Airside Collision Avoidance Device (AsCAD)©

CREATED BY: SHINGAI GEORGE

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Chapter 1: BACKGROUND

Introduction

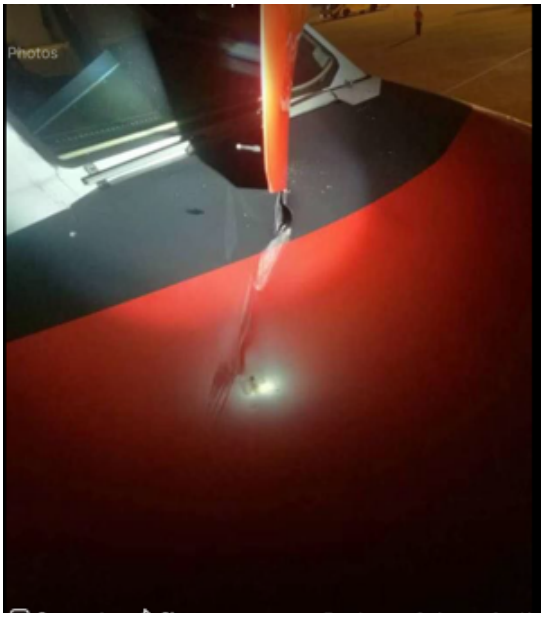
Airside Collision Avoidance Device (AsCAD) is a unit that will assist in preventing collisions between aircraft on ground at airports. The device is meant to address the ground safety needs of major international airports that have many aircraft movements and handle a high number of wide-body aircraft.
The device is similar to an airside safety cone in structure- coupled with a long range motion detecting sensor, which will be able to detect approaching objects (aircraft), which may cause a collision with parked/stationary aircraft. When a potential collision is detected, the sensor will send a cautionary message to air traffic ground control, who will advise the conflicting traffic of the potential incursion. The Unit will also provide the Ground Controller with the location of the potential incursion-therefore each unit/s will be assigned to a specific aircraft stand/gate.

The Problem: Airside and Ramp incidents, a $10 Billion dollar problem

An Airbus A320 collided with the wing of a Boeing 777 while being pushed back from its gate

Ground handling incidents and Airside incursions cost the global aviation industry in excess of $10 Billion dollars in annually. Incidents occur at a rate of 1 in every 1000 aircraft movements. This may seem as if it is a marginal rate- however for every incursion, the impact on airlines, airports and the travelling public is tremendous. Estimates vary, but according to aviation experts, the cost of each incident is approximately US$275,000.

Air Traffic management resources which are already under pressure, are placed under additional strain due to flight cancellations, diversions and extended gate/ramp occupancy duration. Journey disruption has the additional consequence of congesting airport terminals, increasing airport running costs and placing airport personell under stress.



Capital Airlines Airbus A320 collides with a stationary China Eastern Airbus A320

Airlines may be obliged to facilitate alternative travel arrangements for affected passengers with other airlines or surface transportation at an additional cost to the airline involved in the incident. Ground incidents often cause damage to the aircraft structure which requires repair or a replacing a component altogether. Unscheduled maintenance/repair means that airline fleet planning managers have to make contingency plans, to minimise the adverse impact on passengers and the airline's entire network. The personal needs of passengers have to be catered to- hotel accommodation, meals and telephone calls may need to be provided.

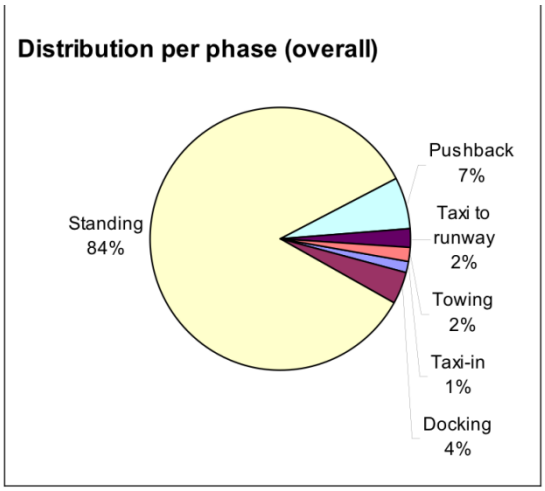
The reputational damage to airlines is difficult to quantify. In the age of social media, information can be distributed globally in a matter of minutes. The affected airline will suffer an unimaginable amount of negative publicity. At the same time, facts may be distorted, and this, at times, hampers investigations into incidents.

