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Floating Black-Box Flight Recorder

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ABSTRACT

Now a days, aviation accidents are major problems due to various factors. So we need black box which is a valuable tool for investigators to find factors behind an accident. But if the black is fallen on the sea, it is difficult to finding out a location of black box within 30 days. Every year international safety board spends lakhs of money to identify the black box under depth of sea because of the presence of sea valley. To overcome above stated problem, we proposed a system to detect location of the black box under sea location and avoid illegal operations by a pilot. This proposal does not need long period of time for beacon sounds. This system saves money which is wasted for searching of the black box, leads easy investigation and ensures safety of the people.

Keywords: aviation accident, black box, buoyancy, flight data, recorder, plastic air bed

I. INTRODUCTION

Now a day's aviation industry got high growth due to rapid economic growth, higher disposable incomes and also rising aspiration of the middle class. For any airplane accident, we have many questions that how and why the accident has been happened. All the answers for the questions are there inside the black box. Flight recorders consist of Cockpit Voice Recorder (CVR) and Flight Data Recorder (FDR). Popularly it is known as black box. These flight recorders are painted in an orange colour to help in their recovery during an accident. The CVR can be named as 'cockpit audio recorder' because it not only provides the voices of the pilots but also creates a record of the total audio environment in the cockpit area. The FDR records flight parameters. But the minimum requirement is to record a basic group of five parameters:

- pressure altitude
- indicated airspeed
- magnetic heading
- normal acceleration
- microphone keying.

Microphone keying (the time radio transmissions were made by the crew) is recorded to correlate FDR data with CVR information. The FDR often tells accident investigators what happened during an accident sequence and the events leading up to it. Each recorder is fitted with battery-powered Underwater Location Beacon (ULB) to aid underwater recovery. When the ULB is immersed in water, it will begin to radiate an acoustic signal which can be received and transformed into an audible signal by a receiver. The ULB is sometimes called a 'pinger' due to the audible signal created by the receiver.

The minimum operating life of ULB is 30 days. The acoustic output will decrease as the battery voltage decreases. It may be possible to still detect the ULB after 60 or more days but the detection range will be decreased. The ULB can only be dedected by a receiver under the surface of the water. The maximum detection range of a ULB is typically up to 2 to 3 kilometres but is dependent on:

- ULB acoustic output level
- Receiver sensitivity

- Whether the ULB is buried by debris (e.g. aircraft structure and mud)
- The ambient noise level (e.g. sea state, nearby boats, marine animals, gas and oil lines)
- Water temperature gradients
- Depth difference between the ULB and the receiver.

II. PROPOSED SYSTEM

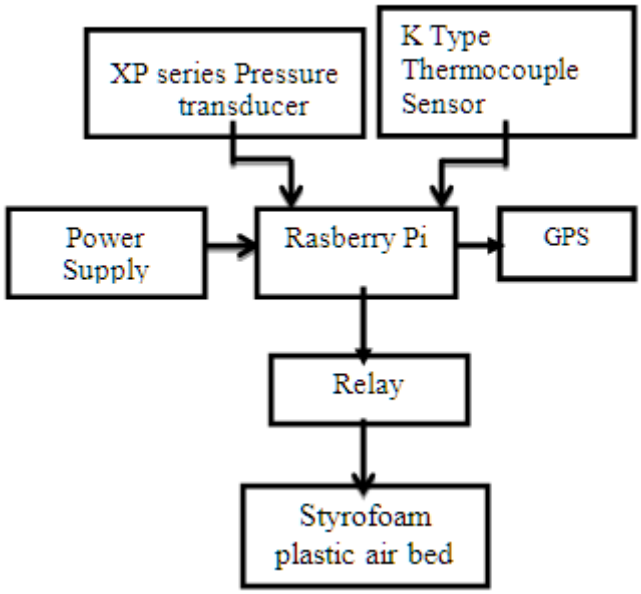


Fig 1. Block Diagram of a system attached to bottom of a black box

In the event of a misadventure, the information stored in these black boxes can be used to help determine the cause of the accident. The withstand ability of temperature of the black box is 2,000°F for one hour and it must be able to withstand an acceleration of 3,400 Gs (3,400 times the force of gravity). The buoyancy of the black box material is greater than the density of water, so it sink into water.

To avoid that, the styrofoam plastic air bed is sealed with low alloy steel, which prevent the bed from the blast. The paraffin insulation is used to avoid the thermal conductivity inside this box. This system is attached to bottom of black box through bolted, and the bed is also attached to the system. Temperature sensor & pressure sensor measure temperature and pressure values which exceed certain threshold level during crash of air vehicle, it sends the input as 1 to the microcontroller, and the lock at bottom is opened automatically.

