Project Deliverable C:

Design Criteria and Target Specifications

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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

Imagine a world where Artificial intelligence and autonomous weapon systems (AWS) aren't used for violence, but rather for altruistic purposes. Our team is developing a plan that turns this vision into a reality. In this deliverable, we have outlined strategies to aid CRAiEDL and Mines Action Canada toward their mission to educate people on the possible dangers of designing and using AWS. Key needs addressed include repurposing AWS for constructive use, exploring the possibilities of ethically developed AI, and promoting transparent and ethical human-robot collaboration. In this deliverable, we are using these needs to outline design criteria which will highlight constraints and requirements so that we may develop a more encompassing solution to the problem. We will also dive into benchmarking and target specifications to develop a well-rounded intention for our design.

2. Client Needs

Note: after further inspection of the project instructions and rubric, we have redefined our needs from Deliverable B. A short description of the new needs follows:

1. **To repurpose autonomous robots for humanitarian development.** Our team will transform Robomaster S1 into a tool that addresses humanitarian needs. This will help our client challenge the use of autonomous robots by demonstrating positive ways in which the same technology may be repurposed.
2. **To develop educational platforms for showcasing the constructive potential of AI.** By creating stimulating, interactive platforms such as simulations, videos, visual designs, and using lab-learned skills such as laser printing, coding, 3D printing, etc., we can demonstrate the versatility of AI and its potential to solve global issues when applied in the correct domains.
3. **To promote transparent and ethical human-robot collaboration.** Our group will use this project to emphasize the importance of integrating human moral judgment in AI projects and maintaining a transparent design process.

3. Design Criteria

3.1. Translating Needs into Design Criteria

Client Need	Design Criteria
1. Repurpose for human development	➢ Weight (kg) ➢ Dimensions (L x W x H) (m) ➢ Cost ($ CAD) ➢ Detection of obstacles, change of light ➢ Temperature sensors (℃/℉) ➢ Voice recognition and speakers ➢ GPS and geolocation ➢ Dust and water resistance ➢ Battery life (hrs) ➢ Product life (years)
2. Develop an educational platform	➢ User friendly and easy to understand message ➢ No display of violence ➢ Can be shown to all ages (PG)
3. Promote ethical and transparent AI use (sherry, 2025)	➢ Data privacy and security system ➢ Manual and automatic switches ➢ Override ability ➢ Implementing Canadian AI ethical design and development laws ➢ Employee ethics training ➢ Bias detection and mitigation software (racial, gender, socioeconomic) ➢ Incident tracking system ➢ Decision log

3.2. Functional Requirements

- Load capacity of minimum 5 kg with an adjustable and secure carry
- Sensors accurately detect and react to objects (detection range at least 10 cm to 5 m) and light change to ensure robots can avoid hitting oncoming objects and safely maneuver outdoors
- Compact size (L < 0.30 m, W < 0.30 m, H < 0.30 m) for maneuverability
- Voice recognition and speakers with ability to understand and respond in English and French
- LED lights
- Temperature sensors and heat adaptability for ability to work in diverse climates
- Implemented GPS on robot that transmits collected data to ArcGIS
- Battery that lasts a long period of time (6+ hours)
- Waterproof up to 1 meter under the surface
- Coded to detect bias and signal for human intervention when it is detected
- Able to explain AI decision in text format after completing them

3.3. Non-functional Requirements

- Product life is 3+ years and parts are replaceable in case of damage
- Friendly and approachable appearance
- Parts are reliable and easily replaceable so robots can last a long time
- UV and corrosion resistant material (stainless steel, aluminum, nickel alloys)
- Compliance with regulations (Canadian AI laws, IEEE standards for AI ethics)

3.4. Constraints

- Video and production costs are under 100$ (CAD)
- Operating conditions: water and dust resistance (IP rating)
- Operating conditions: temperature (-30° <-> 35°), snow, slush
- Part A – video needs to be roughly 90 seconds
- Part B – Report needs to be 1 page in length
- Deadline for project completion is March 26th

3.5. Metrics

Metric	Description
Weight	The mass in kilograms (kg).
Size	Dimensions in maximum length, width, height in meters.
Durability	Description of the conditions in which the product can survive (temperature, IP metrics)
Ease-of-use	How easy the product is to use for human-robot interaction.
Battery Life	Guarantees long term usage by determining how long a device can operate before needing to be recharged.
Safety Compliance	It informs that the system meets all ethical and legal safety requirements while minimizing any associated risks and ensuring responsible deployment of AI processes.
Cost	The project expenses are evaluated against financial feasibility while being within budget constraints.
User Experience	It measures how intuitive and user-friendly the system is for different audiences, ensuring accessibility and ease of interaction.

