International Journal of Informatics and Communication Technology (IJ-ICT)
Vol. 5, No. 2, August 2016, pp. 68~72
ISSN: 2252-8776

Development of System Tracer of Lost Aircraft

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Article Info

Article history:

Received Mar 2, 2016
Revised Jun 26, 2016
Accepted Jul 16, 2016

Keyword:

ADS-B
Airnav
DVOR
Radar
Surveillance

ABSTRACT

Today the world has entered the era of modern air transport where human movement needed to support facilities and infrastructure that support for the movement of activity. The number of routes and flights are always growing by leaps and bounds every year.

In Indonesia alone by more than 10 of the largest airliner in which two, namely Garuda Indonesia and Lion Airline, based on data in 2012 each have no less than 50 routes per day and more than 4,000 flights per week [1] (web magazine ZonaAero). To support the security and safety of air transport, the government through the aviation authorities are trying to build an adequate infrastructure. A number of local governments and central government together with Angkasa Pura and Airnav Indonesia (LPPNPI) has a lot to develop the airport terminal, lengthen and widen the runway, install instrument flight (radar, DVOR, ILS etc.), and make the regulations more guarantees The good level of a security and aviation safety.

However, for things that are not desirable that may occur as aircraft accidents, it is necessary to support the system also prepared to facilitate the search for the location of the accident. Still clear in our memory how when, on May 9, 2012 a plane Sukhoi Superjet 100 has crashed in the promotion and demonstration flights. It takes more than one day to find the crash site in the area around Mount Salak located less than 100 kilometers from the capital city of Jakarta [2] (Indonesia Wikipedia).

The distance of time ranging from a loss of communication with the aircraft until the discovery of the accident scene will be very good if it can be reduced to as small as possible. This will help Basarnas and NTSC accelerate the process of investigation and to provide certainty for the families of the victims as well as those of other interested parties.

Location tracking system of aircraft accident would be able to find the location of a plane crash just a few moments after the breakdown of communication between the aircraft control tower / flight controller.

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1. INTRODUCTION

Basically the prototype development of location tracking system crash this plane will take advantage of ADS-B technology as a surveillance system with the development of various types of antennas to expand its coverage area of surveillance. Currently various types of aircraft owned by the airline in Indonesia have been equipped with ADS-B transponder technology in addition to the system of primary and secondary surveillance radar which has long been used. Various types of aircraft used by airlines to serve the domestic and international including Boeing 737-900ER and 737-800, Boeing 747-400, Boeing 777-300 and 200, Airbus A320, Airbus A330-300 and 200, ATR 72-600, Sukhoi Superjet 100 has had a transponder ADS-B surveillance system as standard fittings her. While some types of classic aircraft that are still operated by several airlines, some of which also have in-plant with ADS-B transponder. Even private jets leased in Indonesia and owned by the Indonesian people including branded and types Bombardier Learjet, Cessna

Citation, Embraer Legacy, Dassault Falcon EX and LX series have all been having ADS-B transponder. Thus the development of a tracking system crash site is really going to benefit the world flight in Indonesia.

2. OBJECTIVES GOALS AND BENEFITS

Technical advantages of kinematic Information System Information System based on advanced surveillance technology for monitoring and tracking of aircraft accidents in Indonesia are:

a. Implementation of technology CNS / ATM technologies, in particular radar-like surveillance ADSB which has been controlled as a result of research experience for over 5 years.
b. Form kinematic data provider development can be provided by national corporate partner of Indonesia (Airliner etc) is a new thing with the provision of data that can be used together.

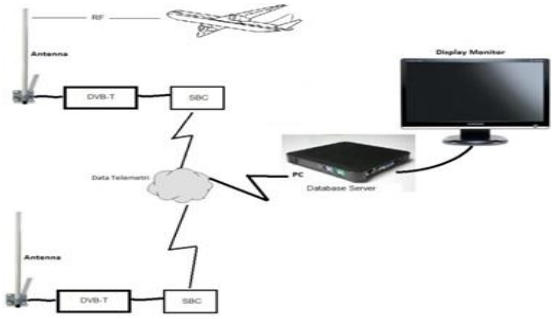
The value of the total investment for the development of the system is very low because it uses modules that class low-end but still has the precision and accuracy is good enough so that the services offered will be very competitive.

