

Brainstorming And Researching Ideas

The S.P.A.C.E. Framework

Objectives

Leverage GenAI in the brainstorming and research process using the S.P.A.C.E. Framework

- Set directions that can be communicated to the AI system
- Prompt AI to produce specific outputs needed
- Assess AI output to validate the information
- Curate the AI-generated text to select what to use along with human written material
- Edit the combined human and AI contributions

The S.P.A.C.E. Framework

To use GenAI purposefully and appropriately to facilitate personalised learning, students need to learn how to incorporate necessary steps into their research and writing process. The S.P.A.C.E. Framework introduced by Dr. Glenn Kleiman was designed to guide students' use of GenAI to support their writing and to foster discussions about how AI can be incorporated effectively into writing instruction.

Dr. Kleiman is a Senior Advisor at the Stanford Graduate School of Education where his work focuses on the potential of AI to enhance teaching and learning.

<h1 style="margin: 0;">S.P.A.C.E. Framework</h1> <p style="margin: 0;">(Kleiman, 2023)</p>	<ul style="list-style-type: none"> • <i>Set directions</i> for the goals, content and audience that can be communicated to the AI system. • <i>Prompt</i> the AI to produce the specific outputs needed. • <i>Assess</i> the AI output to validate the information for accuracy, completeness, bias, and writing quality. • <i>Curate</i> the AI-generated text to select what to use and organize it coherently, often working from multiple alternative versions generated by AI along with human written materials. • <i>Edit</i> the combined human and AI contributions to the text to produce a well-written document.
--	---

Kleiman, G., Dr. (2023, January 5). *Teaching Students to Write with AI: The SPACE Framework*. The Generator. Retrieved June 30, 2023, from <https://medium.com/the-generator/teaching-students-to-write-with-ai-the-space-framework-f10003ec48bc>

Example Activity: Brainstorming and Researching Ideas

This activity is taken from a Discipline Specific Requirement ELC subject. This subject requires students to write professional proposals and deliver persuasive presentations based on original ideas, credible research, and discipline knowledge.

The following activity guides the students to use Dr. Kleiman's S.P.A.C.E. Framework in the process of brainstorming and researching ideas.

Brainstorming Original Ideas and Research

In groups

- decide on a specific target group
- research the problems/needs of your target group and select specific needs/problems you believe could be addressed (with reference to sources)
- brainstorm an original and feasible engineering solution
- justify the need/demand for your proposed idea (with reference to sources)
- justify the feasibility of your proposed idea (with reference to sources)

Target Group: Proposed Idea:	
Real Problems/Needs <i>(embedded source links)</i>	
Need/Demand <i>(embedded source links)</i>	
Feasibility <i>(embedded source links)</i>	



GenAI Tip: Use Dr. Kleiman's S.P.A.C.E. Framework to facilitate your brainstorming process.

Below is an example based on past student work. The students had volunteered with the visually impaired, so they wanted to brainstorm a solution for the visually impaired community in Hong Kong.

S.P.A.C.E. Framework: Identifying Problems/Needs of Target Group

Set and Prompt: Problems with reference to sources

What are the problems of blind people in Hong Kong. Support your answers with reference to research or reports.

What are the problems of blind people in Hong Kong. Support your answers with reference to research or reports.

1. Accessibility and Mobility:

- **Problem:** Navigating the urban environment in Hong Kong can be challenging for visually impaired individuals due to inadequate tactile paving, inconsistent audio signals at pedestrian crossings, and obstacles on sidewalks.
- **Need:** Improved urban planning and infrastructure, including more consistent tactile paving and audio signals, to enhance mobility and safety.
- **Reference:** [Hong Kong Society for the Blind \(HKSBS\)](#)

2. Education and Employment:

- **Problem:** Access to quality education is a significant challenge, with limited resources and support for visually impaired students in mainstream schools. Employment opportunities are also limited, with high rates of discrimination in the job market.
- **Need:** Enhanced support services in schools, including specialized teaching materials and assistive technologies, as well as greater support for vocational training and inclusive hiring practices.
- **Reference:** [Hong Kong Blind Union](#)

