Deliverable D:

Conceptual Design

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GNG 1103: Engineering Mechanics

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Abstract

This report examines ethical concerns surrounding the implementation of autonomous weapon systems in war. It highlights the risks these systems pose to global stability, safety, and human rights. Mines Action Canada, CRAiEDL, and University of Ottawa students have collaborated to aid in educating people on this topic.

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1. Introduction

Our team has a dream where Artificial intelligence and autonomous weapon systems (AWS) aren't used for violence. To achieve this, we are developing a plan that turns AI and AWS into robots that offer services that better our community. In this deliverable, we have outlined many altruistic ideas and new purposes the robot can be used for. Furthermore, we have narrowed the ideas to define complete solutions and purposes that can be presented to the public that combine all our original ideas. These complete ideas are created so that our team may design the best solution possible to address the ethical, appearance and visual recognition concerns our team has regarding the robot we are working with.

2. Subsystems

The design of our prototype is centered around three different subsystems. These subsystems include addressing ethical concerns, appearance, and VRS.

Addressing Ethical Concerns

This subsystem ensures that the ethical concerns highlighted in our problem statement are addressed. A design covering these ethical concerns would consider the repurposing of AWS for humanitarian development, developing our design as an educational platform for showcasing the constructive potential of AI, and promoting transparent and ethical human-robot collaboration.

Appearance

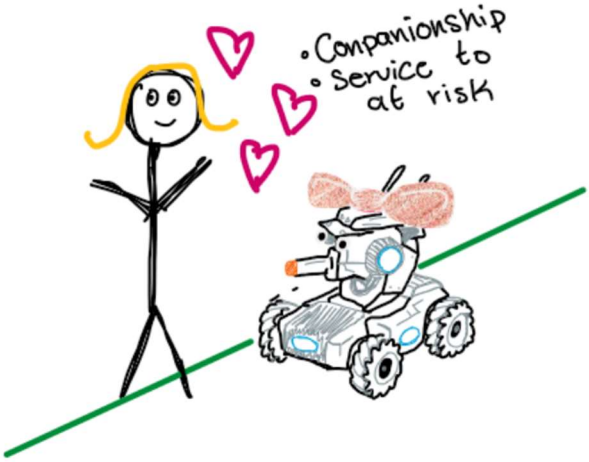
This subsystem focuses on adding features to the RoboMaster S1 that gives it a more approachable and friendly appearance so that users and community members do not fear the robot. It also aids in mitigating misconceptions of the use of the robot and makes people more open to accepting it as a community aid that may help in a positive way.

VRS (Visual Recognition System)

This subsystem enables the robot to interpret their surroundings, as it would allow the robot to identify objects, obstacles and recognize faces/ symbols. This subsystem helps the robot navigate spaces and track movements.

2.1. Daniella's Solutions

Subsystem 1: Addresses Ethical Concerns



The robot can provide companionship and support to members of the community that are at risk of falling but do not have the opportunity or ability to own a service animal. This not only stops the use of these robots from harming others but also turns them into something that aids people at risk of falling instead.

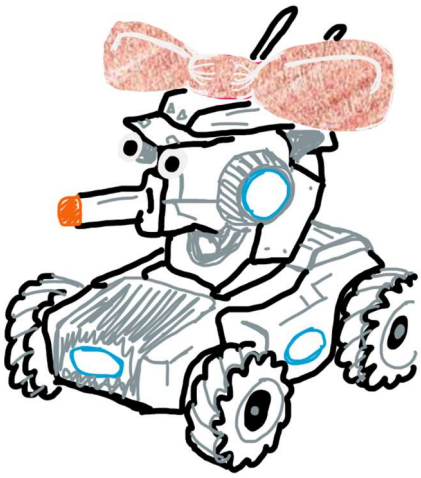
Pros:

- Help many who don't have the opportunity to own a service dog/ have severe pet allergy
- Very low maintenance and affordable to maintain
- Allow at risk community members to live independently if they want to.

Cons:

- Elderly people might fear it as it is something they are not used to
- Could be forgotten about/run out of battery and become un effective for the day

Subsystem 2: Appearance



Bow (pink or Blue) on top of robot with a set of fun googly eyes. This gives a very friendly and childish appearance removing the negativity and fear commonly associated with killer robots.

