Business Proposal

Autonomous Avoiding of Obstacles by Drone

FHICT, MRR Drones

Eindhoven

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Status	Draft
Stakeholders	Elferink, Sieuwe (MRR Drones)
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Version

Version	Date	Authors	Amendments
1.0	29.09.2023	Amira Max Kaan	First version

Communication

Version	Date	Receivers
1.0	29.09.2023	Kuijpers, Nico Lamers, Martijn

Contents

1. Project Assignment

1.1 Background

MRR Drones is a startup that aims to offer Drones as a Service - like Software as a Service (SaaS). Example use cases are Precision Farming, Automated Inspection, and Security. The Drone navigates through unknown territories at relatively low altitudes during its operation. This means there are obstacles like trees and other unexpected objects on the drone's path that vary depending on the drone's territory. Therefore the drone must autonomously avoid obstacles in its path.

1.2 Project Goal

The goal of the project is to use AI to make a drone autonomously avoid obstacles on its predetermined path.

An obstacle is any solid object that a drone could collide with on its path and thereby get damaged or its flight impacted. Obstacles do not need to be avoided in the fastest/optimal way but the model needs to avoid them reliably and keep the drone on its general path (no ridiculous avoidance manoeuvres like flying above it when around is shorter and possible).

Since the drone has a pathfinding module that manages the drone's controls, the obstacle-avoiding model should predict the next waypoint (coordinates: longitude, latitude, altitude) and feed it to the pathfinding module.

1.3 Inventory of Resources

Name	Description
Dataset Recordings	Recorded footage with depth camera from drone flights navigated by a pilot, mainly in AirSim, partially in real life. For each frame, there are flight metrics in a JSON file.
AirSim	"[S]imulation platform for AI research and experimentation" Microsoft. (*Home - AirSim*, n.d.)
Papers, Media	- Learning High-Speed Flight in the Wild (Loquercio et al., 2021) UC Berkeley CS182 - Imitation Learning

1.4 Requirements, Assumptions, and Constraints

Requirement	MoSCoW
The model is end-to-end	
• A single model has to be responsible for avoiding obstacles.	MUST
The model makes the drone avoid obstacles in its path	
• The drone's path is predetermined	MUST
• The drone should stay within a reasonable distance of its path	SHOULD

1.5 Project Scope

In-Scope	Out of Scope
Proof of Concept Drone can autonomously fly through the park in front of TQ without collisions	Edge cases (moving objects, birds, etc.)
Predicting next coordinate (waypoints)	Additional Sensors, Hardware changes
-	Pathfinding
-	Using/Predicting the drone controls

1.6 Research Questions

How to make a Drone avoid obstacles autonomously on its path to a predefined destination using AI?

1. What are the available resources and how can we use them?
2. What techniques are available for training an autonomous flying model?
3. How can we prepare the data in order to improve accuracy?
4. What evaluation criteria are appropriate for assessing the performance of the complete system?

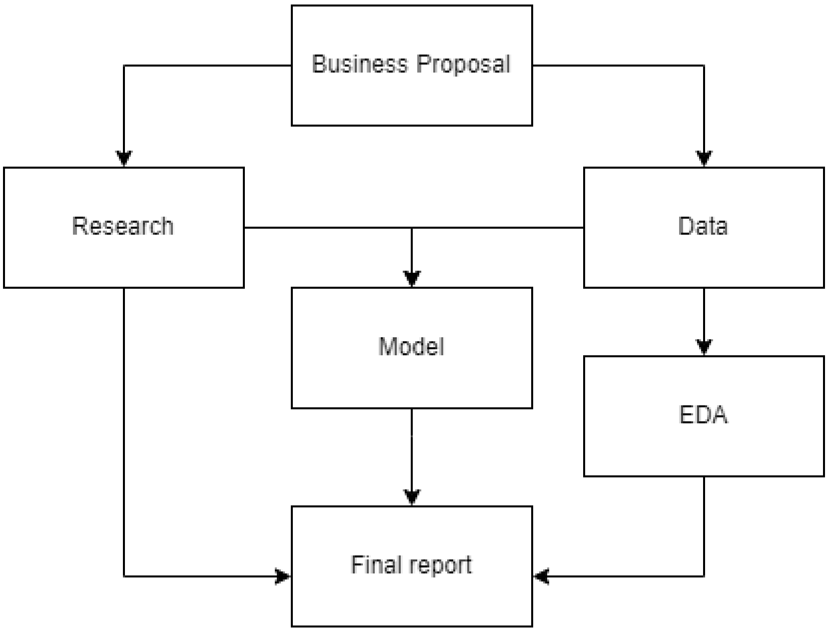
Sub-Question	Method	Type	Application/Reasoning
1	Problem Analysis		Understanding the problem and its domain
	Document Analysis		Diving into the Google Drive folder and exploring which documents are helpful
	Expert interview		Ask Sieuwe about the domain, available research, findings, and data
2	Available product Analysis		Research which model training techniques are available
	Expert interview		Interview Sieuwe about possible model training techniques
	Brainstorm		Compare different machine learning algorithms and select suitable ones
3	Community research		Research what the community has already done and how that can be used in our case
	Data Analytics		Researching the given dataset can help us get insight on the data
	Brainstorm		Think of possible pitfalls and solutions regarding the data
4	Ethical check		Compare different machine learning algorithms and select suitable ones
	Usability Testing		Testing the drone in a random AirSim environment to see if it crashes into anything