3. Social Isolation and Loneliness:

- **Problem:** Social isolation and lack of inclusion in community activities are common issues faced by visually impaired individuals.
- **Need:** Community programs and initiatives to promote social inclusion, awareness campaigns to change societal attitudes, and accessible recreational facilities.
- **Reference:** [Hong Kong Blind Union](#)

4. Companionship and Assistance:

- **Problem:** Many visually impaired individuals lack companionship and assistance, which can affect their emotional well-being and daily functioning.
- **Need:** Support networks, volunteer programs, and assistive services to provide companionship and practical assistance.
- **Reference:** [Hong Kong Society for the Blind \(HKSBS\)](#)

5. Healthcare Access:

- **Problem:** Visually impaired individuals often face barriers in accessing healthcare services, including difficulties in navigating healthcare facilities and a lack of accessible health information.
- **Need:** Improved accessibility in healthcare facilities, training, and accessible health information.
- **Reference:** [Hong Kong Society for the Blind \(HKSBS\)](#)

Assess and Curate:

- Validate the information: Find up-to-date and credible sources
- Critically select what to use

The group wanted to focus on addressing two problems: 1) Mobility and 2) Emotional well-being

Assess and Curate: Validate and critically select information that justifies the two problems

1. Mobility: Complex urban environment, inadequate tactile paving, inconsistent audio signals at crossings, insufficient public transportation accessibility, etc. (Labour and Welfare Bureau, 2022)
2. Emotional well-being: Numerous studies have established a strong correlation between vision impairment and depression (Demmin & Silverstein, 2020).

Source links:

Demmin, D.L. & Silverstein, S.M. (2020) *Visual Impairment and Mental Health: Unmet Needs and Treatment Options*, *Clinical Ophthalmology*, 14:, 4229-4251, DOI: [10.2147/OPHTH.S258783](https://doi.org/10.2147/OPHTH.S258783)

Labour and Welfare Bureau of the Government of the Hong Kong Special Administrative Region. (2022). *Consultancy Study for Enhancement of the Accessibility of Physical Environment in Hong Kong*. Retrieved February 15, 2024, from <https://www.lwb.gov.hk/en/highlights/rpp/Final%20Report.pdf>

Edit: Combine your analysis and GenAI produced ideas

- The group wished to explore whether a robotic guide dog could potentially address the two problems. S.P.A.C.E. Framework: Brainstorming Robotic Guide Dog

Set and Prompt

Is there need and demand for a robotic guide dog? Support your answer with market research or studies based on the situation in Hong Kong.

Need and Demand for Robotic Guide Dogs in Hong Kong**1. Prevalence of Visual Impairment:**

- According to the Census and Statistics Department of Hong Kong, there were approximately 174,800 people with visual impairments as of 2013. This significant population indicates a potential market for assistive technologies.

2. Limitations of Traditional Guide Dogs:

- The Hong Kong Guide Dogs Association (HKGDA) faces challenges in meeting the demand for traditional guide dogs due to high costs and extensive training requirements. This limitation suggests a gap that robotic guide dogs could potentially fill.

3. Assistive Technology Adoption:

- A study by the Hong Kong Society for the Blind (HKSB) indicates that visually impaired individuals in Hong Kong are increasingly adopting assistive technologies, showing a growing interest in innovative solutions.

4. Supportive Environment:

- The Hong Kong government and NGOs provide funding for assistive devices. Local research institutions such as the Hong Kong University of Science and Technology (HKUST), are active in robotics and AI development, creating a conducive environment for the adoption of robotic guide dogs.

5. User Acceptance:

- Surveys by the Hong Kong Blind Union reveal that many visually impaired individuals are open to trying new technologies that can improve their quality of life, indicating potential user acceptance for robotic guide dogs.

Conclusion**Assess and Curate:**

- Validate the information: Find up-to-date and credible sources
- Critically select what to use

Give me links to the sources you mentioned

I apologize for any confusion, but as an AI, I don't have the capability to browse the internet in real-time or provide direct links to sources. However, I can guide you on how to find the information mentioned:

Assess and Curate: Validate and critically select information that justifies the need/demand

1. Hong Kong Guide Dog Association (2023): In 2021-22, there were more than 199,000 people with visual impairment in Hong Kong, but only 34 guide dogs were in service.
2. Hong Kong Blind Union *2022-2023 Annual Report*: Visually impaired individuals are open to trying new technologies and the government as well as NGOs in Hong Kong are supporting the research and development of innovative and technological solutions.
3. News.gov.hk. (2023, May 21): Smart Government Innovation Lab co-operated with a local startup to develop an indoor guiding robot. The robot will be tested in shopping malls and is expected to assist the blind more conveniently than guide dogs in indoor areas.