4. Benchmarking

4.1. Technical Benchmarking

Product / Metric	Importance Weighting	1.TurtleBot3 (*TurtleBot3*, n.d.)	2. ClicBot (*ClicBot Kit*, 2025)	3.Gewbot smart (*Gewbot Complete*, 2021)
Weight	2	1.2kg	1.2kg	1.2kg
Size (L x W x H)	2	0.182x0.24x0.31	0.22x0.22x0.18	0.30 x 0.25 x 0.15
Battery life	5	2-4 hours	3-4 hours	2-3 hours
Waterproof	5	Not waterproof, it's designed for indoor purposes.	Not waterproof, it's designed for indoor purposes.	Not waterproof, it's designed for indoor purposes.
Cost (CAD)	4	800$	550$	400$

4.2. User Benchmarking

Experience / Metric	Importance Weighting	1.TurtleBot3 (*TurtleBot3*, n.d.)	2. ClicBot (*ClicBot Kit*, 2025)	3. Gewbot Smart (*Gewbot Complete*, 2021)
Durability	4	Sensors are not as durable and break/malfunction easily over time. Handle with care.	Light to Moderate, best for educational/ in classroom purposes	Moderate, best for light research tasks but does not do well with high impact or heavy-duty environments.
Ease-of-Use	2	Not as beginner friendly, uses ROS which beginners need to learn.	Very beginner friendly, modular, simple and intuitive app that can be downloaded on almost every device.	Beginner-Friendly, modular, very simple to set up, but not many options or controls.

5. Target Specifications

	Design Specifications	Relation (=, < or >)	Value	Units	Method of Verification
Functional Requirements					
1	Load Capacity	=	5	Kg	test
2	Censor Range	>	5	meters	test
3	Robot Size (Lx W x H)	=	0.3x0.3x0.3	meters	analysis
4	Battery Life	>	6	hours	test
5	Waterproof up to	=	1	meter	test
Non-functional Requirements					
1	Friendly appearance	=	Yes	N/A	Analysis
2	Ease to learn program	=	Yes	N/A	Test
3	durability	=	Yes	N/A	Test
4	Compliance with regulations	=	Yes	N/A	Analysis

6. Reflection

In the first client meeting, Mines Action Canada introduced themselves as a company and explained their values. Alongside this, they raised their concerns about the issue being addressed in this project: autonomous warfare. Their presentation was structured to provide basic background information on autonomous weapons systems and the ethical problems associated with this form of warfare. A demonstration of the RoboMaster S1 was also performed, to give students an introduction to the robot they will be working with throughout the semester. This presentation did not explore any of these topics in detail; despite this, it was noticed that the client placed a stronger emphasis on the ethical issues surrounding the use of autonomous weapons systems than the technical specifications of the robot. For this reason, the design criteria were approached with this in mind.

The client was clear that the video should showcase alternate use cases of the robot that do not encourage warfare or violence of any kind; from this, it was decided that our video should serve as an educational platform advocating for the responsible use of these systems. To do so, it must be user-friendly with an easy-to-understand message, as well as no display of violence (allowing it to be shown to a wider audience range).

Also, the technical specifications of the RoboMaster S1 were decided to be relevant design criteria as well, since an understanding of the robot's functions will be necessary to successfully repurpose it for human development.

6. Conclusion

In conclusion, this document aims to state and organize the design criteria and target specifications for a project that repurposes AWS for humanitarian purposes by using AI in collaboration with human morals for the greater good. The key to developing AI in a way that is responsible and ethical, as highlighted by this document, is implementing systems in the software to minimize bias, ensuring the AI machinery is operated in a way that works with people rather than separate, and innovating in a way that considers solutions to global issues rather than monetary gain. The significance of technical specifications and benchmarking lies in connecting a problem to the solution – considering existing designs, design criteria, and metrics allows us to bring an idea to life. All in all, by using technological tools and actively considering the ethical implications of engineering design, we can help build a future where we can work with AI to heal rather than harm.

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