

# Flight control system using zigbee wireless sensors engineering essay



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Abstract- This paper presents the future concept of flight control systems that is named as Fly-By-Sensors (FBS) flight control system. It can be used for controlling and monitoring of an in-flight functions, taking off and landing, voice communication etc. and can be employed on any kind of air vehicle including Unmanned Air Vehicles, Quad rotor, Aerial Vehicles, Drones, Jet air craft, commercial air craft etc. Nowadays, a fly-by-wire (FBW) flight control system of Air vehicles is employed for last few years in aircrafts through which the internal and external functions of aircraft are controlled and monitored by electrical signals which are transmitted and received by electrical wires. The proposed idea is based on Zigbee Wireless Sensor network that can be implemented on any air vehicle by using Zigbee Wireless Sensors that are low cost, low power, reliable and secure to control and monitor the internal and external functions of the air vehicles. The electrical signals, for controlling and monitoring of internal and external functions of air vehicle, in Fly-By-Sensors (FBS) flight control system will be transmitted and received by using Zigbee wireless sensor network. The proposed idea will bring remarkable improvements in the field of avionics and aerospace.

Keywords-component; Zigbee Wireless Sensors; FBS; FBW; flight control system of Air Vehicles.

### Introduction (Heading 1)

The flight companies are in a struggle to reduce their air craft operational and maintenance costs, saving fuel consumption and the gross take-off-weight of the air vehicles to carry as many as useful things for civil and

military purposes. In past several applications of Fly-By-Wire (FBW) flight control systems to civil aircrafts had been experienced. In FBW flight control systems the commands for controlling of the aircraft's internal and external functions are computed by the on board flight control computer on the basis of instructions by the pilot and without any mechanical linkage[1]. This resulted in the reduction of pilot workload and in general improvement of the Flying Qualities (FQ) characteristics. However the high development costs of a FBW flight control system made it unaffordable for the small aircrafts [2]. Moreover, FBW flight control system is the ability to exhibit aircraft configurations and parameters which provide increased aerodynamic efficiency, but at a cost of reduced natural stability. Moreover, this can cause instability of the aircraft at specific speeds and height conditions (or flight envelope).

However, maintenance and troubleshooting of air vehicles, such as fault detection and monitoring systems of modern fly-by-wire (FBW) flight control system cannot detect faulty location accurately, so that experts can troubleshoot them in a shorter time. However, troubleshooting time depends mainly on the personnel's skillfulness and experience [3].

## Flight Control Systems

### Fly-By-Optics(FBO) flight control system

FBO control system as the name implies that this kind of flight control system is based on the light signals which are transmitted through optical fibers. It uses electronic signals, transmitted through the fiber optics inside the air vehicles to control the employed electro-hydraulic actuators such as <https://assignbuster.com/flight-control-system-using-zigbee-wireless-sensors-engineering-essay/>

flaps, spoilers, slats, ailerons and rudder, in response to input commands. Some times, it is used because of higher transfer data rates. The data generates by the software and interpret by the controller. It is also called as fly-by-light flight control systems.

#### Power-By-Wire (PBW) flight control system [4]

Power-by-wire (PBW) is a control systems employed in some aircrafts to eliminate the bulky and heavy hydraulic circuits to replace by self contained electro-hydraulic actuators or electrical power circuits that are controlled by the digital flight control computers.

#### Proposed Fly-By-Sensors (FBS) Flight Control System

The proposed flight control system is Fly-By-Sensors (FBS) flight control system to employ on any kind of air vehicle. As the name implies this type of control system will base on latest Zigbee technology which is low cost, low power consumption and short distance wireless communication technology that is developed for wireless personal area network (WPAN) [5]. By using this technology, the reduction in high cost in the manufacturing of electrical wires, gross take off weight of the air vehicles, fast detection of faulty equipment, landing and taking off of the air craft on auto pilot function of the aircraft, safety, security and so on, can be achieved.

#### Zigbee Wireless Technology

ZigBee is similar to IEEE 802. 15. 4 protocol, which is a one of the latest research in the field of communications in short distance wireless

communication technology. Its main advantages are low-power, short-  
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distance, low-complexity, self organization, low-speed, low-cost, and so on. It is widely using as monitoring and controlling devices in many fields. It is suitable for low data-rate and low power consumption applications [6].

