Aircraft Real Time Data Monitoring

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Abstract -- The tragedy and frustration surrounding the sudden disappearance and, to date, unsuccessful search for Malaysian Airlines MH370, coming just a few years after the loss of Air France AF477, highlights the fact that current systems and flight crew initiated procedures for tracking aircraft are inadequate. We live in a digital age where the movement of every object can be tracked. In majority of the aircraft accidents flight data monitoring unit, black box aided to reveal the pre status of the aircraft. Disappearance of past aircraft stories are evident that tracking the black box data is insufficient to disclose the status of aircrafts and monopolize the data resulting secret losing. The missing Malaysian aircraft leads to requirement of implementation of improved tracking, data streaming, and emergency locator technologies. Currently real time data streaming is realistic. This will of flight and it can lead to be a secret of flight crashing. This paper discusses an approach to avoid the monopoly of the black box data and real time data streaming to the ground station.

Indexed Terms: Black box, Flight Data Recorder, Cockpit Voice Recorder, Real time data monitoring, smart city concept, Database Duplication, Midair collision, Ghost flight

I. INTRODUCTION

In an era when the location of every cell phone can be accurately tracked moment by moment, a new report from Malaysia's Air Accident is raising questions about why the airline industry still relies on older technologies, including radar and black box recorders, rather than real-time tracking. A traditional flight-data recorder is like an old-fashioned tape recorder. It records something, then play it back later and decide what's valuable and what isn't. Real-time data tracking means you're getting continuous data streaming from thousands of data points from aircraft computers to analyse the data and minimize the mysterious like Malaysia Airlines flight, Air France flight 447.

II. PROBLEM STATEMENT

With the help of facilitating the investigation of aviation accident and incidents to find out what happened just before crash, black box is placed in aircraft. There are two types of recorders, combined in to single unit which are Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR). CVR record the voice data what the crew say and monitor any sound occur cockpit just before the crash. [1] This is located in the tail of plane. FDR is not more significance as CVR. It measures operating functions of the plane all at once such as time, altitude, air speed, direction, etc. Those are measured by old black boxes. But now black boxes measures more than above parameters such as movement of individual aps of wings, auto pilot and fuel gauge. Information stored in the FDR or a plane that has crashed is invaluable for investigates in their search for determining what caused a specific crash. The data stored in recorders helps Air crash investigators generate computer video reconstructions of a flight so that they can visualize how a plane was handling shortly before a crash. But unfortunately if black box is unable to find the plane or black box, we can't investigate what happened to the plane forever. If it was disappeared we don't know what happened to that plane until found the black box. However, in this century majority of aircraft accidents are airplanes missing. Because Political and other reasons. When FDR and CVR data send to the ground station online and store them avoiding the monopoly of data, above Political and other reasons can be exposed. To discover those reasons and avoid the monopoly of black box data this project will be a good solution. The system is enrich with,

- Live data streaming
- Avoid the monopoly of the plane and store the flight data as a universal property
- Instant alerting alarm system

III. OVERVIEW OF ALTERNATIVE BLACK BOX

Alternative black box proposed is to real time transmitting very critical parameters selected under the given circumstances. Critical parameter is sent to central database and duplicate with another three databases at the ground avoiding data monopoly. The modeled design should be able to recognize at least the following causes in case an aircraft disappears.

a) Aircraft disintegrate into small pieces in mid air:
All the historical mid-air collisions are caused to mechanical failure, a rapid fall in cabin pressure or in-flight fire smoke filled the cockpit and cabin, lack of oxygen incapacitated the crew. Therefore this system will measure critical pressure, smoke and the engine parameters of the airplane.

b) Someone deliberately take the aircraft to a high altitude to knock everyone out:
Aircrafts used on flight have maximum service ceiling of 43,100ft. [2] But at this altitude, where the atmosphere drastically thins it would take mere minutes if not seconds for hypoxia - a lack of oxygen to set in if the cabin was manually depressurized by one of the pilots. Oxygen masks not enough to keep passengers conscious. By detecting abnormality of the position (altitude), and the oxygen system of the airplane can identify such a situation.

c) Hijack and Pilot Suicide:
Airline cockpits are vulnerable every time a pilot takes a bathroom break. It can occur in numerous ways. In this scenario flight path and other flight parameters get abnormal. It can identify only detecting the flight path of aircraft when it shows different geographical location with respect to its flying path. Recognizing those abnormalities can identify the hijack or pilot suicide cases.

