International Journal of Advanced Research Methodology in Engineering & Technology,
Special Issue, March 2017, ISBN 978-1-63535-324-2

SELF DETECT COLLISION AVOIDANCE IN AIRCRAFT USING RSSI

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Abstract: **- The idea of ' Sense and Avoid' in unmanned aircraft is receiving considerable attention to avoid collision. One approach to reduce or avoid the aircraft collision can be obtained by using the concept of Received Signal Strength Indication (RSSI). This paper focuses on using the RSSI concept in aircraft, to implement a nearby Sense and avoid in the form of Self Detect Collision Avoidance (SDCA) module. The signals which are generally emitted by the aircrafts are recognized by the SDCA module and the signal strength is determined. The SDCA module after obtaining the strength of the signal calculates the distance from the intruder and the time remaining for collision using the RSSI concept. For different levels of signal strength different forms of warning are issued through look up display and audio form to pilot and decision regarding the change in the direction is made after consulting with the intruding aircraft. This is possible only if the two aircrafts have SDCA system installed on board. Communication between aircrafts is possible through SDCA modules without the involvement of the Air Traffic Control(ATC). In case the signal strength reaches the threshold level set, and there is a lack of pilot response then the SDCA module automatically deviates the aircraft from its scheduled path, by sending commands to the controller automatically to change the direction of actuators through the 'Fly by Wire' technology. Hence SDCA avoids collision due to pilot error also. When SDCA is installed only on one of the aircraft , then this aircraft alone is being deviated from its desired direction to avoid collision It is also equipped with a sensor to detect obstacle and avoids collision.**

***Index Terms*—** **Collision Avoidance, Fly by wire, RSSI, self detect, sense and avoid**

I. INTRODUCTION

The major threat to air passengers is the accidents due to Mid air collision. A large number of accidents and more than thousands of close calls in which the accidents were narrowly avoided have been reported in the recent years. Mid air collision occurs when two or more aircrafts come into an unplanned contact during their travel. The various reasons for the collisions to occur in an aircraft are - traveling on unscheduled path or altitude, pilot error, obstacles, mechanical error, etc. In order to reduce the number of accidents, the developing technology has found many ways. The existing collision avoidance techniques are more generally based on navigation systems such as Radar, GPS, Wi Fi triangulation or cell triangulation. But these systems reduce the risk of collision to only a certain extent. The self detect collision avoidance (SDCA) system will further more reduce the possibility of collision to occur.

II. LITERATURE SURVEY

The most commonly used collision avoidance system is the traffic collision avoidance system (TCAS), in which the TCAS system actively monitors the airspace around an aircraft. TCAS can detect only aircrafts equipped with TCAS and warns the pilot about the presence of an aircraft nearby. The transponder with altitude reporting will send interrogations containing information about the position of the aircraft as well as requesting the position of the nearby aircraft. Depending upon the position of the intruder, the TCAS issues traffic advisories (TA) and resolution advisories (RA). TCAS is costly and is installed in commercial aircrafts. Portable collision avoidance system (PCAS) is a passive version of TCAS. PCAS is less expensive and is designed for general aviation purpose. PCAS transponders only listen to the responses from the interrogations of other transponder.

The proposed self detect collision avoidance operates similarly to TCAS. It uses the RF signal transmitted by the aircraft for various purposes and calculates their strength to determine the possibility of collision to occur. SDCA does not require the intruding aircraft to be equipped with SDCA.

III. METHODOLOGY

A. SYSTEM DESIGN

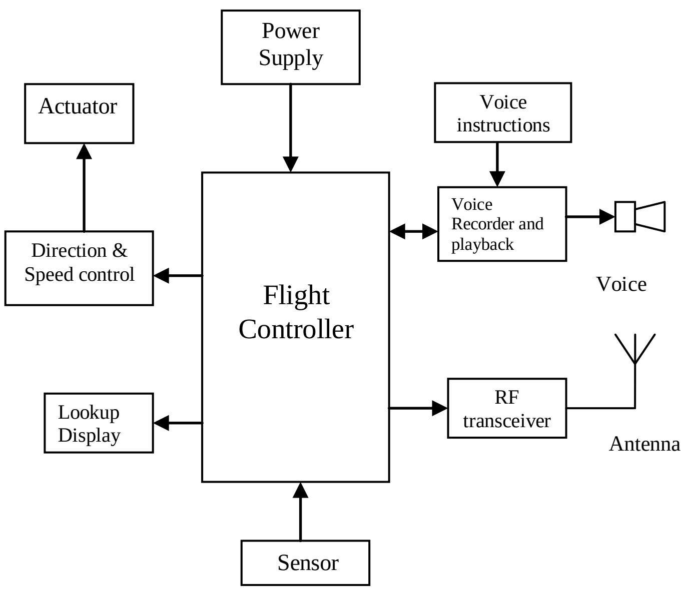

Fig1 : block diagram

B. RECEIVED SIGNAL STRENGTH INDICATION:

Received signal strength indicator is a measure of the strength of the Radio frequency (RF) signal received from other aircrafts in the surrounding airspace. The transceiver used in the aircraft transmits and receives RF signal for many purposes. This signal is used to determine the distance from the other aircraft. The signal transmitted by an aircraft nearby is received by the flight controller and the power or signal strength of the signal is determined. By, knowing the RSSI value, the distance of the intruder from the aircraft is determined by using the relationship between the distance and the value of RSSI.

