CONTRACTPLAN RESEARCHPROJECT REMMERIE ROEL

- **bachelor creative technologies & AI**
- **semester 5**
- **academic year 2025-2026**
- **responsibles**
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  - **Paula Acuña Roncancio**
  - **Wouter Gevaert**

1 INTRODUCTION

1.1 IDENTIFICATION

Date	27/10/2025
Signed by	**Remmerie Roel**
Internal coach Research Project	**Paula Acuña Roncancio**
Internal promotor bachelor's Thesis	not determined
External promotor bachelor's Thesis	not determined

1.2 GOAL

In the Innovation & Research Project and Bachelor's Thesis modules, you will dive deeper into technical competences and combine them with some general competences. By the end of this module, you'll be:

- Able to formulate a question from professional field
- Work structured towards a goal
- Get results by own, technical research
- Take conclusions from your technical research
- Reflect on the conclusions
- Formulate advise
- Present your thesis for a jury of specialists
- Create an attitude for Lifelong Learning

How are we going to start?

1. You start by formulating a research question. It could be from an internship company, from an inspirational list … A team of teachers will check the level of your question.
2. You perform the practical research at school. The question will be fully researched and technically implemented during the Innovation & Research Project module in a span of maximum four weeks. You'll create/research your own solution/design/prototype. It could be pushed into a specific direction by your question.

3. In the bachelor’s Thesis you will reflect individually with experts from the industry (for example in your internship companies) and with community members that have a great knowledge of your project.

Below, you will find a few of the different steps. Your goal is to think critically about the different phases of your research. You will create a plan of approach and think about your process. Try to fill in the form fields as extensively as possible. You will notice that a great and thorough preparation is a great support during the creation of your research project and bachelor’s thesis.

2 PLAN OF APPROACH

2.1 SCOUT THE WORKFIELD AND FILTER

You have received your research question from your teachers, from an internship company, from someone else ... but now you need to get some more information about this topic. Most likely, you’ll already have a little bit of knowledge about this. In some cases, it’s a completely new topic. Maybe the question that you have received is still too broad, wide, or generic. You’ll have to dive deeper into your topic to get comfortable.

Read, read and read some sources and fetch information. Keep track of all the sources you have encountered during your research. The more you read into your topic, the clearer your vision will get. As it gets clearer, you can easily define your topic further. Narrowing down is very important:

- What exactly are you going to research?
- Where is your topic located?
- What perspective are you going to research?
- Who are the actors that benefit from this research?

2.2 REASEARCH QUESTION AND SUBQUESTIONS

This is your main research question: What question do you wish to research and answer?

How can drone swarm AI be used in search and rescue operations?

2.3 SUB QUESTIONS

Write down a bunch of sub questions to structure your project. It will make sure you can split your research in chunks with theoretical and practical parts. Some questions will be answered by a literature study. Other questions will only be answered by practically researching everything.

Try to get a minimum of 5 and a maximum of 10 sub questions. It can be a few smaller and some bigger questions if needed.

- What is drone swarm AI?
    - What is a drone?
    - What is swarm AI?
- What are search and rescue operations (SAR Ops)?
- How are drones currently used in SAR Ops?
    - What are the constraints of a drone in SAR Ops?
    - How does a drone detect a target?

    - How does a rescuer receive information from a drone?
- How do drones form a swarm AI?
    - How does a drone cummunicate with another drone?
    - How can the position of a drone relative to … be determined?
        - the environment
        - another drone
    - Which computations are deployed where?
- What is an easily deployable and fast navigation/exploration algorithm for multiple explorers?
- What are the constraints of a drone swarm AI in SAR Ops?
- How can a drone swarm AI detect a target?
    - How can a drone swarm AI not detect the same target as multiple seperate targets
- How can a drone swarm … a central intelligent system and rescuer?
    - receive instructions from
    - relay relevant information to
- What are the major differences between the technical research and real life use cases?

2.4 THE RESEARCH PROJECT – TECHNICAL RESEARCH

Goal: Your research question will be technically implemented individually (or in a team of two people) during the practical weeks in January, during a period of maximum four weeks. You'll create/research your own solution/design/prototype.

This is the first real practical step as soon as you have formulated your research and sub questions. You clearly defined what way you want to go to, and now you can formulate all the different steps to get to that goal. What components are necessary to reach your goal? How are you going to build these components?

TIP: Write down a mind map (or brainstorm) to structure your approach. Talk this through with experts/your coach.

What are you going to create as technical research? Make sure your context is well defined, go into detail where necessary. Use a plan of approach and include images. Don't forget any important elements! **Warning: Innovation & Research Project in MCT is always a technical realisation. Only including a literature study is not enough.**

Which data will you use?

- greyscale images
- none for non human target
- for human target
    - search an rescue datasets SARD
    - human detection in UAV imagery

What case will you work out?