The biggest tragedy however is the injury or loss of life that may result from these incidents. No matter the economic impacts, human life simply cannot be measured or quantified by monetary gauges. In aviation, the safety of staff, passengers and the public has always, is always and will always be the priority.

Turkish Airlines A321 had its horizontal stabilizer impacted by with another aircraft

Investigative findings and Solutions for Mitigation

Manoeuvring aircraft, especially a large jet with a sizeable wingspan, in an airport environment is a highly complex exercise. The airside is very dynamic, with people, vehicles and other aircraft in constant motion.
Investigators have noted that the root cause for the majority incursions is poor, or lack of communication, coupled with insufficient of situational awareness.
European Aviation Safety Agency (EASA) studies highlighted that aircraft that are standing/parked, are the most vulnerable to airside incidents or collisions by other moving aircraft.



Incident distribution per phase

My innovation aims to address the insufficiencies in communication and situational awareness by providing adequate caution before incidents occur. Though the AsCAD Unit may be seemingly (in a nutshell) as rudimentary as a safety cone* with a motion sensor attached, it is will have make a significant impact in preventing aircraft-to-aircraft ground incursions.
see schematic diagrams on page 10

At present, there is no technology available, or that has been developed with the purpose that AsCAD aims to fulfil. AsCAD will not entirely eliminate the need for vigilance during manoeuvres on the airside. It will however aid in detecting lapses that may have gone unnoticed and which may lead to incidents. Simply put, AsCAD will act as an "extra pair of eyes'' for Airside staff and Aircraft Ground Controllers.
The need for sufficient airside safety training should not be understated.

Due to the absence of comprehensive information relating to the number and frequency of aircraft to aircraft ground collisions or near misses, mitigation has proven to be challenge. AsCAD will also utilize cloud technology to record and store received warnings in a database. Safety managers or authorized airport personnel will be granted access to the AsCAD cloud via a mobile application and identify potential hazard areas where incidents are likely to occur. This information will also be made available to aviation regulatory bodies.

Chapter 2: The AsCAD Unit- Combining Artificial Intelligence and Motion Intelligence

Method of operation

AsCAD will exploit technology provided by Artificial Intelligence and Motion Intelligence. The AsCAD unit will employ Long range Direction Sensing Infrared Motion Detectors with a sensing range of up to 200 Meters. The sensor will also be able to determine the direction of approaching objects (aircraft). If the approaching aircraft, or aircraft wing is within the cautionary distance and heading in a trajectory that the AsCAD unit interprets as hazardous, the unit will transmit a ‘’potential collision hazard’’ warning to the ground controller; who will then advise the pilot of the impending collision.
In essence, the motion sensor will detect the motion, and the software will interpret the data. The AsCAD unit will much resemble a Safety Cone- therefore it will be placed close to the aircraft extremities which may be exposed to collision such as the tail, nose and wingtips.

Technical specifications

Long range Direction Sensing Infrared Motion Detectors

At the heart of the AsCAD system, is the Long Range Direction Sensing Infrared Motion Detectors. The following are reasons why this type of sensor is the most ideal the AsCAD unit:

- Direction sensing- it will only detect movement that may poses a hazard. Hence will eliminate the occurrence of false alarms.
- Infrared sensing- Infrared waves will not create interference with other radio communications around the airport.
- Weather resistant- Infrared sensors are very robust. They can operate at maximum ambient temperatures of +45 Degrees Celsius and minimum ambient temperatures of -30 Degrees Celsius. Therefore AsCAD units can be used at any airport in the world.
- Resistant to dust, moisture or mist- whether a dust storm, heavy pollution or precipitation, the AsCAD unit will maintain its reliability.
- 180 Degree field of view- wide field of view means better coverage

GPS Location Transmitter

When the motion sensor detects a potentially hazardous situation, a message is relayed to the GPS Location Transmitter which will transmit a “potential collision hazard” warning to the ground controller. The ground controller will know the precise location of the hazard. GPS transmitters are the most ideal, because unlike radio transmitters, they will not be affected by bad weather and are less likely to cause interference with other radio communications around the airport. At the same time, GPS technology offers unparalleled location accuracy. As each unit will be allocated to a specific stand/gate which will be programmed into the GPS transmitter, locating the source of hazard warnings will not be ambiguous.