III. HARDWARE DESIGN

1. Rasberry Pi

The Raspberry Pi 3 Model B (Quad-Core 64bit CPU) is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+ and Raspberry Pi 2 Model B. The Raspberry Pi 3 Model B has powerful processor, 10x faster than the first generation Raspberry Pi. Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

Fig 2. Raspberry Pi 3 - Model B

Raspberry Pi 3 - Model B Features

- Now **10x Faster** - Broadcom BCM2387 ARM Cortex-A53 Quad Core Processor powered Single Board Computer running at 1.2GHz!
- 1GB RAM so you can now run bigger and more powerful applications
- Fully HAT compatible
- 40pin extended GPIO to enhance your "real world" projects.
- Connect a Raspberry Pi camera and touch screen display (each sold separately)
- Stream and watch Hi-definition video output at 1080
- Micro SD slot for storing information and loading your operating systems.
- 10/100 BaseT Ethernet socket to quickly connect the Raspberry Pi to the Internet

2. Thermocouple Sensor

A thermocouple is a simple, robust and cost-effective temperature sensor used in a wide range of temperature measurement processes. It consists of two dissimilar metal wires, joined at one end. When properly configured, thermocouples can provide measurements over a wide range of temperatures. Thermocouples are available in different combinations of metals or calibrations. The most common are the "Base Metal" thermocouples known as Types J, K, T, E and N. There are also high temperature calibrations - also known as Noble Metal thermocouples - Types R, S, C and GB. The type K is the most common type of thermocouple. It's inexpensive, accurate, reliable, and has a wide temperature range. The type K is commonly found in nuclear applications because of its relative radiation hardness.

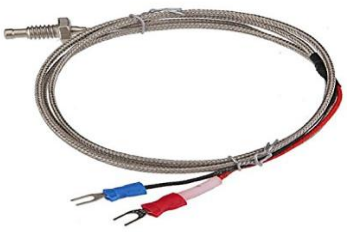


Fig.3. Thermocouple Sensor

3. XP series Pressure transducer

Precision Sensors XP Series Transducers are designed for demanding aerospace applications that include the monitoring or control of flight surfaces, braking, thrust reversers and landing gear actuators. With no internal seals to degrade or cause leakage, the flameproof stainless steel welded design eliminates installation effects.

Polysilicon sensor technology results in the highest level of dielectric strength for improved electronic isolation. XP Series Transducers are available with an optional factory set electronically isolated switch output.

Fig.4. XP series Pressure transducer

Features:

- RTCA DO-160 Qualified
- 5 Million Cycle Life
- Stainless Steel Construction Compatible with all Hydraulic Fluids
- No Internal Seals

4. GPS

The Global Positioning System (GPS), also known as Navstar GPS or simply Navstar, is a global navigation satellite system (GNSS) that provides geolocation and time information to a GPS receiver in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. The GPS system operates independently of any telephonic or internet reception, though these technologies can enhance the usefulness of the GPS positioning information. Here the GPS system sends the latitude and longitude messages to the ground station when the accident occurs.

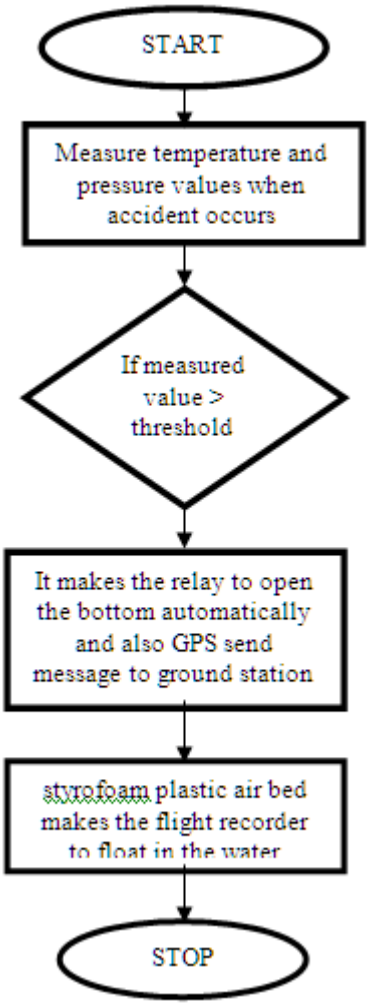
4. Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

Fig. 5 Relay

IV. WORKING PRINCIPLE

The working principle of the flight recorder during accident is shown in the flow diagram.



V. CONCLUSION

The proposed system can solve many problems faced by the rescue team to find aviation accident. This system ensures safety of air passengers. And also this system is more effective so as to make a black box to float indefinitely in the sea water. The future of this paper is to avoid disaster happening in the parameters to ground unit.

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