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Journal of Information Technology & Software Engineering

Research Article

Artificial Intelligence, IoT and their Future on Aviation Safety

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ABSTRACT

Aviation is an industry considered to provide a safe mode of transport, even though that is the case over the past years several plane crashes and missing planes have been recorded. This paper aims to explore some of the technologies that are being adopted and to research new ways of integrating these technologies and techniques to provide a much safe environment for flying, the objectives are to pave way for the development of an aviation system that can detect objects using computer vision, detect anomalies and provide warning to the cockpit crew and most importantly this system be able to override cockpit crew control in certain critical situations where the is the pilot error that can cost lives, with the use of artificial intelligence and IoT.

Keywords: Aviation; Obstacle detection; Anomaly detection; Active smart cockpit; Tone analyzer; Critical safety system

INTRODUCTION

The Internet of Things (IoT) refers to the giant connection of network that connects things and artificial intelligence is the ability for a computer or computer-controlled robot to achieve or perform a task commonly associated with intellectual beings [1]. With the growing applications of artificial intelligence and IoT many industries are adopting these technologies for varying business needs, so has aviation even though the use and applications are still in infancy, the applications of these technologies are vastly limited only to our ideas and time and very important to aviation in the scope that most aviation application is critical-system which failure can lead to tremendous loses.

Although air travel has and is still considered the safest mode of traveling, there are still some present dangers in aviation. The disappearance of Malaysia MH370 on March 8, 2014, the crash of Germanwing flight 9525 on March 2015, and the latest Sriwijava air Boeing 737 passenger plane. While aviation involves the continuous collection and monitoring of flight data and storing using FDR, ADS-B, FDUA even though these technologies are and have been in use for several years they have been severely lacking and have necessitated innovative multi-disciplinary technologies for ensuring aviation safety [1].

It is presently clear today how artificial intelligence is been used to train computer agents, that with a high level of accuracy can learn supervised or unsupervised and be able to perform a task with close to almost human intellect. Clear evidence of this is when January 2020 last year Airbus executed a successful fully automated takeoff with aims to fully automate the taxi and landing [2]. This system wants to take a radical approach deviating from the traditional use of flight data recorders, which are only useful when the crash plane is found and if the flight data recorder is not damaged, relating to various parameters applicable to explain the incidents or moments before and leading to the crash [3]. Replacing it with an active cockpit voice recorder, that will be able to analyze the pilots and with Artificial Intelligence be able to decide to notify the command center of a potential threat and with IoT enabling such communications possible.

Analytics, system management, customer service, and a variety of other processes and activities can all benefit from artificial intelligence and its computational skills for data interpretation. Artificial intelligence has already shown promise in a variety of fields, including banking, commerce, retail, and health. In the aerospace industry, Artificial Intelligence (AI) can assist corporations expedite manufacturing while also addressing safety concerns. Furthermore, AI systems can examine data from a variety of sources and process large amounts of data much faster than humans.

Related work

Safety has always been a major concern in aviation, making sure

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Received: September 15, 2021, **Accepted:** October 01, 2021, **Published:** October 08, 2021

Citation: Njolomole Z, Kalimuthu R (2021) Artificial Intelligence, IoT and their Future on Aviation Safety. J Inform Tech Softw Eng. S5: 002.

that all systems in the airplane are up and running and working properly. Hence development and research in this area have gained some pace to realize a safe system, one such project is the AMELIA: Aircraft Monitoring and Electronically Linked Instantaneous Analytic [4].

- A multi-layered edge computing system that detects automatically aircraft emergencies.
- Transmit only relevant data for quicker emergency responses.
- Help pilots communicate with outside expects to prevent crashers.

MATERIALS AND METHODS

To achieve the objectives of our research the following proposed techniques and models will be explored.

1. Obstacle detection using computer vision onboard, the aircraft system using integrated artificial intelligent agents, should be able to recognize obstacles that can compromise the aircraft safety, give warning to the pilots and with the collaboration of human behavior science experts, give a time interval for the system to wait for a response from the pilots [5-8].
2. Anomaly detection: Giving past data of airplanes that crashed or went missing, this might be the most data-intensive process to figure out peculiar scenarios that led to the crashes or disappearance of those plans and also coming up with likely scenarios that may cause such devastation, as a philosopher George Santayana said over 90 years ago "those who cannot remember the past are condemned to repeat it". These anomalies are not limited to but are inclusive of humans too. In instances of human anomalies the system has to provide a warning to the cabin crew, wait for a response if no response is given two things should be done by the system [9-12].
   - Inform the command center of the possibility of the threat at hand and wait for further instructions.
   - in-case of communications failure and pilots unable to respond to the system warning, the system has to engage itself into auto-pilot for a couple of minutes staying on course and with the help of obstacle detection avoiding crashing it into mountains and buildings.
3. Active smart cockpit and tone analyzer recorder: This will work like the traditional flight data recorder (black-box, FDR) with a twist, this proposed technique makes use of natural language processing to analyze tones in the pilots' voice to make distinctions whether they are panicking or not. A panic tone in a pilot might signal something serious, especially when dealing with critical systems in an industry like aviation [13-16].

While the active smart cockpit will start transmission of relevant data back to the ground and only storing a portion of data before, this will be of particular interest in cases where the plane might disappear, the ground crew will be able to be part of the unfolding events and be in a better position to make informed decisive decisions to help prevent such an accident from happening.

The objective is to develop an aviation system that can be deployed to any passenger aircraft, with the integration of AI and IoT to ensure the safety of the aircraft, people, and the company by trying as much as possible to avoid and prevent such unforeseen circumstances from happening using available data and unsupervised learning to help the system understand and learn better of the different situations that are dangerous in aviation.