Lithium Ion Battery (Li-Ion)
The high energy density of Lithium Ion Batteries makes them the ideal power source for the AsCAD Unit. This means each unit can operate longer between charges. Another advantage is the low cost of maintaining Li-Ion batteries.

The Li-Ion batteries on the AsCAD will be charged in the same manner as any mobile phone. When not in use, the AsCAD unit will be placed on a dedicated charging rack- as well, each unit will have a battery meter/indicator so the level of charge can be determined.

Safety Cone housing
The AsCAD unit will much resemble a Safety Cone. Typically, the colour of safety cones is bright Red/Orange, for high visibility. The additional components will certainly make it heavier than a typical safety cone.
Units will be manufactured from Polyamide-imide plastic which is an extremely resilient and stiff plastic material. It is often used in elevated temperature environments where other plastics would lose their mechanical properties. Therefore, even if the AsCAD unit has to be employed at airports with extreme temperatures, it will not deform and expose the internal components (Battery, Sensor and GPS transmitter).
In the unlikely event of a Lithium-Ion battery fire, Polyamide-imide plastic is flame retardant.

Motherboard and Network Interface Controller
The Motherboard is the hub of the AsCAD unit, where the software is loaded. As I alluded to earlier, AsCAD will utilize Artificial Intelligence (AI) in its operation. The use of AI improves accuracy, enhances threat detection and minimizes the occurrence of false alarms.
The Network Interface Controller (NIC) will act as the linking mechanism between the AsCAD unit and Ground Traffic Control.

Hazard reporting and recording
AsCAD will be easily integrated into the general ground movement control framework. Ground Traffic controllers will be able to refer to a monitor in order to locate hazard warnings.
At the same time, the AsCAD will utilize cloud technology to record and store received warnings in a database. Safety managers or authorized airport personnel will be granted access to the AsCAD cloud via a mobile application.
The data that will be stored will include:
- Date and Time warning received
- Location where warning originated

Data can then be collated and analysed to identify areas in/around the airside where the risk of incidents is high. Therefore, if necessary, corrective action can then be taken.

Targeted End Users

The following are the intended end-users for the AsCAD device:

- Airport Authorities and/or
- Civil Aviation regulatory bodies

Operating economics of AsCAD units

- Units will be made to be simple for airside staff to operate. A few hours of training on basic funtionality will suffice.
- AsCAD units can be utilized alongside existing airport infrastructure.
- Very minimal maintenance will be required, meaning less downtime. Maintenance will usually include checking battery for leaks, removing dirt from the sensor and checking the GPS transmitter for functionality. Basic maintenance tasks can be carried out by airside staff and will not require a technician on site.
- AsCAD units will be made to be light weight, minimising the probability of injury for users. However, they will be made robust in order to eliminate the probability of breakage from accidental mis-handling.
- The simple use and ease of application will not require extensive and time consuming revision of airside safety procedures.
- Low cost of development- AsCAD units utilize current and existing technologies.
- The internal components (battery, sensor and transmitter) will be very low power consuming devices, which can be powered with a battery of similar voltage to a mobile phone. (4.2 VOLTS)
- Implementation will not require extensive upgrades or modifications to airport infrastructure.

