engineering proceedings

Proceeding Paper

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

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† Presented at the 4th International Electronic Conference on Applied Sciences, 27 October–10 November 2023; Available online: https://asec2023.sciforum.net/.

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 also becomes one of the primary sources of pollution, and when considering entertainment aviation the problem becomes even more complicated. In the last 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's taken into account that for various reasons a pilot may decide to abort the maneuver, being a few more kilos of fuel that will be consumed and consequently made 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

Citation: Alves, R.; Matos, P. Reducing Go-Around Attempts Based on History of Successful Landings for Aviation in General. *Eng. Proc.* **2023**, *52*, 0. https://doi.org/

Academic Editor: Firstname Lastname

Published:

1. Introduction

The go-around maneuver is always performed when pilots understand that there are no safety conditions to continue the landing. It can happen for different reasons as an unstable approach, severe weather, a request by ATC, etc. It's 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 gets a successful landing. This time can vary for different reasons: the airport in operation, aircraft type, weather conditions, and 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 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 operations conditions (e.g., bad weather) suggests, within the operational safety parameters, small changes in the Mood 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 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 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.

Another example [8], 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 study [9] the go-around maneuvers having as the 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 perform 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 [10] and solutions that provide real-time meteorology data [11]. In this way, using artificial intelligence algorithms, to correlate the plane parameters (route, speed, etc.) with climate data (temperature, wind, etc.), it's 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's possible to analyze the architecture of the proposed solution. Inside the plane is placed a Raspberry Pi [12] that allows some physical connections to access the necessary inputs. The Raspberry Pi has been chosen because it's a small device, allows physical connections and it is possible to add a sim card.

In Raspberry, an application is put, containing a set of smart algorithms, which analyzes the data received and produces suggestions in order to increase the probabilities of a successful landing for that context.

In most cases, the use of artificial intelligence algorithms requires [13] hardware with a large computational capacity. As it's a relatively small execution environment and as Raspberry Pi doesn't 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.

The rOpenCL [14] 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 Raspberry uses the rOpenCL tool to speed up the processing of incoming data. All data transfers between 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).

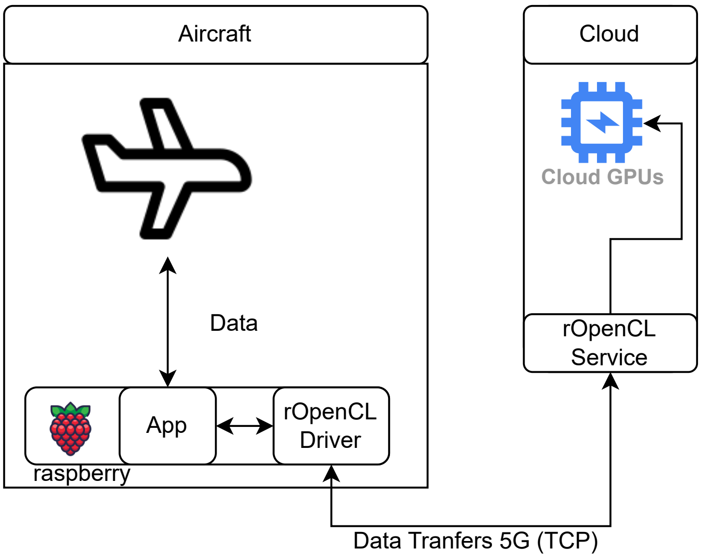

Figure 1. The architecture of the proposed solution.

4. Conclusions

Today, combating climate change is an increasingly important issue. It's recognized that the aeronautical sector is one of the sectors that contribute to climate change [15] derived from fuel consumption carried out in each flight. Considering that there are more and more airplanes in the air, this problem become even more critical.

The go-around maneuver despite being a procedure in aviation in general, consumes extra pounds of fuel when performed. The potential of the presented solution becomes clear, it's not a recurrent maneuver, however, reducing its number has a direct impact on the pollution produced by this sector. Nevertheless, it's 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 the access to data is relatively easy to perform. 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:

- To perform tests with leisure aircraft, to understand the viavility 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.

Author Contributions: Conceptualization, R.A.; Investigation, R.A and P.M.; Methodology, R.A. and P.M.; Validation, R.A. and P.M.; Writing—original draft preparation, R.A.; Writing – review & editing, P.M. and R.A. All authors have read and agreed to the published version of the manuscript.

Funding:

Institutional Review Board Statement: Not applicable.

Informed Consent Statement:

Data Availability Statement: Not applicable.

Acknowledgments: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds FCT/MCTES (PIDDAC) to CeDRI (UIDB/05757/2020 and UIDP/05757/2020) and SusTEC (LA/P/0007/2021).

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Abbreviations

The following abbreviations are used in this manuscript:

ATC	Air Traffic Control

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