# Intelligent Runway for Aircraft

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## ABSTRACT
Safeties aboard aircraft are one of the necessary ways for reducing the fire risk in aircraft using the special sensors. As this technology helps reduce the rate of damage to 75% or more, as it is distinguished by its number of special sensors and sensors in tracking movement when the plane descends on its own runway where a fire occurs outside the plane. In this system, the first sensor is pumping special material to extinguish the fire and when the plane exceeds the first sensor the second sensor works while the first sensor is stopped when the plane crosses it; there is a special camera that tracks the movement of the plane and photographs from the front; the plane can be controlled in tanks manually where it contains a number of 8 tanks and metabolism. When the weather falls to zero, the program will issue an alert. The system was designed using the Visual Basic.net 2012 program and linked to the Arduino control piece, which is a piece that is programmed through a special program in Arduino, with a motion sensor link and a number of LED and MOTOR Air. And the goal of the system's work is to develop technology to fully protect aircraft from combustion.

## Keywords
Aircraft, runway, fire research, special sensors, Arduino .

## 1. INTRODUCTION
The subject of aircraft fires is a prickly issue, and we should think about this issue from all directions. Until we know how to extinguish aircraft fires, we must first understand some important information about the aviation industry, such as installing the plane and its parts, and to take a brief history of the aviation industry. Previously, wood, especially the manufacture of plywood was made for aviation for nearly a century. Plywood panels were made up of layers of its fibers orthogonal steel. With the passage of time, due to the increased technical progress there a need for looking for other materials has been necessary. Metal has strong characteristics of high hardness and light weight, so the emergence of metallic aluminum in the 1930s is extremely important; the industry was the promising alternative for the aircraft industry [1-3].
Security is one of the most significant issues that airplane planners think about most, as well-being is essentially for the travelers and team of the airplane, which therefore gives the important help to the turn of the airplane production wheel [4][5].
Safety on board airplane is one of the primary distractions of airplane producers and carrier organizations. But since the casualty rate on the world fleet has demonstrated little improvement over the most (recent ten years) more endeavors are as yet important to diminish the occurrence rate and increment the traveler and group survivability notwithstanding the foreseen increment of the flight related traffic [6] [7].
Since fire is one of the most dangerous hazards of aircraft, the potential fire area of today's multi-engine aircraft is protected by a fixed fire insurance framework. A fire zone is an area or area of an aircraft that is constructed by the manufacturer and requires fire detection, additional fire fighting hardware, and a high level of inherent fire resistance. The term "fixed" refers to a permanently installed system in contrast to any type of portable fire extinguishing equipment (such as hand-held halon fire extinguishers or water fire extinguishers). This can be a complete fire protection system on modern airplanes and many old airplanes [8] [9],
In an ongoing period, numerous kinds of programmed alarm frameworks are utilized in aircraft [10], which hold on for certain issues. For instance, identification techniques utilizing warm indicators are sometimes influenced by transient current. Smoke alarms can be influenced by different gases created in freight compartment. Because we regularly get deceptive false alarm, fire location frameworks depend on single sensor input and this does not address the issues of genuine alarm. In perspective on the abovementioned, Fake Neural System based alarm framework is more perfect than customary alarm framework since it can insightfully handles the multi sensor data online due its enormous equal preparing ability [11-13].
In [14][15] the authors discuss techniques that figure the region fire and that diminishes or limits the control fires harm. The order and utilizing minutes highlight extraction with K-Means grouping calculation in remote detecting, flames and blasts. This is significant in various dangers, such as danger in the wellbeing of work force and the survivability of aircraft both in peacetime and during battle activities[16][17].
The rest sections of paper are as follows: section 2 presents Advantages of system, section 3 illustrates program worked through image, section 4 illustrates the extinguishing methods aircraft, and sections 5 and 6 present Aircraft components and Causes and opportunities for aircraft fire, section 7 presents Plane Combustible Materials .Finally, the conclusions within future suggestions are given in Section 8.