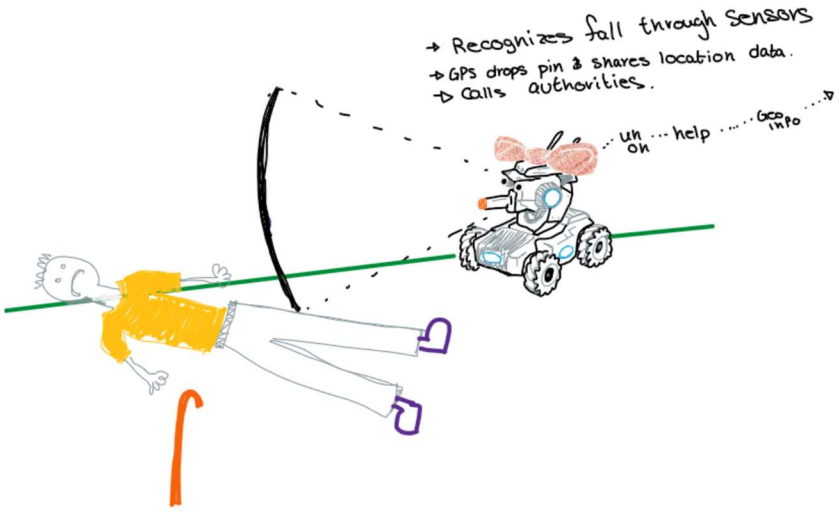
Pros:

- Giving a more friendly appearance makes people more inclined to like the robot and associate it with a positive outlook.
- Children won't be scared of the robot

Cons:

- Eyes and bow many fall off
- Appearance enhancers may also add unnecessary weight and interfere with scanners and robot performance.

Subsystem 3: VRS



Robots will be coded to recognize a human fall and shape together. Once this info is recognized using scanners, the GPS drops a pin of its given location and calls authorities automatically.

Pros:

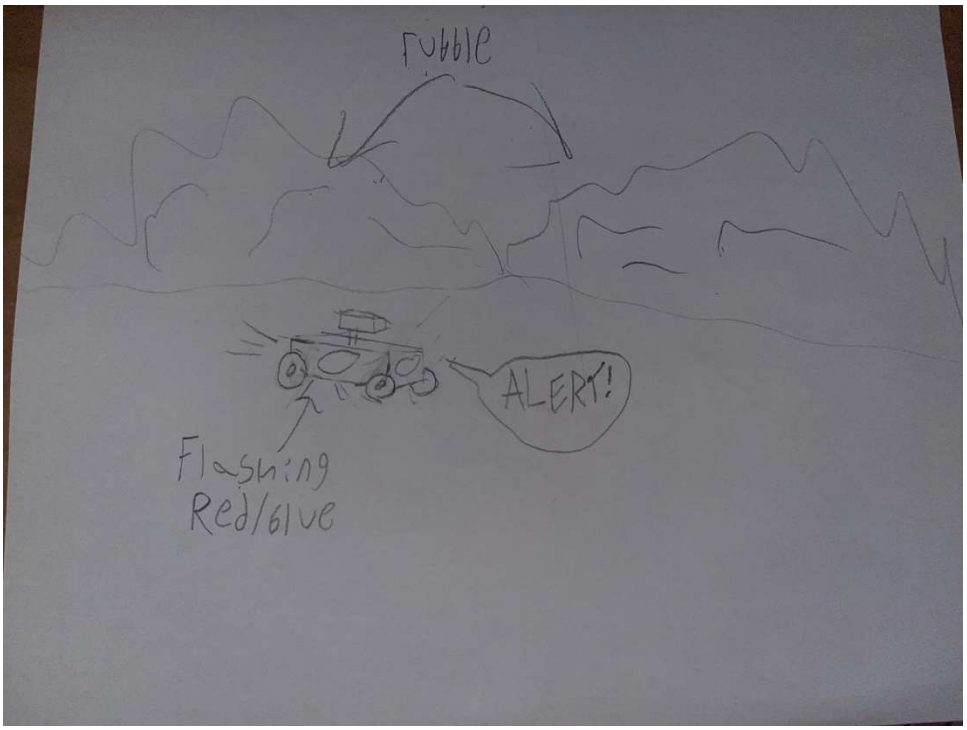
- Robots can follow certain members around and register when they fall and call the authorities, so fall victims don't stay on the ground for prolonged periods of time without help

Cons:

- Misunderstood reading of someone falling when they did not
- Might not always register a fall

