

# Embedded Solution for Aircraft Fault Detection and Passenger Safety System Using Wireless Technology

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**Abstract:** — The recent years were quite bad for aviation world due to serious aircraft crashes. Lots of human being lost their lives in plane crashes over last 3 years and this became very serious & sensitive issue in the world. So we are proposing the idea of detachment of passenger compartment on the detection of major problem in an aircraft which predicts the fatal crash of airplane. We are using some advanced sensors to detect the accidental occurrences of defects or faults in an aircraft. These sensors are selected according to most common problems of aircraft crashes. On detection of sensors data, the data is compared with threshold limits & if the data reaches beyond threshold it predicts the possible crash of plane and gives signal to the detachment control panel. On the signal of sensors, the passenger compartment will get ejected from the fuselage and with help of parachutes or will land safely on ground without any fatal loss. We are using arduino platform with AVR ATmega328 microcontroller. It is 8 bit microcontroller with 32kb memory. This controller board comes with 14 digital I/O pins and out of these 14 pins 6 pins provide Pulse Width Modulation (PWM) output signal. This board also comes with 6 analog input pins. This board can be powered by USB as well as external dc jack with 5 to 12 v input supply.

**Index Terms-** Aviation, detachment, predict, fatal, fuselage

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## I. INTRODUCTION

Today we are living in 21st century in which human life safety is more important than any other things. But as century's increases technology also get increases similarly risk for human life too. But with that risk, humans get research the effective solution on that.

Similarly recent years were quite bad for aviation world due to serious aircraft crashes. Although today airplanes have become a lot safer over the past few decades. Much work goes into making sure that aircraft are safe since there's almost always a loss of life when a flight crashes. Lots of human being lost their lives in plane crashes. This became very sensitive & serious issue in the world. So companies are interested in improving safety in aircraft. So we are proposing idea of the ejection and the recovery system of passenger compartment in an accidental crash situation of aircraft. In this technique the passenger compartment of the aircraft gets ejected from its main body when any accidental or critical situation gets occurred. The ejected passenger compartment get fly in air with the help of parachute attached at the top of the compartment. Rubber tube filled with air used as floater which saves the compartment from drowns. Sensors are selected according to most common problems of aircraft crashes. On detection

of sensors data, the data is compared with threshold limits & if the data reaches beyond threshold it predicts the possible crash of plane and gives signal to the detachment control panel. On the signal of sensors, the passenger compartment will get ejected from the fuselage and with help of parachutes or will land safely on ground without any fatal loss.

We use arduino board with ATmeg328 controller. It is 32 kb 8 bit microcontroller. This controller board has 14 I/O digital pin from which 6 pins are used as Pulse Width Modulation (PWM) output, 6 analog input pins. A USB connector used for 5V power supply and a power jack is used for applying 3.3V-9V power supply to the board.

## II. OBJECTIVE AND SCOPE

The main objective of our project is to make development in the aviation technology and make aircraft safer than past few decades. This technology can be readily used by aviation industry for creating more safe aircrafts which saves the passenger life in critical situation like fire, wings fault, turbine fault etc.

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This project has the large scope as it has the following features which help in making it easy to use, modify and understand it.

- Parachute attached at the roof and rubber tubes inflate on bottom of cabin.
- Storage space holds passenger luggage underneath the cabin.
- Automatic excessive angle change system.

**III. PRESENT STATE**

➤ Present State:

- According to ICAO(International Civil Aviation Organization), over the past 10 years there are 8% of all accidents happen during takeoff, landing- 21% cruising flights-71%.
- The accident rate in Africa, for instance, is nearly five times that of the worldwide average, according to the International Civil Aviation Organization, part of the United Nations. Such trouble spots also happen to be where air travel is growing the fastest
- The analysis of causes of accident show that 75% of them happen because of human factor, other because of omission aeromechanics. To reduce the influence of human factor by rising up safety of airplane is impossible. The new principle of aircraft construction is needed for possibility of collective rescuing by evacuation of them crashing airplanes in the range from several hundreds of meters to several km.
- There are 12.25 fatalities per million flight deaths.
- A plane crashes one out of 1.2 million flights.
- There is a 24% survival rate of passengers on a fatal crash.
- There were 111 plane crashes in 2014, which went down from 138 in 2013.
- Technological improvements are also helping to lower the accident rate. Cockpits now come with systems that automatically warn if a jet is too low, about to hit a mountain or another plane. Others detect sudden wind gusts that could make a landing unsafe.
- The next generation of technology promises to help prevent even more accidents. Honeywell Aerospace launched a new system 18 months ago that gives pilots better awareness about severe turbulence, hail and lightning. The company is also developing a system to improve pilots' vision in stormy weather: an infrared camera will let them see runways through thick clouds earlier than the naked eye would.