## 2. SYSTEM ADVANTAGES
Modern aircraft have great potential for the safety of passengers and crew. For example, in the past, the evacuation of the plane needed 2 minutes, with a number of passengers not to exceed fifty, but now in the proposed system safety measures for the largest aircraft work to remove passengers in a record time ninety seconds (90 seconds) is spent.
Among the important matters in safety and rescue procedures, firefighting systems, what are the systems that are included within the aircraft?
Fire detection systems: They are systems that adopt the early detection of the possibility of fire, by sensing smoke, gases and heat.
Firefighting systems: what is the work in the event of a fire? That by pumping anti-combustion materials
All modern aircraft now have fire detection and firefighting systems that have proven effective, but this does not mean that there will be no fires. Statistics have proven that accidents,

which are Emergency, are the biggest cause of fire, not aircraft systems and devices where the aircraft experience some accidents either during flight or when landing Then ,lands firefighting teams can intervene to stop the spread of the fire,

## 3. PROGRAM WORK

1- At beginning, we will explain diagram all program in the clustering algorithm in remote sensing in Figure (1). Where Arduino piece is connected to the computer and then the special call button is pressed into the program. You can confirm the work of the program and the sensors placed through the box at the bottom where the signal or any movement over the sensor arrives, the system issues an alarm and turns from the number zero to the number one, and remains zero in case not working or a non-movement occurring

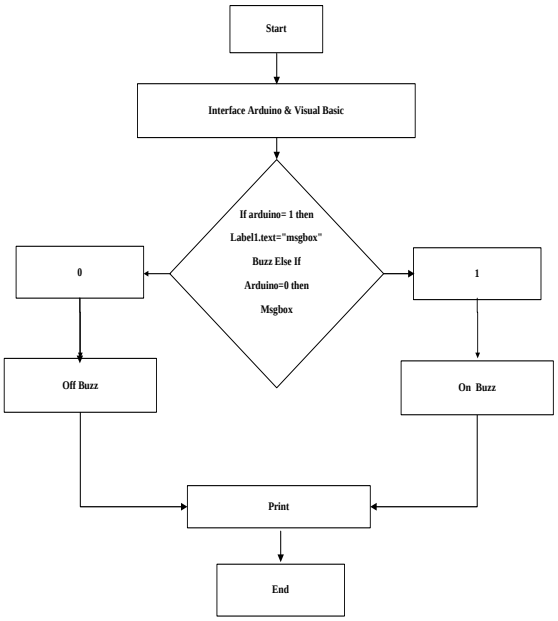


**Fig 1: Algorithm in remote sensing**

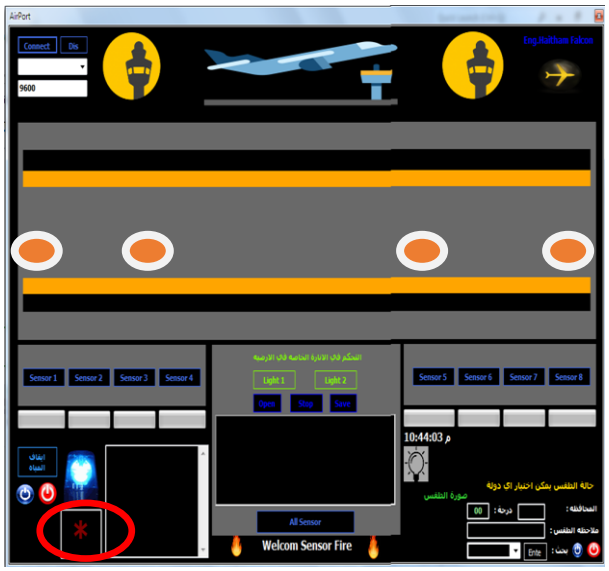


**Fig 2: Home Page for system**

2- In Figure (2). Shown the home page system .Where the system contains a number of special tanks in extinguishing fires, which are working manually or Auto in just the passage of the plane from above the first sensor. The first tank works and when crossing to the second sensor the first sensor is stopped and the second sensor works and can activate all the tanks manually and when the tank is empty, this will be a notification via an alert message as clarified in Figure (3).