3. METHODOLOGY

Development of tracking system crash site includes some process that starts with surveillance technology as the detection position of the aircraft. The kinematic data to be processed and sent via the Internet to multiple servers telemetry data processing and data storage.

A recorder and player application data with the object based on the ID of the aircraft will be developed as a service application menu. This service is useful for playing back any movement of the airplane that will help the analysis of air accidents and investigations on the procedure for error and flight rules.

In addition it will be developed final aircraft movement algorithm application that is useful for predicting the movement of the end of an airplane after losing contact data. The menu of this application will be useful to help narrow the approximate area of the end point of the aircraft that lost contact data before touching the ground.



4. RESULT DEVELOPMENT

4.1. Development of Signal Testing ADS-B

Aircraft data format ID and Emitter Category in the ME bit Mod S is:

Aircraft Identification and Type Message "ME" Field										
MSG BIT #	33 - 37	38 -- 40	41 - 46	47 - 52	53 - 58	59 - 64	65 - 70	71 - 76	77 - 82	83 – 88
"ME" BIT #	1 - 5	6 - 8	9 - 14	15 - 20	21 - 26	27 - 32	33 - 38	39 - 44	45 - 50	51 - 56
FIELD NAME	TYPE [5]	ADS-B EMITTER CATEGORY [3]	Ident Char. #1 [6]	Ident Char. #2 [6]	Ident Char. #3 [6]	Ident Char. #4 [6]	Ident Char. #5 [6]	Ident Char. #6 [6]	Ident Char. #7 [6]	Ident Char. #8 [6]
	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB	MSB LSB

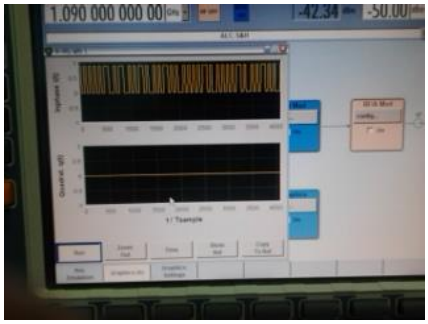
For Ident Char #1 throught #6 will be defined as "GA 1234"

Ident Char #1 [6] = 111000 "G" (000111)
Ident Char #2 [6] = 100000 "A" (000001)
Ident Char #3 [6] = 000001 " " (100000)
Ident Char #4 [6] = 100011 "1" (110001)
Ident Char #5 [6] = 010011 "2" (110010)
Ident Char #6 [6] = 110011 "3" (110011)
Ident Char #7 [6] = 001011 "4" (110100)
Ident Char #8 [6] = 000001 " " (100000)

For definitions of DF, CA and AA follow the following format:
DF set 17 because it follows the format of ADS-B
DF [5] = 17 (10001)
While CA is:

Coding		Meaning
(Binary)	(Decimal)	
000	0	Signifies no communications capability (surveillance only), no ability to set code 7, either on the ground or airborne
001	1	NOT USED
010	2	NOT USED
011	3	NOT USED
100	4	Signifies at least Comm-A and Comm-B capability, ability to set code 7, on the ground
101	5	Signifies at least Comm-A and Comm-B capability, ability to set code 7, airborne
110	6	Signifies at least Comm-A and Comm-B capability, ability to set code 7, either on the ground or airborne
111	7	Signifies "DR" field is NOT equal to zero, or "FS" field equals 2, 3, 4, or 5, either on the ground or airborne.

The signal that has defined this implemented into the signal generator using arbtoolbox.