1. Alternative Black Box Create platform
Arduino based sensor system used to track the critical parameters in aircraft. Measured parameters are lively transmitted to the central database at every 10 minutes time slots. If current parameters of flight path, speed, pressure and such measured parameters are changed from predefined values time slot of data transmitting changed to every one second. To obtain flight data needed electronic sensing system with the senses having the capability of measure small amount of variation of flight data. GPS module for measuring longitude, latitude, altitude, speed, date and time and then BMP module for measuring the pressure inside the aircraft. Gyroscope sensor to measure the angle, acceleration and gyro values. Temperature and smoke level were measured using smoke and temperature sensors.

Fig. 1: System of real time communication link with databases

Data received at the central database duplicated with other three database placed in another three location. Web based aircraft real time data monitoring system placed at the ground station can be accessed by any user to perceive the flight data, aircraft data, cabbing crew data and etc. There is no tactic of editing or updating of received flight data. Administrator is the only key person who can allow all the legal actions on the data receiving and updating. There is an instant alerting alarm system which generates alarms according to fluctuations of the aircraft data.

2. Hardware Implementation
Alternative black box implementation requires hardware equipment which can sense the aircraft varying parameters which affects to given project criteria. Sensing aircraft parameters pressure, temperature, altitude, latitude, smoke and others are done by each sensor modules and all the sensors gather using an arduino mega unit.

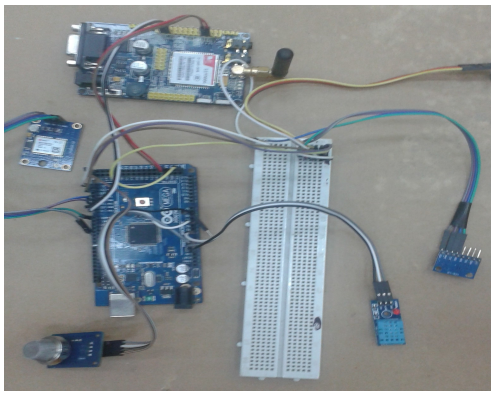
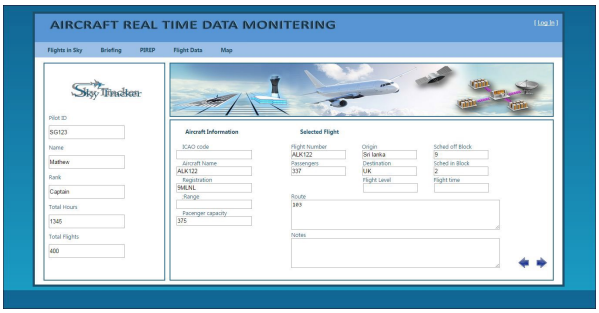


Fig. 2: Hardware system of gathering all sensors

The out puts from the implemented system shown in figure 2 is shown in figure 3.

3. Software Implementation

Obtained data sensing parameters through arduino sensor unit was send to central database at ground using GSM module and measured data receives directly from server which stored central database and web based monitoring system.



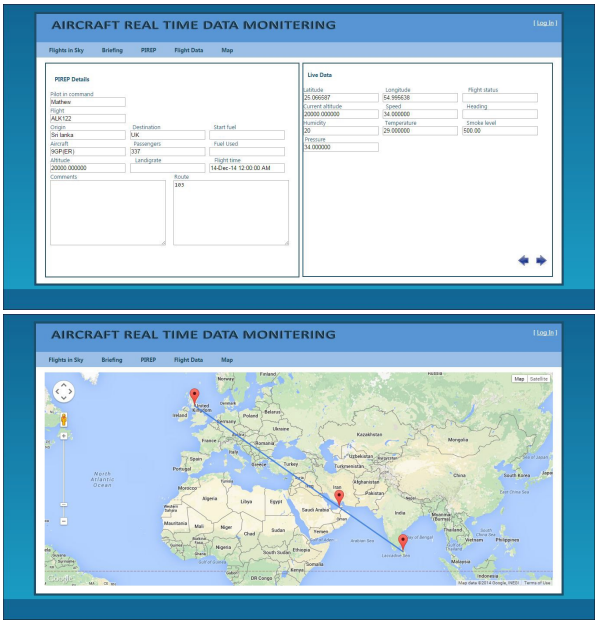


Fig. 3: Web based aircraft monitoring system interface

4. Central Database Design

In this system all the flight data measured from the sensor unit is transmitted to store in central database. Central database is consisted with flight data, aircraft data, passenger details, crew details, maintenance details and the parameters that are test after take-off. Central database system stored states values of the flight data and check that values with latest received data in every second data. Therefore database provides facility of comparing the stored values and received values.