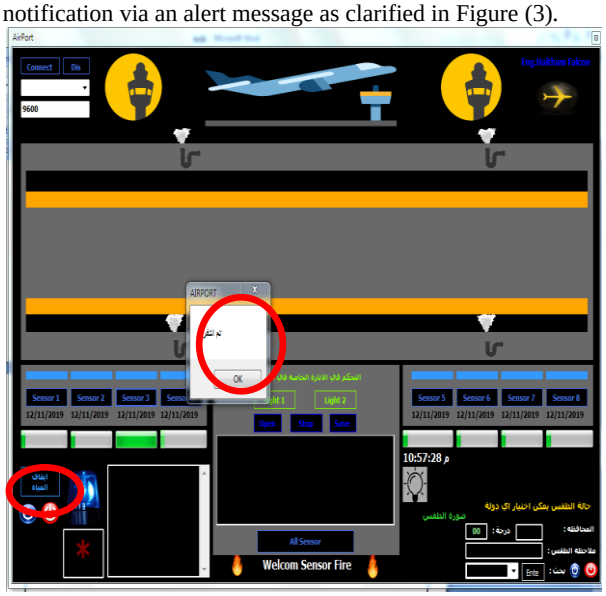


**Fig 3: When the tank is empty**

When the third tank was emptied, attention was paid to it, and the special pipes for extinguishing the fire are placed on the ground; rain water can be used in the process of filling the tanks designated for water, and it may be used from the tank to extinguish fires when necessary and not in the tanks where the basic material is placed To extinguish fires, by using special pumps to water from the runway and help the plane to land in a safe and better way.

3- There is a camera in the half of the private runway in the plane to monitor the plane from all sides and take pictures of it from several sides. The runways private lighting can be activated through the button designated for it as shown in Figure (4)

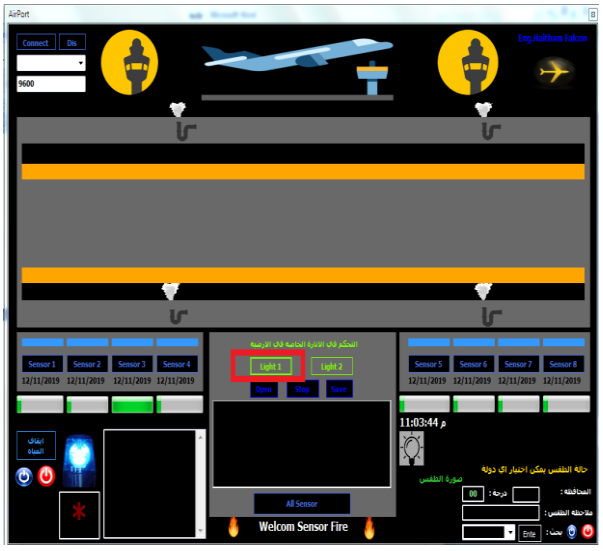


**Fig 4: Private lighting in the runway**

As for the weather condition, it appears through the Internet,

and when the degree occurs below zero, an alarm is issued in that to alert as in Figure (5)

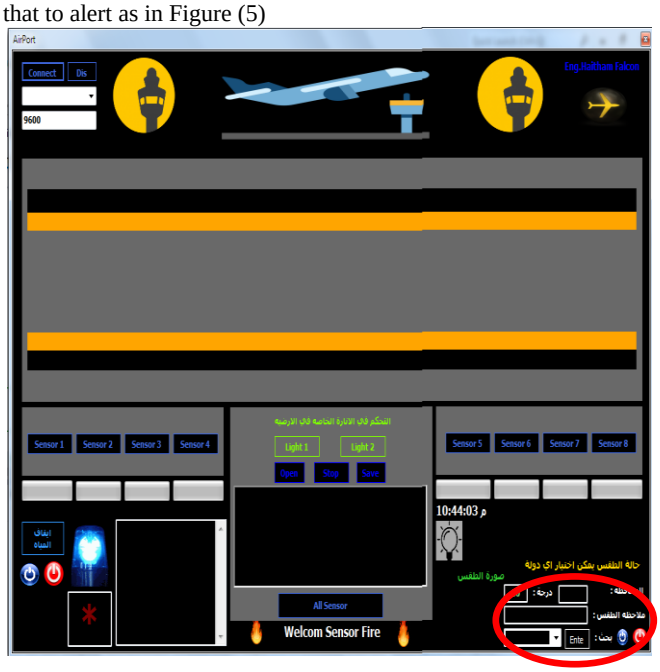


**Fig 5: weather condition**

## 4. EXTINGUISHING METHODS:

The aircraft are extinguished fire using the following materials:

### 1. CO2

This gas is packed in cylinders under high tension, which is isn't combustible and when fired on fire it comes out of the cylinder in the form of snow fog covering the surfaces of the plane, preventing air contact with fire, which leads to the extinguishing of the fire immediately.