Chapter 3: IMPACT

POTENTIAL BENEFITS FOR END USERS

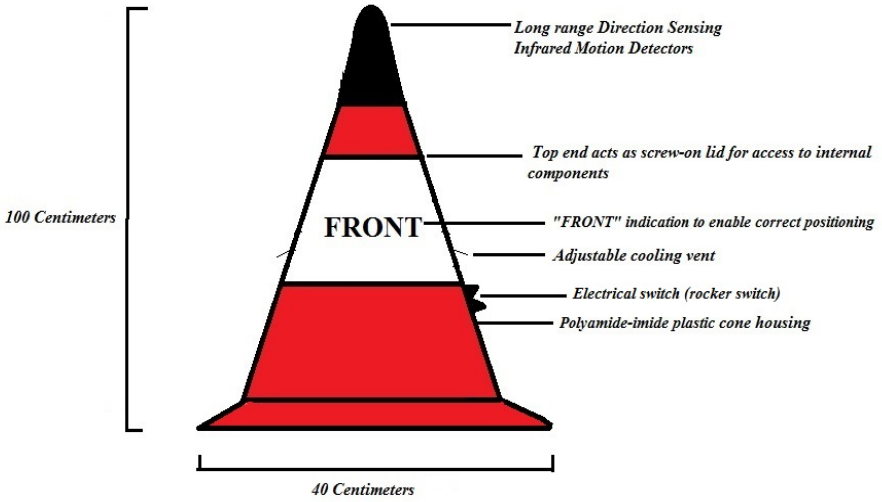
The implementation of AsCAD will have the following tangible benefits:

- The AsCAD will help the global aviation industry save billions of dollars by averting costly ground collisions between aircraft.
- Fewer delays due to incidents will mean improved customer service, and ultimately happier passengers.
- Improved safety for all concerned stakeholders who utilize the airport and its facilities.
- Air traffic management resources will not have to deal with the additional pressure from delays caused by incidents. Reduced pressure will result in minimal airspace congestion and less CO2 emissions.
- Accurate data collection of potential hazard areas around airside will be available. Areas where incidents are likely to occur can be identified and risk mitigation can be carried out.
- Data collection of potential hazard areas will be carried out utilizing Cloud technology-therefore eliminating the requirement for additional IT infrastructure.

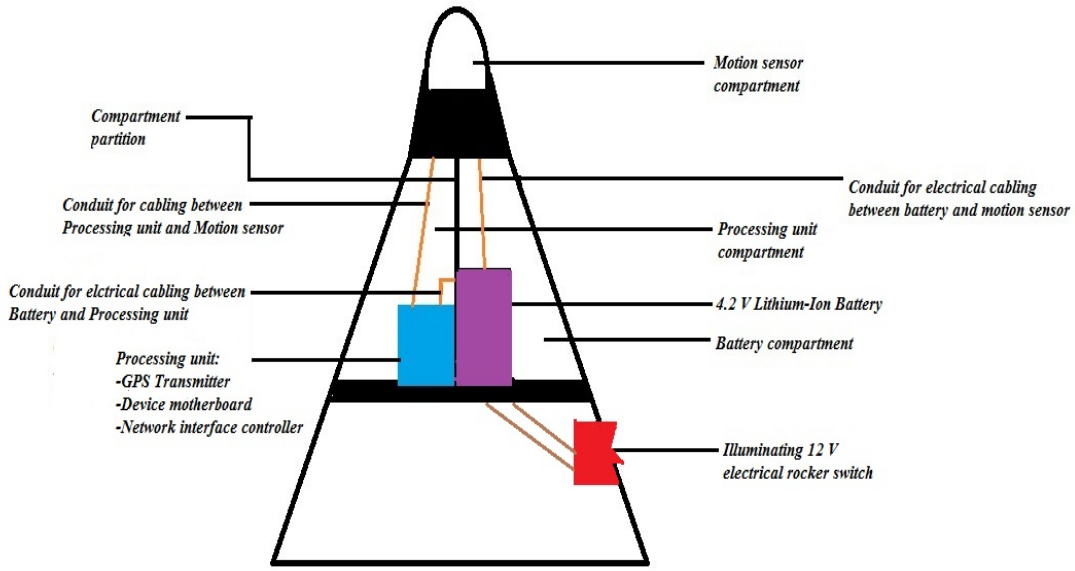
With AsCAD, costly incursions as the one above between a Asiana A330 and a Korean Air A380, will be a thing of the past

SCHEMATIC DIAGRAMS

AsCAD Unit external view



AsCAD Unit internal view



A busy airside with AsCAD Units in place

*Note the red triangles symbolize AsCAD units in their positions.