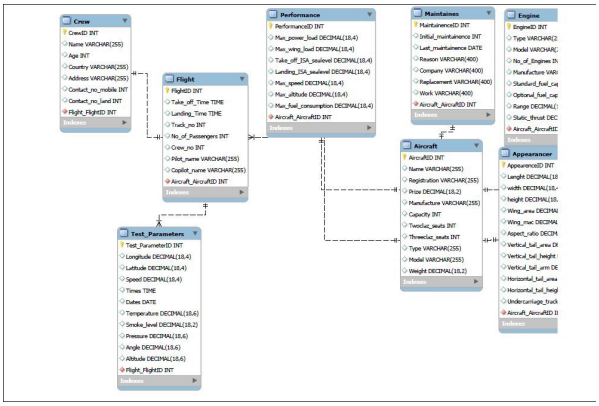


Fig. 4: ER Diagram of central database

5. Instant Alarm System

Instant alarm system have combined with the central database and when aircraft data get severity level

after comparing with the database allowable range instant alarm system generates alarms indicating severity of the fluctuation.

IV. RESULTS

The purpose of the project was real time data transmission with central database and duplicated databases and warning system which generated alert messages when system parameters change. The output results of the system are shown in below figures.

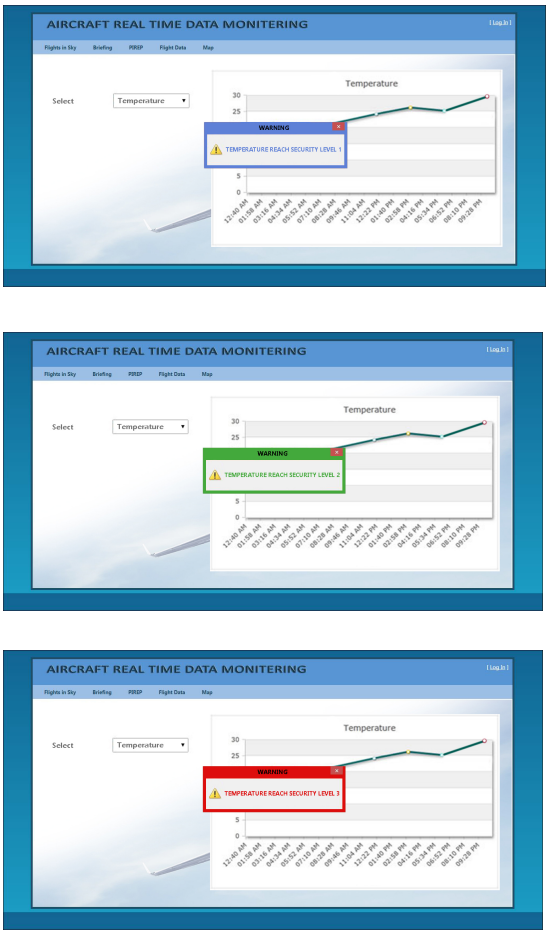


Fig. 5: Output alerts according to parameter changes

V. CONCLUSIONS

This paper discusses a system which transmits data which gets critical in the case of midair disintegrate, mechanical failures pilot suicide and hijacking to central database at the ground station and process the data in database by generating instant alarm according to the data in aircraft.

In the black box there are lots of parameters are measured. But In this context it is difficult to develop a system similar to the real black box in aircraft. Actual black box tracks large number of parameters nearly 88. In the case of least resources, few sensors have taken to project. In addition to that testing of real time data transmitting from aircraft to ground station is impossible in this context. Therefore transmission path has replaced with short messages transmission through GSM.

Using the web application all flight data and status of the aircraft can be seen. Graphical description of each and every parameter can be obtained. This project can use not only as the real time data monitoring system but also implementing the Smart city concept. In that scenario data sensing unit can created sensor network and monitor many aspects of city traffic in real-time, power networks, weather, street lighting, and water / waste systems are used.

REFERENCES

[1] Author A.B., Author C.D.E. and Author F.G. (Year): Title of the Book and Edition x, Publisher Name and Address. ISBN.

[2] Abelson H., and Susmann G.J. (1985): Structure and Interpretation of Computer Programs. Cambridge, MA, MIT Press, USA. ISBN 81-7758-875-3.

[3] Author A.B. and Author C.D.E. (Year): Paper Title. Conference Name. Proceedings Details.

[4] Sirisena E. and Rajgama P.N. (2008): Adaptive Hight Control for UAV under Varying Weather Conditions. IET 5th Symposium on UAV Design and Control. 2-nd Vol, pp. 203-209.

[5] Author A.B. and Author C.D.E. (Year): Title of the paper. Journal Name. Volume, Number, Pages.

[6] Kalman R.E. and Pucy N.S. (1961): New results in linear ltering and prediction theory. Transactions of the ASME. Series D,

Journal of Basic Engineering.Vol.83-D, March 1961, pp 95-110.

[7] Author A.B. and Author C.D.E. (Year): Web Page or Article Title: Web address.

[8] Author A.B. (Year): Thesis Title. Ph.D. Thesis. University.