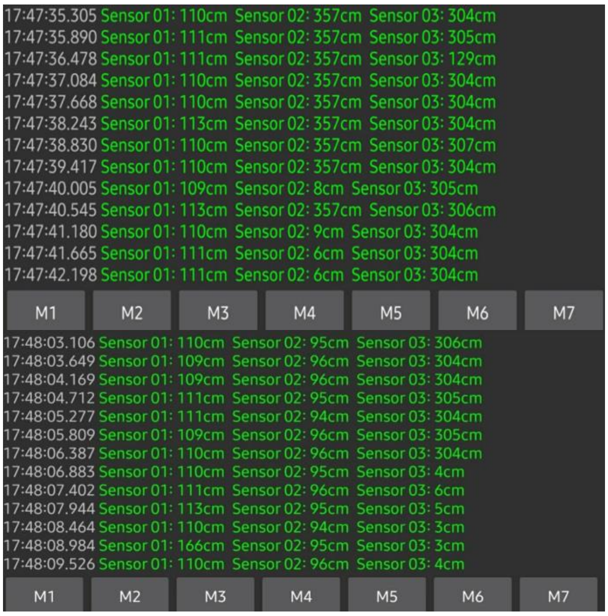
4. TESTING AND RESULTS

The obstacle detection UAV is constructed and operated successfully. The theories and test results behind the successful project are compiled in order, and the steps of construction are explained in general and complete machining steps are explained. Pictures supporting the mechanisms, parts and procedures are also included for illustration.

As we used ultrasonic HC-SR04 sensor for the detection of obstacle with distance at a suitable accuracy and resolution. The detection results of the sensor have been included as images.





5. CONCLUSION

The objective of the project was to design and implement an ultrasonic distance meter. The device described here can detect the target and calculate the distance of the target. The ultrasonic distance meter is a low cost, low a simple device for distance measurement. The device calculates the distance with suitable accuracy and resolution. It is a handy system for non-contact measurement of distance. This device will also have its application in civil and mechanical field for precise and small measurements. For calculating the distance using this device, the target whose distance is to be measured should always be perpendicular to the plane of propagation of the ultrasonic waves. Hence the orientation of the target is a limitation of this system. The ultrasonic detection range also depends on the size and position of the target. The bigger is the target, stronger will be the reflected signal and more accurate will be the distance calculated. Hence the ultrasonic distance meter is an extremely useful device.

6. REFERENCES

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