4.2. Directional Antenna Testing

Figure. 3

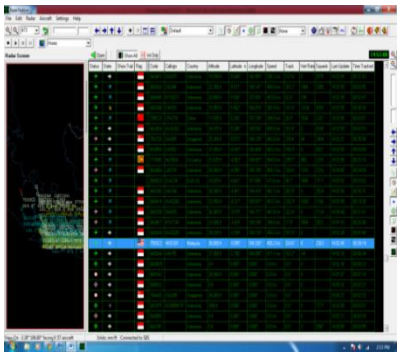


Figure. 4

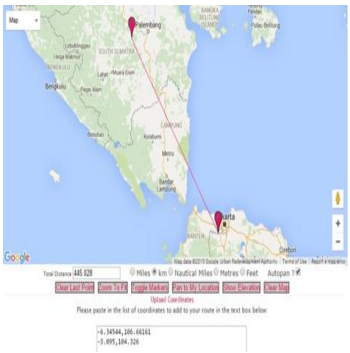
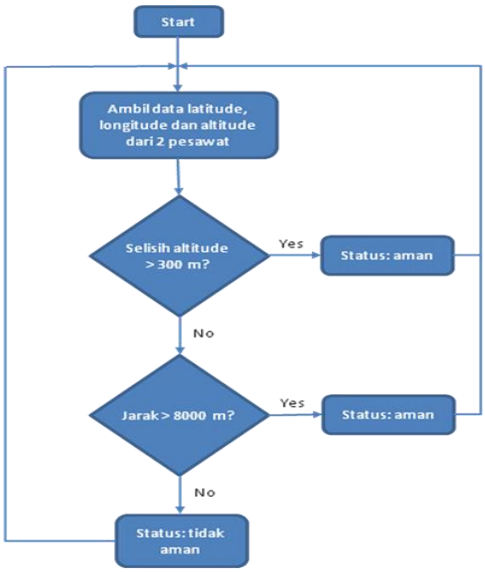
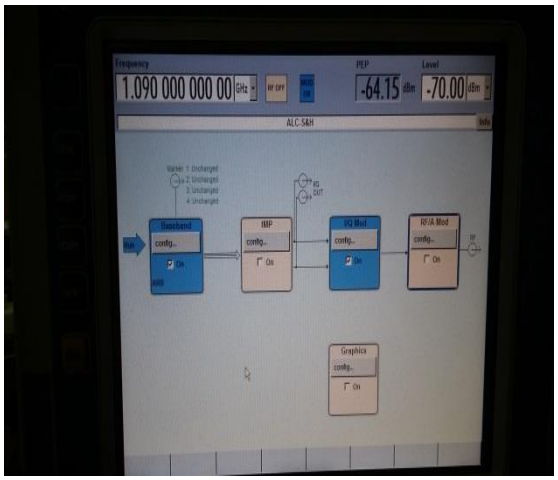


Figure. 5

4.3. Testing of DVB-T2 as ADS-B Receiver

One of the components required in the testing standard documents ADS-B receiver is testing MTL (minimum triggering level). In testing MTL for this SDR, signal source test using a signal generator SMJ100 with files that have been created using tools Arb Toolbox ADS-B signal is valid with only a single data sub issuing aircraft ID: GA1234 and mode-S address 8A5599.





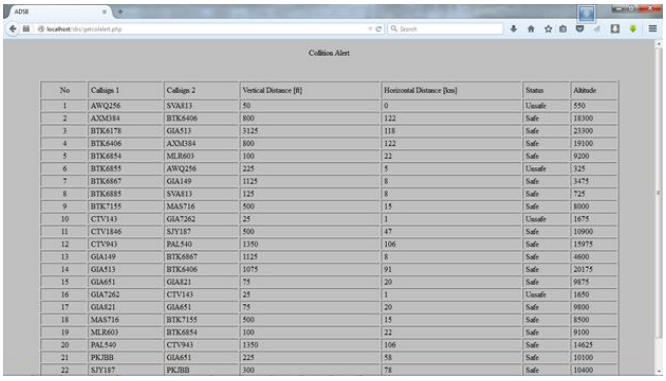
MTL is the ability of the receiver to receive up over 90 percent of the data (the provisions of the standard document) is at the level of -79 dBm. If the test continues to do so is obtained the following results: The receiver can still receive data up to the level of -97 dBm to the amount of data received by 8 data per second. At the level of -98 dBm receiver is no longer able to receive data.

