

Reducing Go-Around Attempts Based on History of Successful Landings for Aviation in General [†]

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Abstract: Nowadays, flying is a fundamental part of society. Traveling is increasingly accessible, which supports not only the aeronautical industry but also the tourism sector in some regions around the world. However, despite its importance in society in general, where there are more and more airplanes in the air, the aviation industry has also become one of the primary sources of pollution, and when considering entertainment aviation, the problem becomes even more complicated. In recent years, all aeronautical manufacturers have been working on solutions that reduce the sector's impact on climate change. Landings are of particular importance in the fuel consumption aspect, especially if it is taken into account that for various reasons a pilot may decide to abort the maneuver, meaning a few more kilos of fuel that will be consumed consequently making more pollution. The present work suggests an architecture based on the history of successful landings providing the pilot suggestions to reduce the probability of a go-around.

Keywords: aviation; go-around; landing; fuel; safety

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1. Introduction

The go-around maneuver is performed when pilots understand that there are not the proper safety conditions to continue the landing. It can happen for different reasons, such as an unstable approach, severe weather, a request by the ATC, etc. It is a normal procedure in general aviation allowing the landing to be made safely [1].

However, despite being a planned action in an aeronautic context, a go-around procedure is always associated with extra fuel consumption because a new landing attempt is required [2,3]. The value of this extra fuel consumption is directly linked to the time that the aircraft needs to be in the air until it makes a successful landing. This time can vary for different reasons: the airport in operation, the aircraft type, the weather conditions, and the number of planes in the queue to land, among other factors [4].

The weather conditions are often one of the main reasons for performing a go-around maneuver [5]. Despite this, in situations of adverse weather conditions (within the established safety parameters), the professional experience [6] of some pilots allows for a safe landing without the need for a go-around maneuver.

This paper presents a theoretical solution that, based on the history of successful landings for adverse operating conditions (e.g., bad weather), suggests, within the operational safety parameters, small changes in the mode of operation (e.g., speed, rate of descent, route, position of the aircraft). The rest of the paper is organized as follows: Section 2 details related work, the architecture is detailed in Section 3; the conclusion and future work are described in Section 4.

2. Related Work

In the literature of the area, there are some solutions that study and analyze the go-around maneuvers in order to maintain and/or increase the level of operational safety.

In [7], the authors analyzed the go-around maneuvers performed in 2019 at the San Francisco airport based on data taken from the OpenSky Network. The go-around maneuvers, using the HDBSCAN clustering algorithm, have been categorized, which allowed the identification of the unusual go-around maneuvers and the understanding that most of them were linked to energy management problems.

In another example [5], using simulations, the authors used machine learning models to predict go-around maneuvers. This study concluded that the decision to go around was very subjective based on the pilot's behavior, experience, and flying skills.

Finally, the authors of [8] study the go-around maneuvers having as their main objective to provide a tool that assists the ATC in deciding whether an airplane should start a go-around maneuver in the final approach.

Despite all the potential that the solutions illustrated previously have, none of them have their focus on providing a tool that assists pilots in the final approach. The main goal of this paper is, based on the history of successful landings for the same conditions, to provide operation suggestions to pilots to increase the likelihood of landing without the need to resort to a go-around maneuver.

3. Proposal Solution

Although it can be applied to both commercial and leisure aviation, as already referenced, the proposed solution is only technical because of the sensitivity of the data required for its implementation.

In relation to commercial aviation, the solution presented is implemented using data provided by current ADS-B systems [9] and solutions that provide real-time meteorology data [10]. In this way, using artificial intelligence algorithms to correlate the plane parameters (route, speed, etc.) with climate data (temperature, wind, etc.), it is possible to categorize, although in a limited way, possible patterns to increase the probability of a successful landing in adverse conditions (e.g., severe weather).

In leisure aviation, the proposed solution has a greater relevance, since it becomes possible to access data such as speed, route, position of flaps, engine power, and other important parameters that allow tuning the data model in a deeper way.

In Figure 1, it is possible to analyze the architecture of the proposed solution. Inside the plane, a Raspberry Pi [11] is placed that allows for some physical connections to access the necessary inputs. The Raspberry Pi has been chosen because it is a small device, allows physical connections, and it is possible to add a SIM card.

An application is put in the Raspberry Pi containing a set of smart algorithms which analyze the data received and produce suggestions in order to increase the probability of a successful landing for that context.

In most cases, the use of artificial intelligence algorithms requires [12] hardware with a large computational capacity. As it is a relatively small execution environment and as the Raspberry Pi does not have the computational capacity needed to process the data and algorithms, to accelerate the processing, this proposed solution uses edge computing tools such as rOpenCL.

rOpenCL [13] is a tool that allows the execution of OpenCL code in several remote accelerators as long as there is a TCP/IP network available. In the context of the current solution, the application on the Raspberry uses the rOpenCL tool to speed up the processing of incoming data. All data transfers between the Raspberry and existing accelerators in the cloud are performed over a VPN connection and using the 5G network (SIM card installed in Raspberry for this purpose).

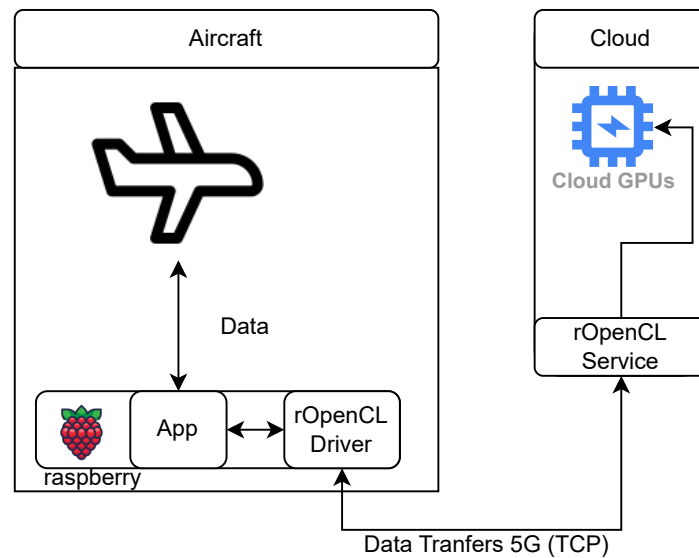


Figure 1. The architecture of the proposed solution.

4. Conclusions

Today, combating climate change is an increasingly important issue. It is recognized that the aeronautical sector is one of the sectors that contribute to climate change [14] as a result of the fuel consumption carried out during each flight. Considering that there are more and more airplanes in the air, this problem becomes even more critical.

The go-around maneuver, despite being a procedure in aviation in general, consumes extra amounts of fuel when performed. The potential of the presented solution becomes clear. Although it is not a recurrent maneuver, reducing its number of uses has a direct impact on the pollution produced by this sector. Nevertheless, it is important to understand that the final decision is always taken by the pilot who is in command of the landing.

Finally, in leisure aircraft, this solution should be easy to implement because access to the data is relatively easy to obtain. Moreover, currently, edge computing solutions and technologies for data transfer exist that allow the production of useful runtime results. However, in commercial aircraft, the potential of the solution may be compromised since data from existing ADS-B systems and weather APIs may not be sufficient.

Future Work

The points identified for future work are:

- Perform tests with leisure aircraft to understand the viability of the solution;
- Apply machine learning algorithms to data from ADS-B systems, understanding whether they are sufficient to obtain results;
- Understand if this solution can be used in other phases of flight for fuel savings.

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Abbreviations

The following abbreviations are used in this manuscript:

ATC Air Traffic Control

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