➤ After implementation of project:

- The year 2014 left a strong impression on the aviation industry, with Malaysian Airline's MH 370 going missing to various plane crashes. It was just a bad year and the industry had to fight out the odds. But, there was still no solution to prevent or at least battle plane crashes in a way it saves the lives of the passengers. But our project a small step to solve that problem.
- In this project such aircraft construction is offered. Which provides separation of the lower part of the fuselage with situated there passengers and their luggage, gradual decline of separated part and its soft landing(splashdown), afterwards providing an opportunity for its searching and finding by rescuers.
- The guaranty of success of offered airplane structure is in the fact that outlined in structure solutions are based on lifelong checked technical solution of landing in transport aviation

**IV. PROCESS DESCRIPTION/METHODOLOGY**

*Block Diagram*

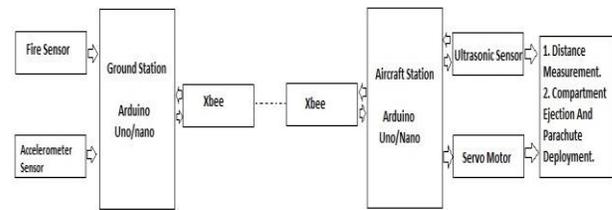
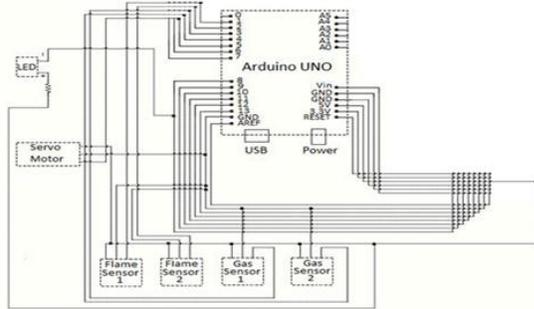


Fig:1 Block Diagram

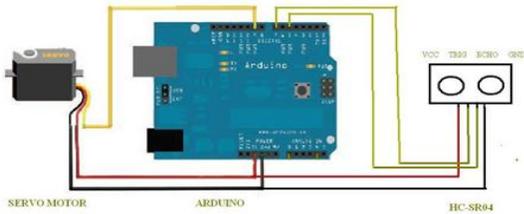
There are two ARDUINO base stations present which are connected with each other through XBEE module. First Arduino Detect the fault occurred in aircraft by using fire sensor, Accelerometer sensor. And second Arduino board controls the servo motor and ultrasonic sensor, which is in aircraft station. XBEE module is the wireless communication model. It communicates with other XBEE which in line of sight with it.

The fire/flame sensor detects the small fire in aircraft and sends that signal to the ground station Arduino. Ultrasonic sensor is used to detect the distance of falling compartment from ground. Servo motor is used for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

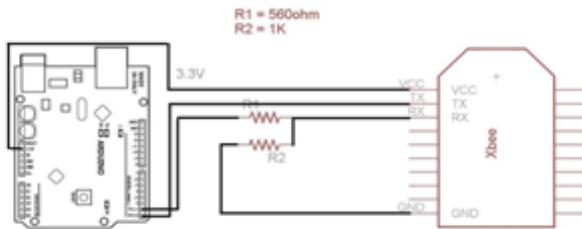
**B. Circuit Diagram**



**Fig 2. Interfacing Of Flame Sensor And Servo Motor.**



**Fig 3. Interfacing of Ultrasonic Sensor with Servo Motor.**



**Fig 4. Interfacing of Xbee with ARDUINO.**

**V.PROPOSED WORK**

- **Hardware Part:**
- **MCU: (Arduino unit)**

As Arduino are the simple and effective controller boards used in digital circuit design in industry, this system uses it for the centralized operation and digital processing. The embedded technology is used in arduino.