The speed in which the aircraft is traveling is a known data to the flight controller, by using this value and the calculated distance value the controller determines the time left for collision. The look up display contains information such as the time left for collision, distance the aircraft is from intruder and the RSSI value.

For different values of RSSI different means of warnings are issued to the pilot, through the look up display as well as in audio form. The pilot is given a certain time to respond to the warnings. If the RSSI value keeps increasing and the pilot does not take necessary actions to avoid the collision, then the SDCA system freezes the commands from the pilot to the controller and it deviates the aircraft. Initially the speed is reduced gradually and then the direction of the actuator is changed so as to deviate the aircraft thereby to avoid the pilot error. Once the aircraft moves away from the intruder then it returns to its normal operation.The lesser the value of RSSI, the safer the aircraft is from collision.

The various warnings and actions for the respective RSSI values are listed in Table 1.

RSSI Value	Warning / action
0	Clear of conflict
10	Look up display alert
20	Traffic advisory through speaker
50	Regulatory advisory through speaker
100	Buzzer warning
180	Change in speed
200	Change in direction

Table 1

C. FLY BY WIRE

A semi automatic system that replaces the conventional manual flight controls of an aircraft with that of an electronic. With the help of this system the workload of pilot is reduced. Spinning , stalling and other unintentional performances are prevented by the computer automatically without giving much work to pilot and so called ‘ Carefree handling’. In the recent years the analog form of fly by wire flight control system is replaced by the digital computers, which process the signals. The input to the digital computer can be received from any aircraft sensors such as that of the altimeters and the pitot tubes. The flexibility of the flight control system is increased. Pilot induced oscillations can be avoided by including softwares.

In fly by wire the movements of the controls are converted into electrical impulses, which are sent to the flight controller that reconverts the electrical impulses into instructions for control surfaces. The position of the potentiometers or pots in the control surfaces are measured by them and the data regarding their position is transmitted back to the flight control computer. The computer freezes the component ensuring the pilot's commands are followed, once a control surface is in correct place. The gyroscopes fitted in the aircraft are connected to the on board controller which facilitates the fly by wire and keeps the flight much more stable.

The level of RSSI is used to avoid collision in the SDCA system. A threshold value of RSSI is set. The controller is programmed in such a way that when the RSSI value reaches 180, it freezes the commands from the pilot and sends the commands so as to reduce the speed of the aircraft. If the RSSI value keeps on increasing and reaches 200, the command is sent from the controller to change the direction of actuator. This occurs in rare cases only when the pilot does not take necessary actions from the beginning of the issue of initial warnings

D. AUDIO COMMUNICATION.

Generally the aircrafts are controlled by the Air traffic control (ATC). During the chance of collision to occur it is time consuming to communicate to the ATC and then take appropriate actions. In order to overcome this the SDCA system is provided with a voice communication module, which makes communication with the intruding aircraft possible. The SDCA system transmits and receives voice messages. Since communication is made possible both the aircraft interact to select the direction of deviation and avoids collision. This helps to make the pilot to take decisions immediately without the involvement of ATC.

E. OBSTACLE DETECTION SENSOR

Aircraft collision even occurs due to obstacles such as power line, crossing telecommunication tower, wind turbines, etc., Obstacle collision avoidance system (OCAS) the pilots are being alerted if the aircraft is in danger due to the obstacle. OCAS operates by using a low power ground based radar. OCAS is an audio visual warning system. In some places the operation of RADAR may not be effective in such cases the use of sensor is advisable. The SDCA is equipped with a sensor which senses the obstacles and provides the details about the obstacle to the controller.

IV. CONCLUSION

This paper proposes the idea of using the signals emitted by the aircraft to avoid collision. SDCA calculates the signal strength of the intruding aircraft, and performs the following actions. If the signal strength is low it gives us visual and audio advisories else if it is high it automatically reroutes the aircraft. This might be useful as it need not be installed in all the aircrafts involving the collision. Hence, it will be relatively cheap. This is also used to detect other obstacles. Thus, it can be used for both cooperative and non cooperative sense and avoid applications. It is also equipped with a sensor, which provides us with additional obstacle sensing and collision avoidance. The possible integration of SDCA in the aircraft can be studied and researched further in the future to improve its functionality.

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