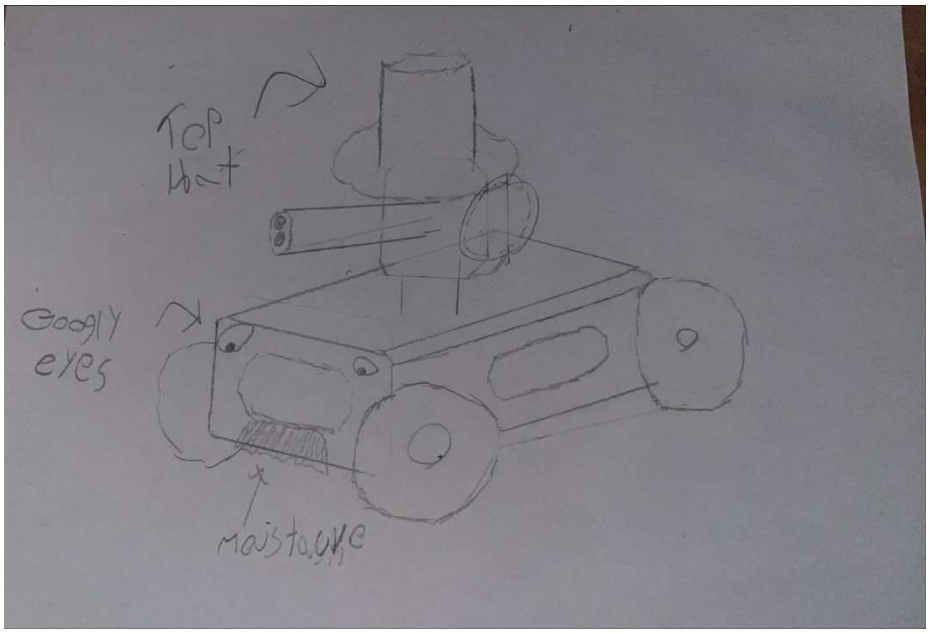
2.2. Maddox's Solutions

Subsystem #1: Addressing Ethical Concerns



Used for search-and-rescue missions during state of emergency like scenarios. It could flash its lights and use the speaker to root out any people needing help.

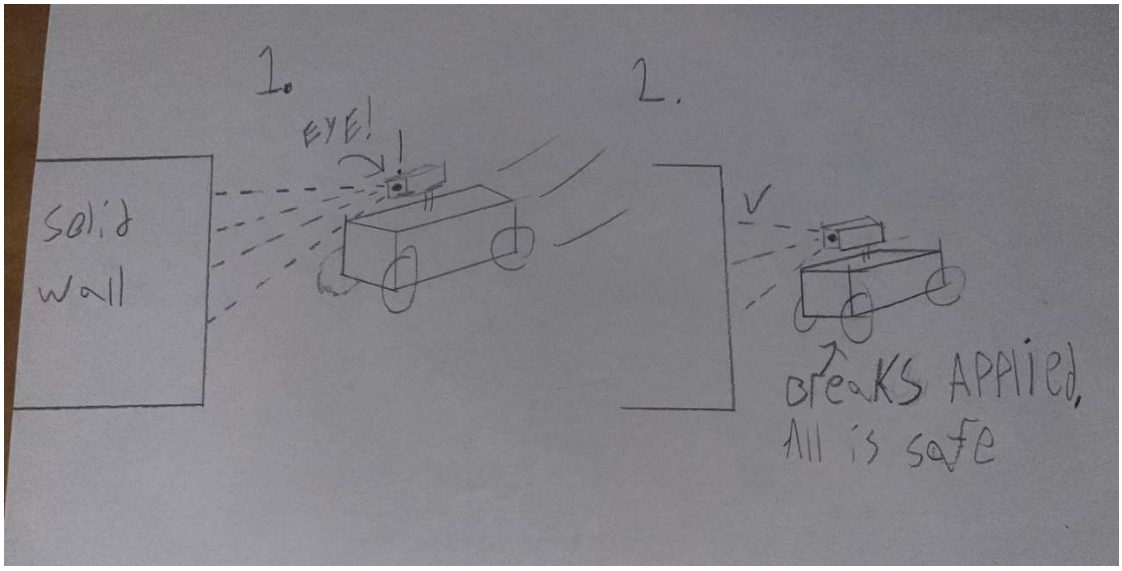
Subsystem #2: Appearance



Added: googly eyes, moustache, top hat

- Pros: gives the robot a much friendlier appearance.
- Cons: the top hat could interfere with the scanner's ability.

Subsystem #3: VRS



The robot is driving forward, but once it gets into a certain proximity to something, it would stop.

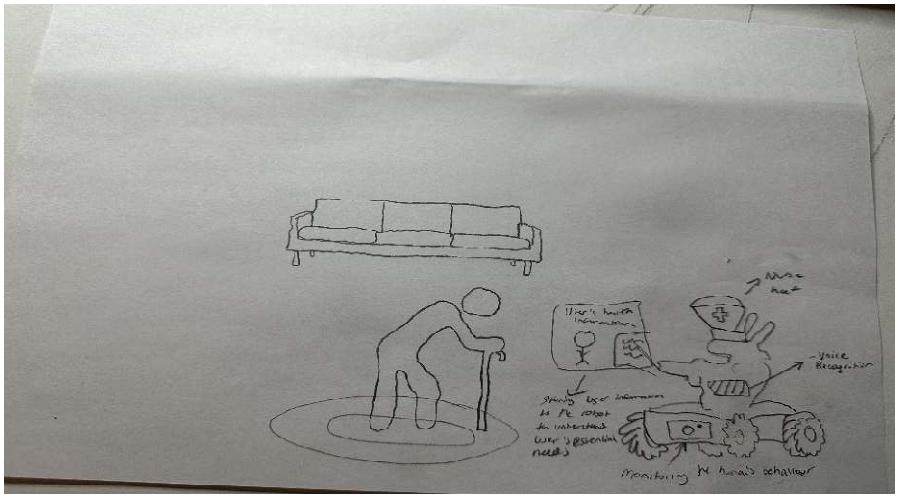
- Pros: keeps the robot from damaging itself
- Cons: if the sensor is too sensitive,

2.3. David's Solutions

Nanny Bot is an advanced caregiving robot designed to assist with daily tasks, ensure safety, and provide companionship, while also offering unique reminder capabilities.