The Figure Shows Arduino board with ATmeg328 controller. It is 32 kb 8 bit microcontroller. This controller board has 14 I/O digital pin from which 6 pins are used as Pulse Width Modulation (PWM) output, 6 analog input pins. A USB connector used for 5V power

supply and a power jack is used for applying 3.3V-9V power supply to the board.

It is a simple microcontroller board. It is an open source computing platform and has an environment for developing software for the Arduino board. It takes input from sensors or switches and controls the outputs. Arduino boards are inexpensive compared to other microcontroller based devices.

- **SENSOR:**
- **Flame Sensor**

A flame sensor detects the presence of fire or flames. In extremely hazardous environments, flame sensors work to minimize the risks associated with fire. There are several different types of flame sensor - some will raise an alarm while others may activate a fire suppression system or deactivate a combustible fuel line. Among the many different types of flame sensor, ultraviolet flame sensors, near IR array flame sensors, infrared flame sensors and IR3 flame detection sensors are the most prominent.

- **Ultrasonic Sensor( HC-SR 04)**

Ultrasonic sensors are based on measuring the properties of sound waves with frequency above the human audible range. They are based on three physical principles: time of flight, the Doppler Effect, and the attenuation of sound waves. Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target, and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target.

- **Accelerometer Sensor**

One of the most common inertial sensors is the **accelerometer**, a dynamic sensor capable of a vast range of sensing. Accelerometers are available that can measure acceleration in one, two, or three orthogonal axes. They are typically used in one of three modes. As an inertial measurement of velocity and position. As a sensor of inclination, tilt, or orientation in 2 or 3 dimensions, as referenced from the acceleration of gravity ( $1\text{ g} = 9.8\text{m/s}^2$ ). As a vibration or impact (shock) sensor. There are considerable advantages to using an analog accelerometer as opposed to an [inclinometer](#) such as a liquid tilt sensor – inclinometers tend to output binary information (indicating a state of on or off), thus it is only possible to detect when the tilt has exceeded some threshold angle.

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• **SERVO MOTOR**

A servo motor is a [rotary actuator](#) or [linear actuator](#) that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor although the term *servomotor* is often used to refer to a motor suitable for use in a [closed-loop control](#) system.

• **XBEE:**

Xbee is a device which is used for wireless technology which provides connection between the devices. It is the low cost, low power wireless network used for instrument control. 784 MHz, 868MHz and 915 MHz Data rate varies from 20 Kb/s to 250 Kb/s.

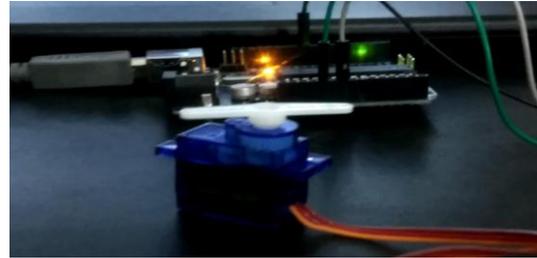
Its transmission distance is limited to 10 to 100 meters line of sight. It depends on power output and environmental factors. It can use long distance communication using intermediate devices. It can be used in several applications such as wireless light switches, smart grid, medical devices etc. It is used for wireless transmission purpose. Xbee was designed to provide high data [throughput](#) in applications where the [duty cycle](#) is low and low power consumption is an important consideration.

**IV.RESULT**

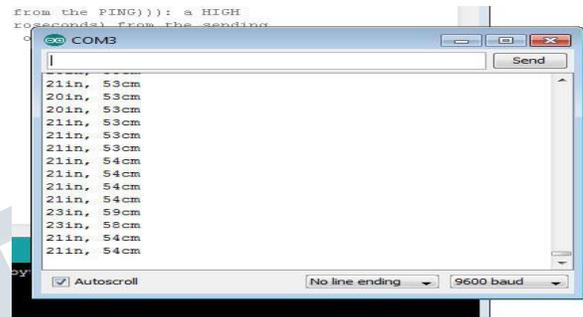
From our project we got some sensor result.  
For Accelerometer Sensor



*For Servo motor:*



*For Ultrasonic Sensor*



**VII. CONCLUSION**

From all above the project, we said that the project is very useful to increase the percentage of human safety when plane get crashed. It will become a very important life saving technology in plane engineering. But Passenger might have to pay more money to fly on a plane

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