- materials
    - 1 x Loco Swarm bundle - Crazyflie 2.1+
        - 8 x Loco positioning nodes

        - 10 x Loco positioning deck
        - 10 x Crazyflie 2.1+
        - 3 x Crazyradio 2.0
        - 20 x 350mAh LiPo battery
        - 10 x 500mA LiPo USB charger
    - 8 x AI deck 1.1
    - 8 x Flow deck v2
    - a central computation unit (computer, laptop, raspberry pi)
    - a screen for frontend information (included in computation device or seerate in case of raspberry pi)
- Crazyflie sepcs/limitations
    - controllable range = 1km -> maximum perimeter is circle where r = 1km
    - drone body size = 7cm x 7cm
    - average drone fly time 7 minutes
    - recommended to not fly outdoors
    - controllable by
        - on device programming/instructions
        - controller based
        - phone based
        - radio based
    - danger of hitting obstacles, walls
- location
    - large indoor space with no obstacles (like: Kortrijk sports centre, Kortrijk expo, Depart kortrijk, Bruges sportsinnovation campus, Kortrijk weide parking 3 storage unit and maybe Kortrijk weide energy lab)
- target
    - recgonlizable object (like: trafic cone or sports cones)
    - human (acting in distress)
- proof of concept
    - a rescuer uses a frontend app to ... with the predifined materials at a predifined location-like
        - set a searchable perimeter
        - set a number of missing targets
        - send out the drone swarm to search the missing targets withtin the searchable perimeter
        - recall the drone swarm
        - receive information from the central compute instance
    - the central compute instance
        - houses the frontend application
        - houses the navigation/exploration algorithm for multiple explorers
        - receives ...
            - the drones' locations
            - found targets' locations
            - drone images of the found targets' and uses this information to
            - display in the frontend app
            - make new navigation/movement decisions

        - sends
            - instructions to the drones on where to move
    - a drone in the swarm
        - receives instructions from the central compute instance
        - runs an ai model to detect targets using the ai deck
            - it inspects a certain area with it's camera
        - runs the flow deck software to determine it's postion based on movement
        - (extra) communcates with other drones for better relative positioning

Which evaluation or comparison criteria will you use?

- average time to target(s) found compared to a human piloted drone
- amount of targets detected/are all targets detected? (more compared to a human piloted drone)
- amount of surface arrea flown over that has already been flown over compared to a human piloted drone

What are the minimal requirements of your project / app?

- in the context of the use case a swarm AI of Crazyflies can find a single non human target more efficiently then a single human piloted Crazyflie.

How do you make sure your application is relevant?

- literature study
- interview with field experts
- survey (colleagues lifeguards Bredene)

Technical plan of approach

- ☐ **09/02 - 15/02**
    - ☐ come up with research question
    - ☐ fill in google forms
    - ☐ search sources for contractplan
- ☐ **16/02 - 22/02**
    - ☐ create first draft of contractplan
    - ☐ request first draft feedback
    - ☐ implement first draft feedback into second draft
- ☐ **23/02 - 01/03**
    - ☐ hand in contractplan
    - ☐ lifelong learning
        - ☐ create media post strategy/template/plan
    - ☐ literature review
        - ☐ collect literature
        - ☐ assess & select literature
        - ☐ preperation
- ☐ **02/03 - 08/03**
    - ☐ literature review
        - ☐ synthesise literature

        - [ ] start literature review document
- [ ] **09/03 - 15/03**
    - [ ] literature review
        - [ ] synthesise literature
        - [ ] finalise literature review document
    - [ ] videos
        - [ ] review leho material
        - [ ] create video playlist outline/plan
- [ ] **16/03 - 22/03**
    - [ ] technical research
        - [ ] relevancy check
    - [ ] videos
        - [ ] review leho material
        - [ ] continue video playlist outline/plan
        - [ ] start recordings
- [ ] **23/03 - 29/03**
    - [ ] technical research
        - [ ] relevancy check
        - [ ] drone experimentation
    - [ ] videos
        - [ ] continue recordings
- [ ] **30/03 - 05/04**
    - [ ] technical research
        - [ ] drone swarm experimentation
    - [ ] videos
        - [ ] finalise recordings
- [ ] **06/04 - 12/04**
    - [ ] technical research
        - [ ] start frontend development
        - [ ] start backend development (central compute)
    - [ ] videos
        - [ ] start editing videos
- [ ] **13/04 - 19/04**
    - [ ] technical research
        - [ ] continue frontend development
        - [ ] continue backend development (central compute)
    - [ ] videos
        - [ ] finalise editing videos
- [ ] **20/04 - 26/04**
    - [ ] hand in swarm AI educational video
    - [ ] hand in literature review
    - [ ] technical research
        - [ ] start work on drone requirements
- [ ] **27/04 - 03/05**
    - [ ] technical research
        - [ ] finalise drone requirements

        - [ ] integrate frontend, backend (central compute) and drones
        - [ ] start **2.6** deliverables
- [ ] **04/05 - 10/05**
    - [ ] technical research
        - [ ] **2.6** deliverables
        - [ ] work on extra's
- [ ] **11/05 - 17/05**
    - [ ] demo

2.5 TECHNICAL RESEARCH: SUCCESS CRITERIA

Now that you have well defined how your project will be made, it is important to define some goals and success criteria.