Carbon dioxide helps to extinguish aircraft at an extreme speed, and if it is fired in abundant quantities on the plane in the absence of strong winds, it extinguishes the fiercest gasoline and inflammatory fires in a few seconds.

But carbon dioxide also has defects, as it causes difficulty in seeing and due to its lightness, it loses its effect if the air stream carries it away from the fire, which requires when using it always take the appropriate position on the fuselage, i.e. directing directly in the direction of the wind as close as possible to the burning plane.

Another disadvantage is that the surface that is extinguished by it remains at the temperature of gasoline, so it must be cooled well after extinguishing for fear of the risk of sudden ignition.

### 2. Powder Chemical Power:

This powder, which is a chemical compound, It is packaged in a steel cylinder in powder form under high pressure and is driven during use; covers the burning surface and floods the fire area to prevent oxygen from entering from the fire area, so the fire is immediately extinguished. The defect of this substance is almost the defect of carbon dioxide

### 3. Foam materials:

It is a mixture of water and viscous chemicals. When mixed under high pressure, it will produce a large amount of foam material, covering the combustion surface, preventing oxygen from reaching and extinguishing the fire.

The foam is distinguished from other extinguishing materials by preventing the evaporation of gasoline, thus reducing the risk of fire, and excludes the possibility of fire again after extinguishing it.

The disadvantages of the foam material are that it is not considered a complete refrigerant. Accordingly, it becomes clear that the task of firefighters and firefighting does not end with just extinguishing the fire, but must be made after extinguishing it, that the temperature of the extinguished fuselage body has decreased to the degree that prevents the occurrence of sudden ignition.

### 4. Fog Generator:

The water mist is produced by pushing water with a certain pressure in the hose. Then the water becomes mist-like very small particles, these small molecules have a lot of energy to absorb heat.

And the fire area can be submerged with this spray to cool down the temperature, and spray is also used to protect and help firefighters from the heat and enable them to storm the plane to save the passengers.

It should be noted that the task of using this spray must be assigned to a firefighter with sufficient knowledge and experience, as he must warn of getting too close to the plane in order not to disrupt the efforts of firefighters and to limit his work to cooling the air around the plane only.

### 5. Caution Heavy Water:

One of the properties of gasoline (fuel) is that it floats above the surface of the water and does not prevent it from igniting in this situation; therefore:

1-If a severe water stream sheds light on petrol or burning fuel, the water will flood a large area of the land carrying with it the burning gasoline, which will lead to extending the danger to another area or areas that were safe from fire.

2- In the event that the fire ignites at the bottom of the tank, then abundant water can be used by pouring it into the tank to occupy the place of gasoline, which leads to the extinguishing of the fire immediately.

## 5. AIRCRAFT COMPONENTS:

The plane consists of two main parts, namely the chassis and the engine (motors).

### 1. Airframe:

The structure of the plane consists of the body, wings, and the tail group. In the design and manufacture of this structure two main characteristics are taken into account, which are as light as possible and strong; the metal of aluminum has the first characteristic which is lightness and there is no second characteristic which is hardness; this problem had to be resolved and after painstaking research was reached to an alloy (and metallic alloys) a mixture of several metals

according to specific proportions was used; codified mixing and manufacturing that ends with heat treatment in a special way) consists of aluminum metal and magnesium metal called (Dior aluminum); this alloy succeeded in combining the qualities of strength and lightness together, as Magnesium is one of the highly flammable materials with very high temperatures. The Dior aluminum alloy is also a highly flammable material with high temperatures.

## 2. Thermal sources and motors

Airplanes contain a group of systems and devices, which work to provide them with what they need, and these systems operate in more than one way and manner.

### *1. The engines:*

Among the most important parts of the plane and entrusted to it is the production of the force necessary to complete the air operations, such as takeoff, flight and landing, which is in more than one type; what we care about is that it is a great thermal source as the heat of the combustion chamber reaches more than 1000 degrees Celsius (1000 C), as well as heat Gases from the engine extend outside the engine (these gases were one of the reasons for the burning of the Concorde plane.