### **Figure : Difference of other wireless network standards with Zigbee Network standards (Source: [www.zigbee.org](http://www.zigbee.org))**

#### Zigbee Characteristics

The IEEE 802.15.4 or Zigbee standard includes the features of low power consumption that is needed just for two major modes (Tx/Rx or Sleep), high density of nodes per network, low costs and simple installation of devices.

Following are some more features for Zigbee:

It operates on radio bands of 2.4GHz in this high band is used in most of the jurisdictions of world wide, 868/915 MHz, this lower band in the areas of North America, Europe, Australia and New Zealand.

High density of network nodes which is up to 65,000 network nodes.

Low in cost, complexity & power consumption as compared to competing technologies.

Data rates ranges are 250Kbps for 2.45GHz, 40 Kbps for 915MHz and 20Kbps for 868MHz band.

Handshaking and 3 Frequencies bands with 27 channels.

Extremely low duty-cycle (<0.1%).

Star, cluster tree and mesh topologies can be used in Zigbee technology with the devices named as network coordinators, routers and end devices.

## **Figure Zigbee Devices Characteristics**

Zigbee Wireless Network used for landing of aircraft

Zigbee technology has been used for landing of the Unmanned Air Vehicle (UAV) and tested. The results showed that the recognition rate is over 90%, and the calculated error of position in landing of the UAV is less than 3m with 5000m distance and 0.2m with a measure of 500m distance. [7].

## **Figure Landing of UAV through Zigbee Wireless Sensors Networks [7].**

As the Figure 3 shows the landing of UAV by using Zigbee sensors so we propose that Zigbee devices can also be used to control the aircrafts or UAV's for taking off purposes too so that the function of auto pilot can be used in an unfavorable climate conditions for safety and security purposes.

## **Figure Proposed Future Concept of Taking off of the Aircraft through Zigbee Sensors**

Proposed Fly-By-Sensors (FBS) over Fly-By-Wire (FBW) flight control System

In FBW flight control system, as the all electrical signals to Electro Hydraulic Actuators, Aileron, flap, rudder etc. are transmitted through wires. So the cost and weight of electrical wires limits the FBW control system to the commercial aircrafts only. Moreover, maintenance and troubleshooting of the faulty electrical wires consumes time and cost. The Safety and security of FBW flight control system is costly and non reliable for long term usage.

Whereas, FBS flight control system will have the following advantages over FBW or PBW:

It will be cheaper to use Zigbee technology than using electrical wires as it will costs almost 80% more than using the wireless sensors.

The low power feature of Zigbee wireless sensors makes it to use for years without rechargeable batteries.

The operating radio frequency is license free that is 2. 4GHz with 16 channels

FBS control system will provide the safe monitoring system for controlling the aileron, rudder, electro hydraulic actuators etc.

The Zigbee wireless sensor can also provide the Voice communication between pilot and co-pilot and the remaining staff for commercial aircrafts.

The promising features of Zigbee technology will improve the reliability in the in-flight fault diagnostics and identification (FDI) as well as fault-tolerant control (FTC).

By using Zigbee wireless sensors we will achieve the remarkable decrease in weight of the aircraft that will also help in more stability of the aircraft. At the result, there will be increase the number of passengers, goods or any material for transport purposes etc.

Proposed Fly-By-Sensors (FBS) Flight Control Systems Block Diagram

Structure

## **Figure Block Diagram of proposed FBS flight Control Systems**

As Figure 5 shows the commands from the Pilot or from the Autopilot function of the aircraft will transmit by Zigbee Wireless Sensor Network through the on board computer on the aircraft. This technology will also be used for voice communication and other communications purposes in aircrafts.

### **Conclusion**

The proposed idea of Fly-By-Sensors (FBS) flight control system by using Zigbee Wireless Sensors will be better than Fly-By-Wire (FBW) if it will be employed on the air vehicles. Specifically the decrease in weight, manufacturing cost, maintenance costs, troubleshooting time, power consumption, fuel consumption and increase in stability, reliability, safety, security etc. will bring the remarkable benefits to the aircraft industry.

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