- When is your project finished according to your standards? Describe a few of your results that you want to achieve. Use a list.
    - [ ] a rescuer can use a frontend app connected to a compute instance with frontend functionality as defined in the proof of concept
    - [ ] a compute instance can communicate with Crazyflie drones using the flow deck radio
    - [ ] a crazyflie drone can detect a non human target using the AI deck
    - [ ] the central compute sends instructions to the drones to move in certain directions to cover all the ground in the perimeter
        - using a navigation/exploration algorithm for multiple explorers
    - [ ] in the context of the use case a swarm AI of Crazyflies can find a single target more efficiently then a single human piloted Crazyflie.
        - average time to target(s) must be lower then the human pilot
        - amount of targets detected and correctly located must be higher then the human pilot
        - amount of surface arrea flown over that has already been flown over must be smaller then the human pilot
- What will your technical demo or proof-of-concept contain?
    - the proof of concept defined previously in **2.4** as the use case
- What if you’re done in a few weeks, and you want to do some alternatives?
    - [ ] use multiple targets
    - [ ] use human targets
    - [ ] the crazyflie drones can communicate with eachother using either bluetooth BLE or radio signals

2.6 HANDING IN YOUR RESEARCH PROJECT

In the end of the Innovation & Research Project, you should hand in all of these required things:

- User manual
    - How can someone use the project that you have developed?
    - What are all the things that one should think of when using this project?

- Installation manual
  - How can someone install this project on their own setup?
  - Where are the pitfalls in the installation?
- Source code
  - During the development of an application, or when writing any code, hand everything in.
- A few more optional things:
  - Technical schema’s
  - Graphical representations of technologies
  - Other illustrations that can be interested for your project
  - Video’s of your demonstration that you created

Talk to your coach about what to hand in in your situation.

2.7 Bachelors Thesis

not applicable

2.8 SOURCES

2.8.1 Research related

1. S. Sambolek, M. Ivasic-Kos. "SEARCH AND RESCUE IMAGE DATASET FOR PERSON DETECTION - SARD." SEARCH AND RESCUE IMAGE DATASET FOR PERSON DETECTION - SARD | IEEE DataPort. Accessed: Feb. 16, 2026. [Online.] Available: https://ieee-dataport.org/documents/search-and-rescue-image-dataset-person-detection-sard
2. S. Sambolek, M. Ivasic-Kos. "Automatic Person Detection in Search and Rescue Operations Using Deep CNN Detectors." Automatic Person Detection in Search and Rescue Operations Using Deep CNN Detectors | IEEE Journals & Magazine | IEEE Xplore. Accessed: Feb. 16, 2026. [Online.] Available: https://ieeexplore.ieee.org/document/9369386
3. D. P. Simões, H. C. de Oliveira, D. R. Pereira. "Unicamp-UAV: An open dataset for human detection in UAV imagery." Unicamp-UAV: An open dataset for human detection in UAV imagery - ScienceDirect. Accessed: Feb. 16, 2026. [Online.] Available: https://www.sciencedirect.com/science/article/pii/S0924271625004149
4. "Loco Swarm bundle - Crazyflie 2.1+." Loco Swarm bundle - Crazyflie 2.1+ – Bitcraze Store. Accessed: Feb. 16, 2026. [Online.] Available: https://store.bitcraze.io/products/loco-swarm-bundle
5. "AI deck 1.1." AI deck 1.1 | Bitcraze. Accessed: Feb. 16, 2026. [Online.] Available: https://www.bitcraze.io/products/ai-deck/
6. "Flow deck v2." Flow deck v2 | Bitcraze. Accessed: Feb. 16, 2026. [Online.] Available: https://www.bitcraze.io/products/flow-deck-v2/
7. "Mind mapping for everyone." MindMeister | Online Mind Mapping & Brainstorming Software. Accessed: Feb. 17, 2026. [Online.] Available: https://www.mindmeister.com/pages/home-version-1
8. "FAQ" FAQ | Bitcraze. Accessed: Feb. 22, 2026. [Online.] Available: https://www.bitcraze.io/support/f-a-q/

