Declaration

This report has not been submitted for any other degree at this or any other University. It is solely the work of us except where cited in the text or the Acknowledgements page. It describes work carried out by us for the capstone design project. We are aware of the university's policy on plagiarism and the associated penalties and we declare that this report is the product of our own work.

Student: Date:

Signature:

Student: Date:

Signature:

Student: Date:

Signature:

Abstract

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Acknowledgment

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

Table of Contents

List of Figures

List of Tables

1 Introduction and Motivation

1.1 Problem statement

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

1.2 Project significance

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

1.3 Project objectives

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

2 Background and Related Work

2.1 Background

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

2.2 Related work

One of the essential ideas of the project is navigating and tracking the objects while minimizing the required time to detect all targets. Various methods and approaches were studied and implemented in previous research papers with different constraints and goals in mind. The methodology and algorithm in each paper was different as some of them used AI related algorithms while others relied on heavy mathematical calculations to determine the best path. In paper **hua21**, the main idea was to propose a navigation algorithm that enables each UAV to determine its own movement locally and track pedestrians (mobile targets), it focused on multiple drones to cover a specific area. **pen21** took the advantage of DRL to develop an online path planning algorithm based on double deep Q-learning network (DDQN). The constraints were to minimize the energy consumption of the UAV, the objects on the ground were not stationary and were following a Gauss-Markov movement pattern. Author **hua20** aimed to propose a reactive real-time sliding mode control algorithm to navigate a team of UAVs (UAS). The area was divided into multiple sub-areas using the Voronoi partitioning technique, each drone was responsible for a sub-area, he implemented his ideas for both types of tergets, stationary targets and mobile.

All the mentioned papers presented their solutions using different simulation software. However, none of them was implemented in the real-world which questions the reliability of the algorithms.

3 Requirements Analysis

3.1 Functional requirements

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

3.2 Design constraints

Name	*Description*
Power supply	The Anafi and the Raspberry Pi must be battery powered because they are mobile (with ?? voltages DC/mAh)
Flying range/altitude	The flying range of the Anafi is limited by the signal strength of the communication between the computer and the Raspberry Pi. Also, the altitude is dictated by the Anafi's maximum height it can reach and the performance of the drone at a certain height.
Flying time	The maximum flying time must be lower than the Anafi's 25 minutes max flight lower than the Raspberry Pi's ?? minutes
Transmission delay	The delay in the communication between the Raspberry Pi and the Anafi must be acceptable
Payload/weights	The Raspberry Pi with its peripherals should not exceed the maximum load the Anafi can carry.

Table 1: Technical design constraints

Type	*Name*	*Description*
Economic	Cost	The cost of the entire system must not exceed x $
Environmental	Light source	The Anafi requires good lighting to take pictures of the targets
Safety/Security	Secure communication	The communication between Anafi-Raspberry Pi and Raspberry Pi-computer should be uninterrupted and secured against interference
Safety/Security	Safety	The Anafi must know how to return to base should there be a discommunication with the computer
Ethical	Privacy	The drone must not invade the privacy of the entities other than the targets
Ethical	Privacy	The monitored targets must be acceptable by law to be tracked
Environmental	Eco-friendly	The system only uses electricity and emissions
Sustainability	Modularity	The system must be such that the DRL algorithm can be swapped with an improved one easily
Reliability	Efficiency	The DRL should perform as expected all the time

Table 2: Practical design constraints.

3.3 Design standards

Standard	*Usage*
IEEE 802.11	To be used in the communication between the Raspberry Pi and the Anafi and the Raspberry Pi and the computer
WPA2	To be used in securing the communications above
GPS	To be used by the Anafi to convey its position to the Raspberry Pi
SSH	To be used between the Raspberry Pi and the computer
JSON-RPC version 2.0	Communication protocol used to control the components of the simulated Anafi
Google Protocol Buffers	To be used by Gazebo for the message passing between its server and client

Table 3: Design standards table.

3.4 Professional code of ethics

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

3.5 Assumptions

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

4 Proposed Solution

4.1 Solution overview

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”?

Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

4.2 High level architecture

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

4.3 Hardware/software to be used

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

5 Proof of Concept

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

6 Market Research and Business Viability

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

7 Project Plan

7.1 Project milestones

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

7.2 Project timeline

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

7.3 Anticipated risks

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like "Huardest gefburn"? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

8 Short Guide

Please read the guides available online about the right way to write LaTeX such as how to include a math symbol in text (e.g. x not x) and a proper noun with all capitals (e.g. SQL not SQL).

Below are examples of different constructs in a report. You can copy-paste and change the content. For more information, refer to the relevant package manual in CTAN.

Figure 1: The arch linux logo

8.1 Figure

8.2 Equations

$$
\begin{align}
E_p &= mgh = mg(x_f - x_i) \tag{1}\\
E_k &= E_t + E_r \nonumber\\
E_t &= \frac{1}{2}mv^2 \tag{2}\\
E_r &= \frac{1}{2}I\omega^2 \tag{3}\\
I &= \frac{1}{2}MR^2 \tag{4}\\
\omega &= \frac{v}{r} \nonumber\\
E_k &= \frac{1}{2}mv^2 + \frac{1}{2}I\left(\frac{v}{r}\right)^2 \tag{5}
\end{align}
$$

where E_p is the potential energy, E_k the kinetic energy, E_t the translational energy and E_r the rotational energy.

$$
\begin{aligned}
\frac{\partial E_p}{\partial m} &= \frac{\partial}{\partial m}(mgh)\\
&= gh\\
\frac{\partial E_p}{\partial g} &= \frac{\partial}{\partial g}(mgh)\\
&= mh\\
\frac{\partial E_p}{\partial h} &= \frac{\partial}{\partial h}(mgh)\\
&= mg
\end{aligned}
$$