Subsystem: Monitoring Safety uses cameras and AI to monitor movement, detect falls, and identify distress signals, enabling caregivers to respond quickly in emergencies. Additionally, it promotes safety at home by suggesting features like anti-slip mats to prevent accidents.

Subsystem #1: Addressing Ethical Concerns



The Nanny Bot raises ethical concerns about privacy, autonomy, and emotional dependency. While it ensures safety through monitoring, there is a fine line between protection and intrusion, making data security and user consent essential.

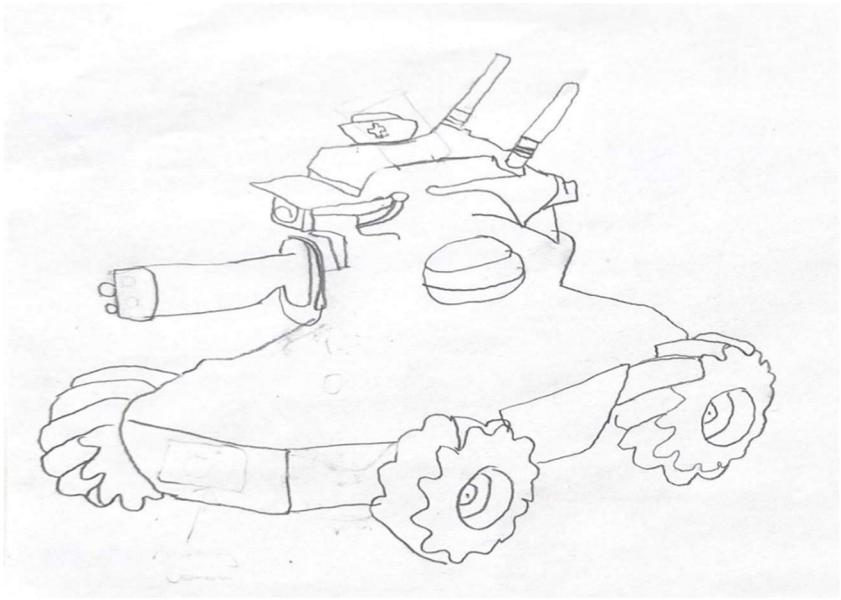
Pros:

- Ensuring transparency about how it collects and stores data builds trust with users
- AI programmed with ethical safeguards ensures it prioritizes user well-being over automation
- Respecting personal space by using passive monitoring rather than intrusive surveillance makes users feel safe

Cons:

- If it constantly watches and listens, it may feel invasive, leading to discomfort and distrust.
- Storing sensitive personal data, even securely, could still pose privacy risks.
- Some people might become too dependent on it, reducing human caregiving interactions.

Subsystem #2: Appearance



The Nanny bot should feel like a gentle, caring companion rather than just a machine. With a friendly nurse hat, it can create a sense of security, while its smooth, compact design allows it to move around any location effortlessly, making it feel like part of the family.

Pros:

- A warm, friendly design makes the Nanny Bot feel like a companion rather a machine.
- A digital face with expressive features can create a sense of comfort and emotional connection
- A sleek, non-intrusive build ensures it blends into a home setting without feeling overwhelming.

Cons:

- If too robotic, it might feel cold and impersonal, making users uncomfortable
- Too many exposed mechanical parts can make it look intimidating
- A bulky or rigid design may limit its ability to navigate cozy, cluttered living spaces

Subsystem #3: VRS

The Nanny Bot's voice recognition system should feel like talking to a patient and caring companion, understanding natural speech with ease. It listens attentively, responds warmly, and adapts to different voices making conversations feel effortless.