The system designs include multiple diagrams such as the architecture diagram which emphasizes the overall design of the system operations that describes the structure, behavior, and more views and analysis of performance. In logical design, the input and output of data in the system of an abstract representation of how data flows. It includes Entity-Relationship diagrams (ER diagrams). While physical design dwells much on how inputs and outputs are explained relating to how data is feed to the system, and how that data is processed. Divided into many parts systems design gives a glimpse of how the project will look like from the user's point of view. In the system, we use system architecture, UML diagrams, and data flow just to show how the system coordinates [17].

System architecture

System architecture is the process of defining the components, modules, interfaces, and data for a system to satisfy specified requirements. The following is the architecture for the system (Figure 1).

RESULTS AND DISCUSSION

Event detection algorithm

Traditionally event detection algorithm is used to track and monitor processes or tasks to identify occurrences. In recent year's people in this domain used to perform this task manually from collected data for events of interest [5]. Here, our system has to be able to automatically perform this task and be able to detect events of interest that may be critical or can affect the safety of the aircraft and passengers onboard.

Anomaly detection AI algorithm

Anomaly detection AI algorithm is used to observe deviation from normal behavior. That detected behavior that does not behave normally is called outliers [6]. Depending on what anomalies can be included in our scope and other unseen anomalies regarding the aircraft.

Deep learning techniques

This technique is used to imitate the functionality of the human brain, by creating models used for classification and these models are made up of several layers of hidden layer called neural networks which can extract features from the data. Each layer starting from the left-most layer to the right-most layer extracts a low-level feature-like edge and subsequently predicting accurately.

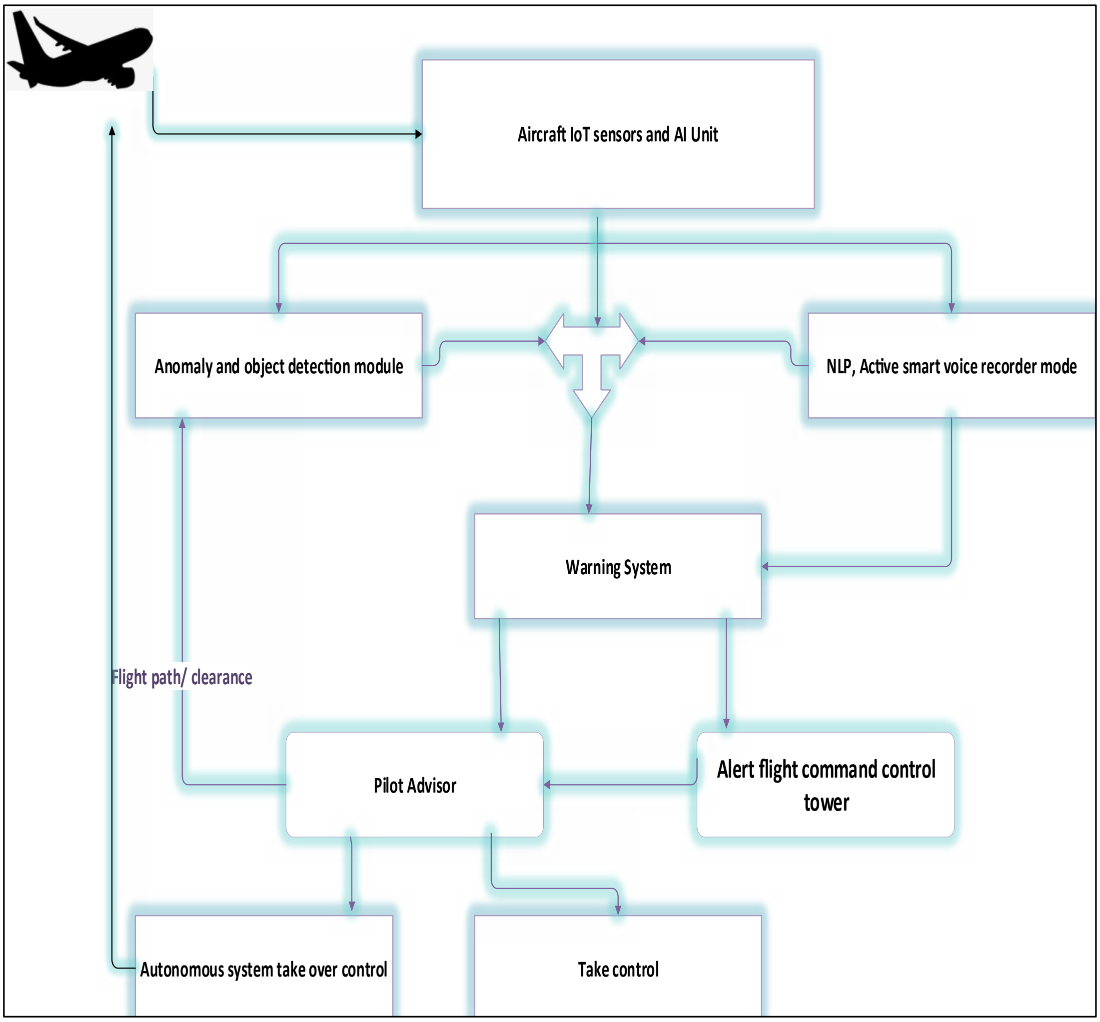

Figure 1: Overall system architecture.

CONCLUSION

In conclusion, the system is aimed to provide a high level of safety for aircraft by integrating human capabilities with artificial intelligence and IoT to enable the aircraft to make critical decisions in critical scenarios and to enable communication of relevant aircraft data and communication with expectations in situations of a possible crash.

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