8.3 Simple table

Table 4: Slope, intercept and their uncertainties

Slope		Intercept (J)	
Value	Error	Value	Error
1.0933	0.0300	0.0148	0.0157

8.4 Table from a csv file

Table 5: Translational and rotational energies.

m kg	v_m $\mathrm{m\,s^{-1}}$	E_t J	δE_t J	E_r J	δE_r J
0.055	0.17	0.000 79	0.000 01	0.280	0.007
0.075	0.20	0.001 50	0.000 02	0.387	0.010
0.095	0.23	0.002 51	0.000 03	0.512	0.013
0.115	0.25	0.003 59	0.000 03	0.605	0.015
0.135	0.27	0.004 92	0.000 04	0.706	0.018

8.5 Graph from a csv file

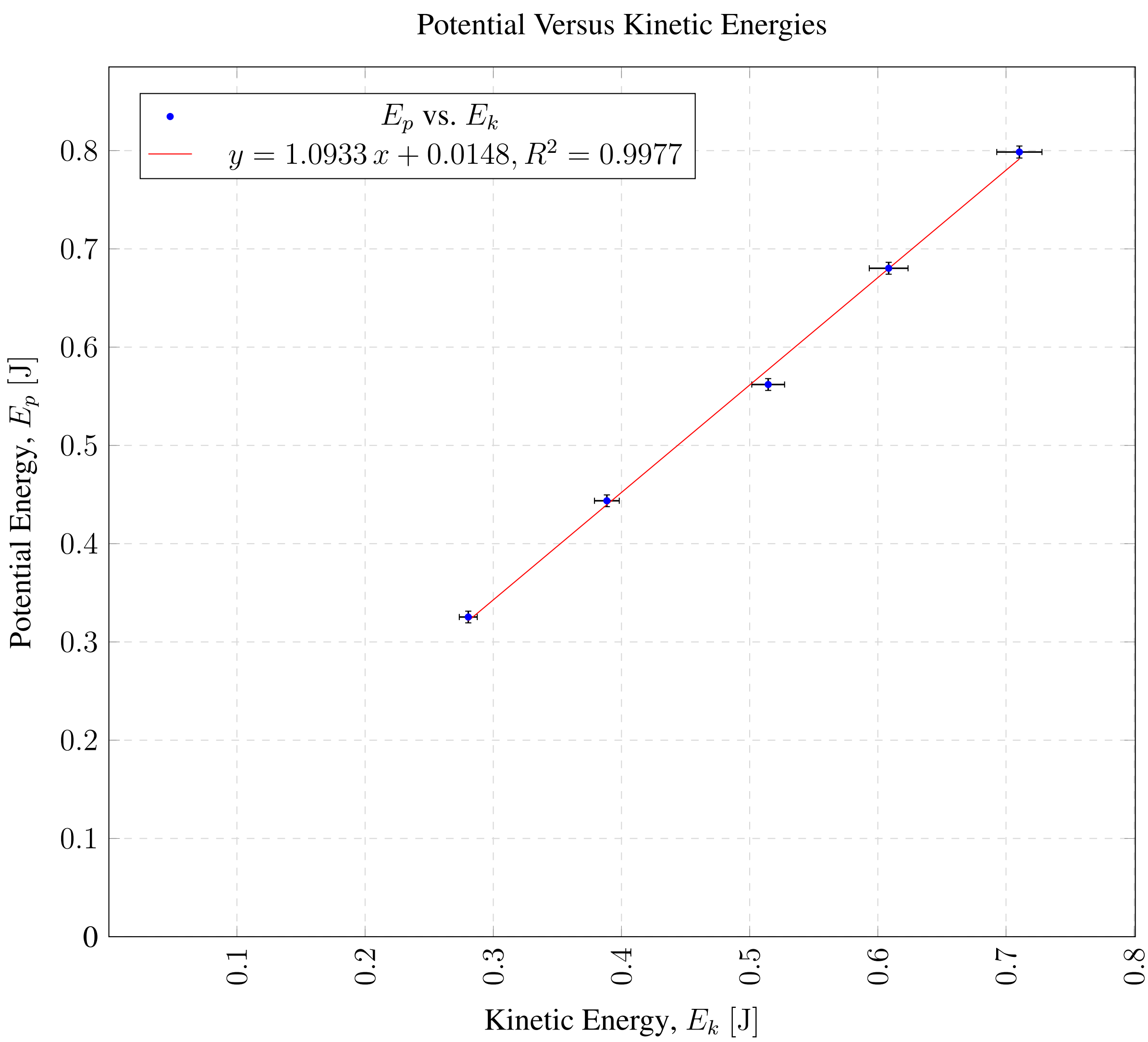

Figure 2: The relationship between potential and kinetic energies.

8.6 Citations

- **in-text citation**: use `\cite{dirac}` to produce **dirac** or `\textcite{dirac}` to produce **dirac**
- **citation in parentheses**: `\parencite{knuthwebsite}` produces [**knuthwebsite**] (for IEEE, this has no difference to the `\cite{}` command above.)

8.7 Cross-references

Label using suitable names with the following format: figure `\label{fig:<name>}`, tables `\label{tab:<name>}`, sections `\label{sec:<name>}` and equations

\label{eq:<name>}.

Then when cross-referencing, use \cref{<type>:<name>} (or \Cref{<type>:<name>} when used at the beginning of a sentence)

Appendix

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.