2.8.2 IEEE related

1. J. Caulfield. "IEEE Website Citation | Guide with Examples." IEEE Website Citation | Guide with Examples. Accessed: Feb. 14, 2026. [Online.] Available: https://www.scribbr.com/ieee/ieee-

website-citation/
2. IEEE Author Center. "IEEE Editorial Style Manual." IEEE Editorial Style Manual - IEEE Author Center Journals. Accessed: Feb. 14, 2026. [Online.] Available: https://journals.ieeeauthorcenter.ieee.org/your-role-in-article-production/ieee-editorial-style-manual/
3. IEEE Author Center. "Refrence Guide." IEEE Reference Style Guide for Authors - Google Documenten. Accessed: Feb. 14, 2026. [Online.] Available: https://docs.google.com/document/d/1j1L96U2NagwWI9MEVDNVKt9pXxRzTH7h3krI3Mb6wZE/edit?tab=t.0

2.8.3 Python sources

these were used to create a script that helps with IEEE style sources

```
from bs4 import BeautifulSoup
from urllib.request import urlopen
from datetime import datetime
import pyperclip
import os

REQ_AUTHOR = "Author: "

AUTHOR_EXIT = "none"

def get_authors() -> str:
    authors = ""
    author = input(REQ_AUTHOR)

    while author != AUTHOR_EXIT:
        authors += author
        author = input(REQ_AUTHOR)
        if author != AUTHOR_EXIT:
            authors += ", "

    if authors != "":
        authors += ". "

    return authors

REQ_URL = "URL: "

def get_url() -> tuple[str, str]:
    url = input(REQ_URL)
    try:
        soup = BeautifulSoup(urlopen(url), features="html.parser")
        website_title = soup.title.get_text()
        return url, website_title
    except Exception:
        print("could not read page")
        website_title = input("Website Title: ")
        return url, website_title
```

```
months = {
    1: "Jan",
    2: "Feb",
    3: "Mar",
    4: "Apr",
    5: "May",
    6: "Jun",
    7: "Jul",
    8: "Aug",
    9: "Sep",
    10: "Oct",
    11: "Nov",
    12: "Dec"
}

ieee_citation = "{authors}\"{page_title}\" {website_title}. Accessed:
{month}. {day}, {year}. [Online.] Available: {url}"

def get_citation():
    authors = get_authors()
    page_title = input("Title: ")
    url, website_title = get_url()
    now = datetime.now()

    citation = ieee_citation.format(
        authors=authors,
        page_title=page_title,
        website_title=website_title,
        month = months[now.month],
        day = now.day,
        year = now.year,
        url = url
    )

    return citation

if __name__ == "__main__":
    try:
        while True:
            os.system('cls' if os.name == 'nt' else 'clear')
            print("IEEE Citation\ninput ^C to quit")
            citation = get_citation()
            print(citation)
            pyperclip.copy(citation)
            input("press Enter to continue ...")
    except KeyboardInterrupt:
        pass
    except Exception as e:
        print(e)
```

1. N. Mikhailov. "Python.gitignore." gitignore/Python.gitignore at main · github/gitignore · GitHub. Accessed: Feb. 14, 2026. [Online.] Available: https://github.com/github/gitignore/blob/main/Python.gitignore
2. S. Kumar. "Extract title from a webpage using Python." Extract title from a webpage using Python - GeeksforGeeks. Accessed: Feb. 14, 2026. [Online.] Available: https://www.geeksforgeeks.org/python/extract-title-from-a-webpage-using-python/
3. IlanL, K. Kundu. "BeautifulSoup different parsers." python 3.x - BeautifulSoup different parsers - Stackoverflow. Accessed: Feb. 14, 2026. [Online.] Available: https://stackoverflow.com/questions/55880415/beautifulsoup-different-parsers
4. Soviut, R. Duffield, T. Merouane, P. Mortensen. "How can I clear the interpreter console?" python - How can I clear the interpreter console? - Stack Overflow. Accessed: Feb. 14, 2026. [Online.] Available: stackoverflow.com/questions/517970/how-can-i-clear-the-interpreter-console
5. D. Masquelier, atomizer, D. Lowe, Dreftymac. "How do I copy a string to the clipboard?" python - How do I copy a string to the clipboard? - Stack Overflow. Accessed: Feb. 14, 2026. [Online.] Available: https://stackoverflow.com/questions/579687/how-do-i-copy-a-string-to-the-clipboard
6. Asweigart. "Pyperclip." GitHub - asweigart/pyperclip: Python module for cross-platform clipboard functions.. Accessed: Feb. 14, 2026. [Online.] Available: https://github.com/asweigart/pyperclip

2.8.4 Hounourable mentions

1. Greetje Desnerck
    - assisted with brainstorming
2. Nathan & Paula
    - gave contractplan pointers

3 SIGNATURE

I hereby declare that I will complete my project according to the defined planning like above.

Your (digital) signature.

Surname and name: Roel Remmerie

Date: 22/02/2026