The engines are provided with fire detection / protection and extinguishing systems, both inside and are connected to the cockpit, for emergency use.

Motor fires do not pose a serious threat, as detection and protection systems warn the pilot of a high temperature in the engine, and the extinguishing cylinders attached to it are sufficient to put out the fire, taking into account the pilot's safety measures in place, to prevent the spread of the fire and its connection to fuel tanks and to prevent an unexpected disaster. Secondary power units (APU) are attached to the engines, and their mission is to provide the necessary energy to the plane, before and after stopping the engines from running, which are small engines, taking advantage of their energy to produce the necessary electrical energy for the plane; they are protected in the same way as the engines.

### *2. Electricity:*

It is represented by units operating with electricity and electrical wires. The danger is that if the insulator thaws from these wires and causes it to produce an electric spark that will be able to ignite the fire, especially in the groups of wires passing through the fuel tanks (as happened to the Boeing727 of Japanese Airlines).

Modern aircraft rely on optical fibers and electrical wires, especially for the transmission of electricity and information as for the resulting fires; they end quickly, and are detected by fire detection systems, unless they extend to fuel tanks.

We cannot ignore the effect of static electricity and the electric energy resulting from it in electrical discharge. In the event of a defect in the discharge system, charges may be generated that cause fire, and in addition to what the plane is subjected to by lightning strikes from clouds.

### *3. Wheel set:*

The heat in the wheel set is caused by the friction caused during the braking process. The braking system in the aircraft operates using hydraulic pressure, which is a non-flammable liquid, as the pressure affects the brakes or bits of the braking to produce the necessary braking by increasing the friction, and this friction produces heat that may reach more 500 ° C (500C) (the Fokker plane 28 has a braking temperature of 200 ° C / 200 C); it may cause the tire to ignite sometimes in which gas expands inside the frame when the brake unit is broken and this type of fire is usually in the wheel unit. As long as it does not reach the wing area where the locker tanks D is good, this accident usually affects the fuselage more than it causes fires.

It is useful to know that the tires in the plane's wheels set use nitrogen gas in the filling, which is non-flammable gas, and the pressure inside the tires varies according to the design, for example, for the company's planes:
Airplane Type Front Wheel Set (PSI)
Fokker - 28 90 70
Twin Otter 38 32
As for modern aircraft, they contain systems that sense the heat caused by the braking, so that the pressure results from the expansion of gas inside the tire in the event of a rise in temperature.

### *4. Friction:*

By this, we mean friction with the hull of the plane for any of the reasons, perhaps the most famous of which is the failure of the landing units (wheel group), so that the pilot of the plane is forced to take emergency landing procedures that require the plane to land on its lower body (the belly of the plane). This friction produces a high temperature that causes the surrounding area to rise, and it is usually the fuel tanks that ignite as a result of the heat. In such cases, it reduces the volume of existing fuel after sliding on the runway floor.

## 6. OPPORTUNITIES AND CAUSES OF AIRCRAFT FIRE

1 - Collision: If it hits the ground or another aircraft or a mountain, the collision will cause structural components and engines to rupture and cause the burning fuel to overflow, thereby igniting all combustible materials it passes, and the structure will burn.

2 - Friction: If an aircraft is taxiing on the runway, whether it is due to bad weather, technical failure of the gear train or human error during take-off or landing, the part that enters the runway will be heated strongly, generating enough heat to ignite and burn the aircraft.

3 - A thunderbolt: If the plane was hit by a thunderstorm.

4 - Fuel leakage: due to a malfunction or technical faults and the occurrence of an electric spark that comes into contact with the fuel and ignites it in the leakage area.

5 - Faulty landing: the last stages of a plane landing, i.e. the failure to land properly, may lead to certain combustion.

6 - Engine defects: the engines, like other industries, are on fire.

7 - Technical faults: There are faults that lead to a fire without any introductions.

8 - Operational errors: it is a violation of one of the work crews of the operating systems and went out of it; this

inevitably leads to a fire.

9 - Human faults: such as maintenance errors by technicians, the use of expired parts or carrying flammable materials.

10 - Unknown reasons, as many aircraft fires have no known cause.