Pros:

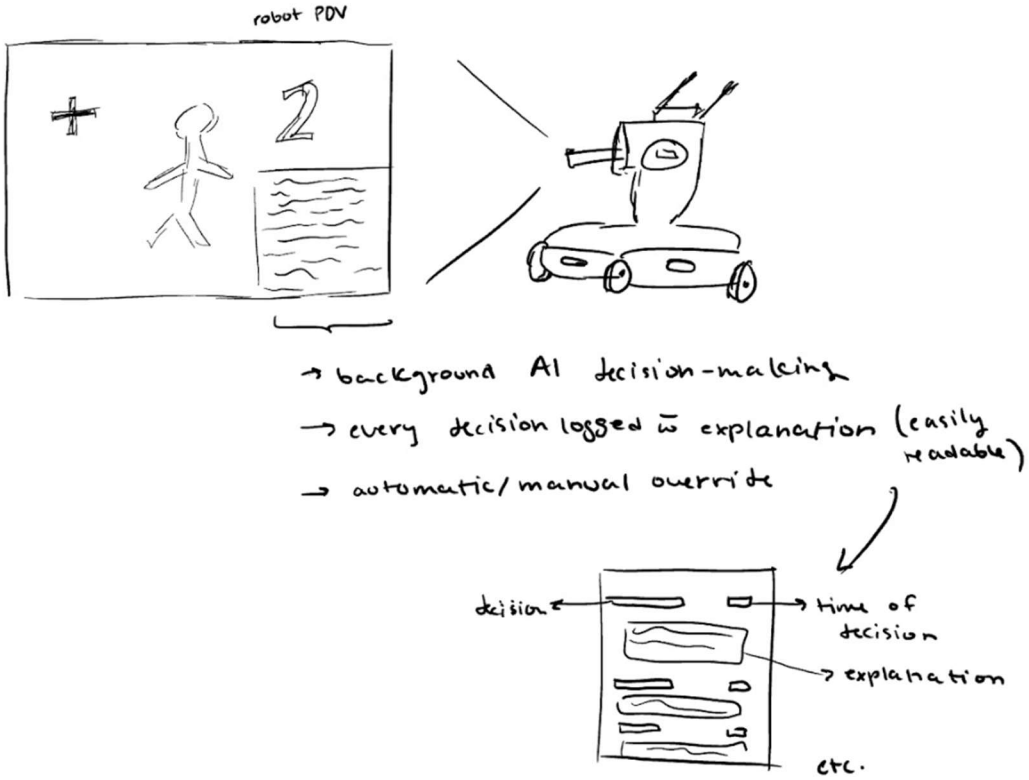
- A natural, soothing voice helps create a sense of companionship, reducing loneliness.
- Personalized responses make it feel like a caring assistant rather than a programmed machine.
- The ability to recognize different tones and emotions makes interactions feel more genuine.

Cons:

- Misunderstanding speech or accents can lead to frustrating interactions, making it feel unhelpful.
- A robotic or overly mechanical voice might just make users feel they are talking to a machine and not a helper
- If it's too conversational, it might blur the line between technology and the human relationships it has, leading to over-reliance to the robot.

2.4. Vanya's Solutions

Subsystem #1: Addressing Ethical Concerns



One way to ensure the robot is ethical is by introducing a decision logging system. Here, every decision made by the robot is explained in a sheet with the time in a way that is easily readable by workers using the robot. This way, the automated decision-making process is transparent and can be checked for bias.

Pros:

- Increases trust by making explainable decisions that can be reviewed by workers
- Makes it easier to spot bias in decision making and thus make corrections for future models
- Easier to ensure that it complies with requirements for AI ethics transparency

Cons:

- It might not be possible to get this data from the RoboMaster S1 if it requires changing the code
- Takes a lot of processing power and storage
- Might have too many decisions stored to go over (data overload)

Subsystem #2: Appearance

Having a more human appearance will help the RoboMaster S1 look more friendly and thus be easier to empathize with, which directly related to the manifesto we will write later from the robot's point of view, where the main goal is to get the readers to empathize. For a more human appearance, I added a bow tie, googly eyes, and ears where the antennas are.

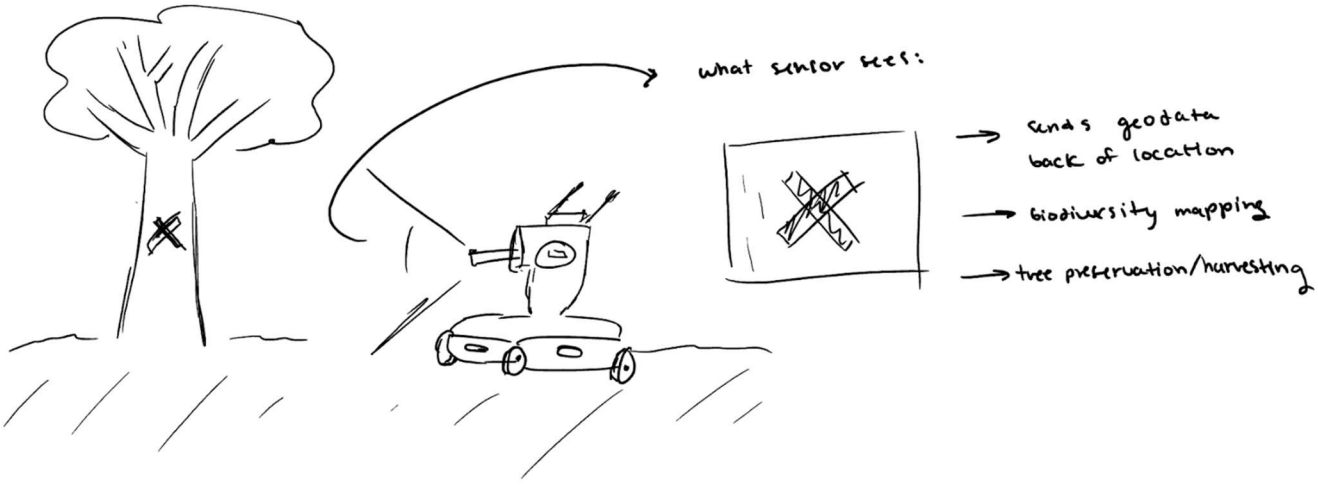
Pros:

- Higher level of empathy
- Less intimidating and more approachable for workers who may interact with the robot
- Unique design that engages users
- Helps with the manifesto

Cons:

- A silly design might cause potential users to undermine the credibility of the skills and usefulness of the robot
- For humanitarian projects, an unserious look may not align with its serious purpose
- Decorations that don't contribute to the functionality of the robot might cause confusion with what the purpose of the robot is, what is decoration/functional

Subsystem #3: VRS



Sensors can read symbols in tree preservation and harvesting, or symbols for different plants in biodiversity mapping. With an added GPS to the robot, it could collect geolocation data which can later be used to analyze the ecosystem.

Pros

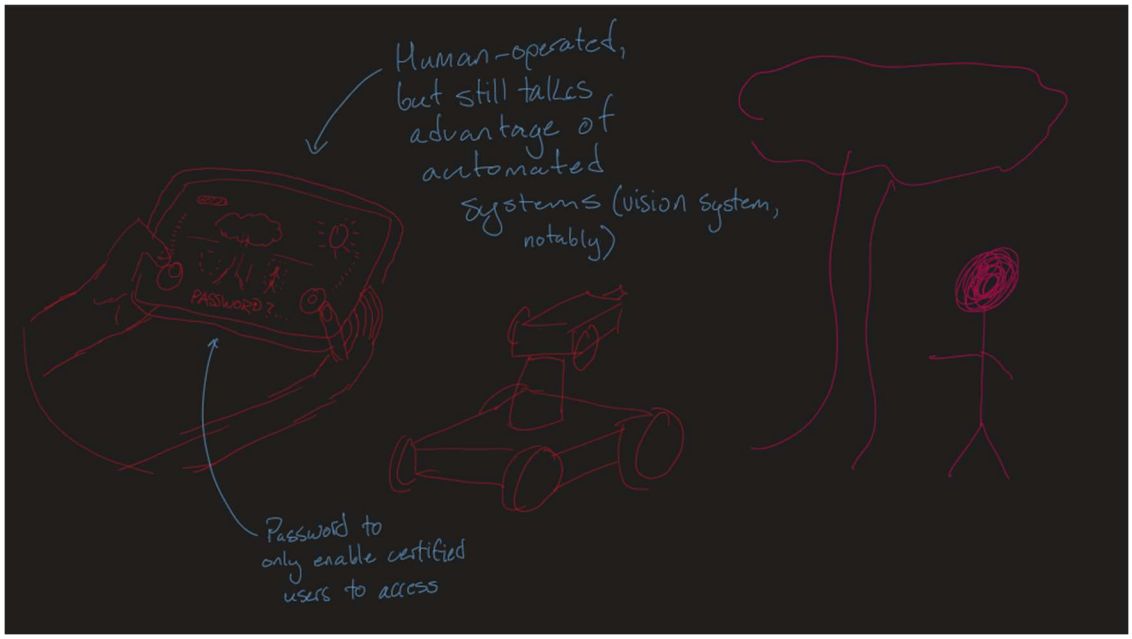
- Simple symbols used in tree preservation and biodiversity markers align with RoboMaster S1's abilities well
- Reduces the need for tedious manual surveys
- Scanning, logging, and mapping of tree markings or biodiversity markers in real-time
- GPS integration for use in GIS software and georeferencing

Cons:

- Markings that are faded or obstructed may not be caught which would otherwise be marked down using real human judgement
- GPS limitations with low signals in dense forests, etc.
- Climate and terrain issues with the temperature and movement limitation of the RoboMaster S1

2.5. Jake's Solutions

Subsystem 1: Addressing Ethical Concerns



To address the ethical concerns for the robot (specifically the lack of human understanding and judgement, I suggest returning most of the operations of the robot to the user, giving them the final decision when it comes to what the robot does. Users would control the basic operations of the robot, notably movement, through the RoboMaster app, but they would still benefit from certain automated features, such as vision recognition, which could help make certain tasks easier.