4.4. Development of Collision Avoidance

Aircraft Collision Detection Application is a Java-based applications and php which has a function to calculate the distance of the planes were detected by ADSB-receiver. Distance is meant here is the vertical distance (vertical distance) and the horizontal distance (horizontal distance).

In the aviation world say that two aircraft at the position enroute considered safe if it has a height difference of at least 300 meters (1000 feet) or a distance of at least 8000 meters (5 miles). While the terminal position of minimum distance is 4800 meters (3 miles).

Test result:



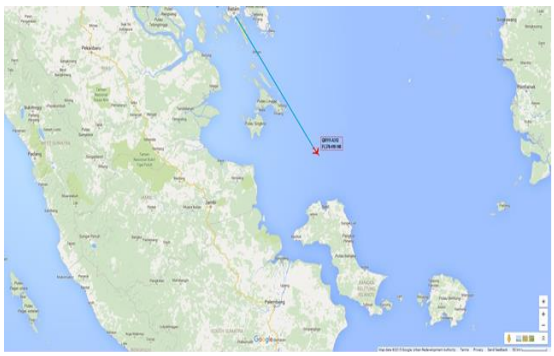
Collision Alert

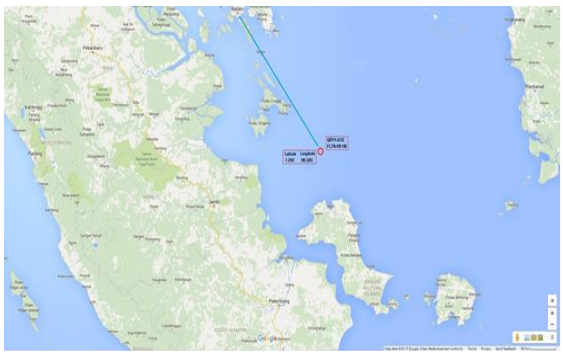
No	Callsign 1	Callsign 2	Vertical Distance [ft]	Horizontal Distance [km]	Status	Altitude
1	AWQ256	SVA813	50	0	Unsafe	550
2	AXM384	BTK6406	800	122	Safe	18300
3	BTK6178	GIA513	3125	118	Safe	23300
4	BTK6406	AXM384	800	122	Safe	19100
5	BTK6854	MLR603	100	22	Safe	9200
6	BTK6855	AWQ256	225	5	Unsafe	325
7	BTK6867	GIA149	1125	8	Safe	3475
8	BTK6885	SVA813	125	8	Safe	725
9	BTK7155	MAS716	500	15	Safe	8000
10	CTV143	GIA7262	25	1	Unsafe	1675
11	CTV1846	SJY187	500	47	Safe	10900
12	CTV943	PAL540	1350	106	Safe	15975
13	GIA149	BTK6867	1125	8	Safe	4600
14	GIA513	BTK6406	1075	91	Safe	20175
15	GIA651	GIA821	75	20	Safe	9875
16	GIA7262	CTV143	25	1	Unsafe	1650
17	GIA821	GIA651	75	20	Safe	9800
18	MAS716	BTK7155	500	15	Safe	8500
19	MLR603	BTK6854	100	22	Safe	9100
20	PAL540	CTV943	1350	106	Safe	14625
21	PKJBB	GIA651	225	58	Safe	10100
22	SJY187	PKJBB	300	78	Safe	10400

4.5. Development of Final Position

This application was developed to analyze and calculate the final position of an aircraft that radar signals lose its ADS-B. The final position of an aircraft would be recorded kinematiknya data, the data will then be converted into vertical speed (VS). Data VS, heading, air speed (AS) and wind direction will be interpolated to obtain estimates of the final position of the aircraft.

This application was developed using Visual Studio tools and carried out by two people ES from WP.2 and has lasted for two months. Currently in testing with a number of iterations for improvement. It is estimated that within the next two weeks will be obtained a final application with good results.





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[2] N.N. "DO242A, RTCA, 2003.
N.N. "DO181C, RTCA, 2003