	Product review		Do a (simulated) test flight with Sieuwe

1.7 End Products

A model that can fly and avoid obstacles autonomously.

Final report.



2. Project organisation

2.1 Team members

Contact & Roles	Availability
DEVELOPER D, Max Student Fontys	Tuesdays & Thursdays 9:00 - 16:00 Fridays 9:00 - 12:00
DEVELOPER C, Amira Student Fontys	Tuesdays & Thursdays 9:00 - 16:00 Fridays 9:00 - 12:00
CLIENT Elferink, Sieuwe MRR Drones s.elferink@student.fontys.nl	Thursdays
DEVELOPER G, Kaan Student Fontys	Tuesdays & Thursdays 9:00 - 16:00 Fridays 9:00 - 12:00
TECHNICAL TUTOR Kuijpers, Nico Teacher Fontys nico.kuijpers@fontys.nl	Thursdays 13:00 - 16:00
PROCESS TUTOR Lamers, Martijn Teacher Fontys m.lamers@fontys.nl	Tuesdays 13:00 - 16:00

2.2 Communication

We will make use of three communication channels, WhatsApp, Teams and In-Person. Each type of communication will be used in a different setting.

WhatsApp

We use WhatsApp to stay in contact with the entire Drone Project. This included Sieuwe but also all other students who are involved in the project. All together we are in a WhatsApp group chat.

Teams

Via Teams we can schedule meetings, standups and any other moments we should get together. This gives us a nice overview through the Teams Calendar. This way we can also avoid double meetings since the lectures are also being planned in this Teams-Calendar.

In-Person

Every week we meet with the entire drone project group for a standup.
Every other week we have a meeting just with Sieuwe.

3. Finance and Risks

3.1 Cost budget

Tools and environments are available Open Source, there are no costs and there is no budget needed.

3.2 Risks and fallback activities

In Table 6 risks, how they should be prevented, and fallback activities are identified.

Table 6: Risks, Prevention and Handling of Risks

Risk	Probability *(After prevention)*	Impact	Prevention	Fallback Activities
Delays due to set-up time of tools	HIGH (*MEDIUM*)	LOW	Look for already made solutions	Doing tasks that are not currently on hold
Misinterpretation of user requirements	LOW (*VERY LOW*)	HIGH	Agile WoW, Reviews	-
Damaging the Drone	VERY HIGH (*VERY LOW*)	HIGH	Using simulator before testing on actual drone	-
Loss of data (files, code, etc.)	LOW (*VERY LOW*)	HIGH	Using Cloud Storage (OneDrive, GoogleDrive) and Version Control (Git)	Informing stakeholders and recreating lost data if necessary
Delays due to matters being more complicated than expected	MEDIUM (*MEDIUM*)	HIGH	-	Talk to supervisors and/or stakeholders

and requiring longer learning processes				and de-scope functionality.

References

Home - AirSim. (n.d.). https://microsoft.github.io/AirSim/

Loquercio, A., Kaufmann, E., Ranftl, R., Müller, M., Scaramuzza, D., & Koltun, V. (2021). Learning High-Speed Flight in the Wild. *Science Robotics*, *6*(59), abg5810. https://doi.org/10.1126/scirobotics.abg5810