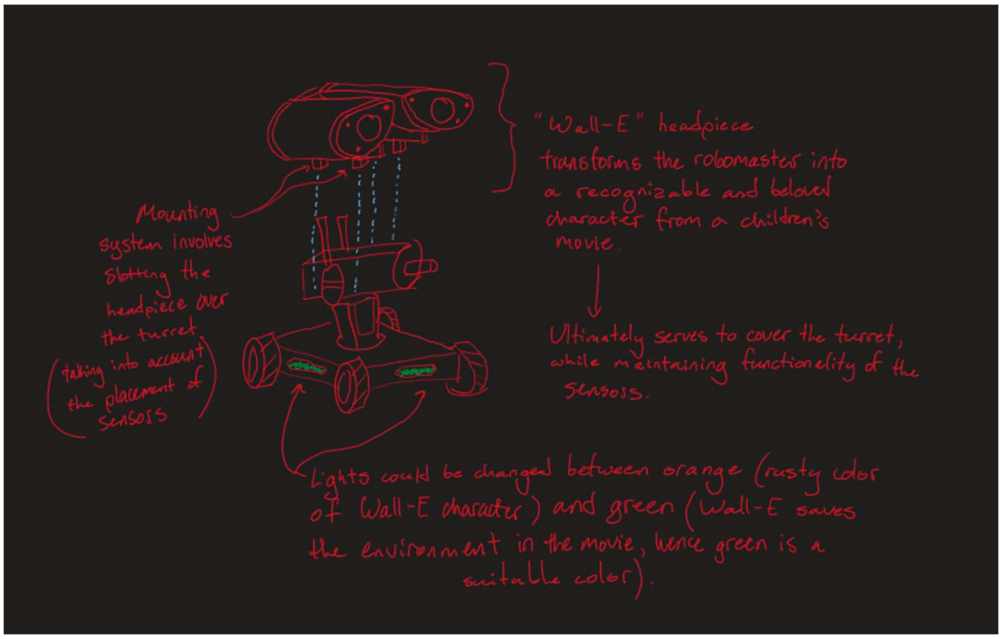
Pros:

- Requires human judgement and understanding to fulfill tasks.
- Users could be limited to only those who are certified to operate the robot to limit misuse.

Cons:

- There is the possibility of introducing human errors in addition to errors made by the robot during operation.
- The speed at which the robot can perform tasks might be reduced, since the time it takes for a human to think and then control the robot will be a limiting factor.

Subsystem 2: Robot appearance



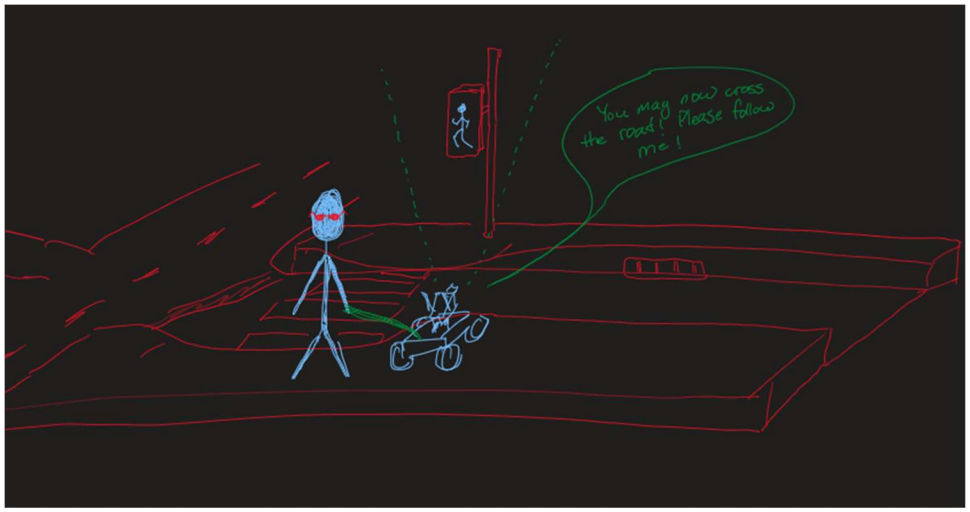
Pros:

- The character this design aims to mimic is a cheerful, non-violent, environmental-friendly robot that many children and adults will recognize. For this reason, people will be more likely to empathize with the robot.
- The turret and gun is one of the primary features of the RoboMaster S1 that is contentious; hiding it aims to make the robot look less like a weapon of war and more like a toy.

Cons:

- The design of the headpiece may prove to be complex, since it must fit securely on the turret to not fall off during robot traverse and turret movements.
- The size of the headpiece might be unwieldy, since it must fit over the turret and will increase the overall profile of the robot.
- The increase in weight may negatively affect certain positive features of the robot, notably its mobility and battery life (the weight might be more taxing on the electric motors).

Subsystem 3: Vision Recognition System



Here, I am proposing that the vision system is used to detect simple symbols that are often used in society to assist people who are visually impaired, like how a service dog might operate. The crosswalk symbol could be detected by the robot to determine if the time is right to cross the road. It would then communicate this information to the human it is accompanying via its speakers.