In addition, there are other related matters aircraft fires:-

## 1. How do aircraft fires happen?

Often what happens to aircraft fires if it hits the ground, is the fire which is the biggest thing that happens, then the plane's fuselage hits and then it rocks the ground violently, causing a high temperature that results in the plane igniting in seconds

The airframe includes all the fuel needed for the flight in the wings, which is a very large amount (up to 70 tons in giant planes such as the Boeing 747) and the fuel that is used in jet engines is kerosene, a liquid that must have several characteristics and is to be evaporated and highly flammable. It has a high fluidity and is not freezing at very low temperature (58 degrees below zero centigrade) in the high altitudes the plane reaches, and these are all characteristics required for combustion within the engine, and the plane's structure attaches to or includes engines (depending on design).

The hull of the passenger plane includes furniture such as the seats made of cloth stuffed with foam (foam) and the walls and partitions made of plastic materials.

## 2. Aircraft Firefighting:

In order to extinguish fire, it can reduce the temperature by cooling, and prevent oxygen from entering the fire by insulating the inflamed surface. As for removing of material (starvation), this is almost impossible in an airplane fire, but by making the airplane a non-flammable material, it is implicit, so it covers it with an oxygen insulation material

It is always taken to prepare in airports to combat two types of fires (aircraft fires - and facility fires) and each requires different methods of extinguishing and firefighting work. The speed factor in extinguishing aircraft fires must be estimated as the direct fire and rescue operation takes place simultaneously, as it occurs in sudden fires where the pilot does not have a sufficient chance to get rid of fuel with the minerals melted

Sometimes in less than 90 seconds, firefighters believe that if the delay in starting conventional firefighting will increase material loss, then the plane fire will put innocent lives in great danger and increase the most precious material loss. Therefore, airport firefighting and firefighting are an important issue. Subtle technology, the process from beginning to end; it requires constant training and practical exercises to obtain adequate and necessary technical expertise while facing the real danger in aircraft firefighting work.

## 3. Rescue duty of plane passengers:

By that, we mean saving lives that are threatened inside the plane, so this duty should not be neglected while fighting the fire. Rescuers prepared for that and chosen from among firefighters must always motivate and prepare to storm the plane as soon as they are able to approach them to perform their highest duty, which is saving lives. The squad leader must come closer with an appropriate opportunity to order the squad to do so, and the process of saving lives in fires must be a priority, given that it is a delicate and bold operation that contains a very large number of passengers, especially in giant aircraft.

## 7. PLANE COMBUSTIBLE MATERIALS

1- Fuel: It is a flammable material, and its flammability is used by burning it with the air inside the combustion chamber, to manage the engine. The fuel is stored in its own tanks that are concentrated in the body and wing of the plane, by exploiting the existing voids. These tanks are usually secured, and provided. Some planes have fuel unloading units in danger.
2- Furniture and furnishings: Although these parts are made of non-flammable materials or ignited in a slow manner and do not produce smoke, except that upon burning these materials, they will be burning and dangerous materials.
3- Wire insulators and fillers: They are also flammable.
4- The body of the plane: It is originally non-flammable, as it is a metal in the form of an alloy whose properties differ from the properties of the metal. When the body of the plane in the case of ignition and its exposure to high temperatures, aluminum ignition can reach degree 800 ° C / 800 C), the metal is used in the aircraft because a mixture in the form of an alloy resists heat to high temperatures and after it enters the melting phase.
5- Oxygen: We cannot consider pure oxygen as a flammable substance. The danger is that it will overheat and expand strongly within the cylinders in which it is preserved, and after an explosion, as it helps as a gas to ignite strongly

## 8. CONCLUSION

Safety on board aircraft is one of the important factors to decrease the incident, and it is one of the principles that airplane makers and aircraft organizations should take into account. The fire threat in the aviation industry has been decreasing. This paper discusses the current safety issues of fire detection; this paper helps define the characteristics required for the combustion of composite materials in order to use new advanced sensors for early detection. However, it provides a set of security best practices and a method for determining when and where these enhancements are appropriate. In addition, by using this new system, it provides many security best practices and techniques to determine when and where these improvements are appropriate. And there will be a reduction in human and material losses that were affects all over the world.

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