Pros:

- The vision sensor can recognize simple symbols reliably.
- The robot can quickly communicate information that it detects due to its operating being based on algorithms.
- Serves as an alternative for people who can't take care of a service animal or who are allergic to one.

Cons:

- More complex symbols will not be recognized reliably by the sensors, limiting functionality.
- Symbols might be detected unintentionally (the robot detects the crosswalk symbol and plays the cue to cross the road, when the person does not actually intend to cross the road).

3. Functional Solutions

3.1. Solution 1: Environmental Scanning

The robot is used for environmental scanning purposes. It has sensors to track symbols for forestry and biomarking and map areas, gather environmental data, and georeferenced this data for GIS analysis to aid in biodiversity research and ecology conservation.

Subsystem 1: Vanya's

Subsystem 2: Jake's

Subsystem 3: Vanya's

3.2. Solution 2: Service-Bot

The robot is used in lieu of service animals for members of the community that are not able to take care of a service animal, cannot afford to, or are allergic to animals.

Subsystem 1: Daniella's

Subsystem 2: David's

Subsystem 3: Jake's

3.3. Solution 3: Nanny-Bot

The robot is used to assist in safe caregiving for the elderly. It uses AI to help monitor health, detect falls, provides reminders for daily tasks such as taking medication, and uses a voice recognition system to offer personalized support.

Subsystem 1: David's

Subsystem 2: Maddox's

Subsystem 3: Daniella's

4. Analysis and Evaluation of the Sub-System Designs

To effectively evaluate the sub-system designs proposed by each group member, the design criteria developed in the previous deliverable will be used. The sub-system designs will be ranked based on how well they can solve the issues related to the design criteria: a score of 1 (green) will be assigned to designs that meet the required design criteria; a score of 2 (yellow) will be assigned to designs that somewhat meet the design criteria; a score of 3 (red) will be assigned to designs that do not meet the design criteria.

Table 1: Ethical

Concept / Design Criteria	Importance	Daniella	David	Vanya	Maddox	Jake
Friendly Appearance	2	2	2	3	3	2
Respects Load Capacity	2	2	2	1	2	1
Easy to Learn Program	1	2	2	2	2	1
Utilizes Sensors	1	1	1	1	1	1
Addresses Ethical Concern	1	1	1	1	1	1

Table 2: Robot Appearance

Concept / Design Criteria	Importance	Daniella	David	Vanya	Maddox	Jake
Friendly Appearance	1	1	2	1	1	1
Respects Load Capacity	3	2	2	1	2	2
Easy to Learn Program	3	1	1	1	1	1
Utilizes Sensors and Sensor Range	3	3	3	3	3	2
Addresses Ethical Concern	2	2	2	2	3	3

Table 3: Vision Recognition system

Concept / Design Criteria	Importance	Daniella	David	Vanya	Maddox	Jake
Friendly Appearance	3	3	2	3	3	2
Respects Load Capacity	2	2	2	1	1	1
Easy to Learn Program	2	2	1	3	2	1
Utilizes Sensors and Sensor Range	1	1	1	1	1	1
Addresses Ethical Concern	2	1	1	1	3	2

5. Global Concept- “Wall-E" Enviro-Bot

The “Wall-E” robot was our first choice, as it follows an iconic character many people will know that was known for being an environmental saviour. Our idea of the enviro-bot is designed to embody the likeness of the non-violent, environmentally friendly robot that everyone loves, to give off a very friendly and approachable perception then it did before these additions.

The eyes would also cover the gun, addressing a large source of unfriendly feelings, although the headpiece could obstruct some sensor components. The returning of data to a human user will bring in a level of human judgement that no robot could match. Removing or disguising features similar to weapons turns the Enviro-Bot into a companion in sustainability, reinforcing even more firmly the fact that technology is here to help the users and not here to threaten the users. Non-threatening designs makes it convenient to introduce it to public spaces and research initiatives where it can be actively involved in solving the problems that we come across.

Finally, this Robot would better our community and nature by using sensors to scan environmental and process geodata for markers like sick trees that need to be removed or helped. This aids in diminishing the spread of diseased trees across heavily forested areas. This robot will also be able to register biodiversity markers and invasive species markers and geolocate and transmit this data to labs so they can study the health of a specific environment even better and know if it needs aid.

6. Conclusion

In conclusion, our chosen designs aim to ethically and effectively incorporate the vision recognition system of the RoboMaster S1, while also improving the appearance of the robot and addressing some of the primary ethical issues surrounding automated robot systems. We believe that our design accomplishes these goals and follows the previously proposed design criteria. Following the next client meeting, we will gather the feedback we received and reflect on it in order to create a prototype. Ultimately, we will make changes as needed to produce a high-quality deliverable that meets the standards of Mines Action Canada.