References:

Hong Kong Blind Union (2023). *2022-2023 Annual Report*. Retrieved February 15, 2024, from https://www.hkbu.org.hk/uploads/files/Annual-Report-20240523023052-file_en.pdf

Hong Kong Guide Association. (2023). *Guide Dog Training*. Retrieved February 15, 2024, from <https://www.guidedogs.org.hk/services/#tab--guide-dog-training> (2023, May 21).

Robotics for a better life. Retrieved February 15, 2024, from https://www.news.gov.hk/eng/2023/05/20230518/20230518_182459_331.html

Edit: Combine your analysis and GenAI produced ideas

- Up-to-date news and reports show clear interest and demand from target group and support from gov and NGOs
- Project could leverage existing technology and development of robotic guide dogs in indoor areas
- Possible Idea: What are the limitations of existing robotic guide dogs?

Set and Prompt

Is there a functioning robotic guide dog in the market?

Currently, there are no fully functioning robotic guide dogs available on the commercial market that can completely replace traditional guide dogs. However, research and development in this area have been progressing steadily.

Several prototypes and experimental models have been developed by various companies and research institutions. These include:

- **MELDOG:** A pioneering project by a Japanese team at Nagoya University, which was one of the earliest attempts to create a robotic guide dog. While MELDOG was developed in the 1980s, it laid important groundwork for future research in this field.
- **AiDog:** A robotic guide dog developed by a team at Loughborough University in the UK.
- **RoboDog:** A project by Microsoft and Guide Dogs UK to develop AI-powered assistance for visually impaired people.
- **SIAT's robotic guide dog:** Developed by the Shenzhen Institutes of Advanced Technology (SIAT) in China.

Would you like to explore more about any of these projects or discuss other advancements in assistive technology for visually impaired individuals?



Set and Prompt

What are the key technologies/capabilities and limitations of Meldog?

Key Technologies/Capabilities and Limitations of MELDOG**Key Technologies/Capabilities**

1. **Navigation System:**
 - **Technology:** MELDOG was equipped with sensors and cameras to detect obstacles and navigate environments.
 - **Capability:** It could guide users around obstacles and follow predefined paths, providing basic navigation assistance.
2. **Obstacle Detection:**
 - **Technology:** Utilized ultrasonic sensors to detect obstacles in the user's path.
 - **Capability:** Enabled the robot to identify and avoid obstacles, enhancing user safety.
3. **User Interface:**
 - **Technology:** Included a tactile feedback system to communicate with the user.
 - **Capability:** Allowed the user to receive guidance through vibrations or other tactile signals, making it easier to understand directions.
4. **Autonomous Movement:**
 - **Technology:** Integrated basic AI algorithms for autonomous movement.
 - **Capability:** Enabled MELDOG to move independently without constant user input, providing a hands-free experience.

Limitations

1. **Technological Maturity:**
 - **Limitation:** Developed in the 1980s, MELDOG's technology was relatively primitive compared to modern standards.
 - **Impact:** Limited its effectiveness and reliability in complex environments.
2. **Obstacle Detection Range:**
 - **Limitation:** The range and accuracy of ultrasonic sensors were limited.
 - **Impact:** Reduced the robot's ability to detect smaller or more distant obstacles, potentially compromising user safety.
3. **User Interface Complexity:**
 - **Limitation:** The tactile feedback system was not as intuitive as modern interfaces.
 - **Impact:** Made it challenging for users to interpret guidance accurately, reducing overall usability.
4. **Battery Life and Power:**
 - **Limitation:** Early robotics often suffered from limited battery life and power constraints.
 - **Impact:** Restricted the operational time and range of MELDOG, requiring frequent recharging.
5. **Environmental Adaptability:**
 - **Limitation:** Struggled to adapt to highly dynamic or unpredictable environments.
 - **Impact:** Limited its usefulness in real-world scenarios where conditions frequently change.

Conclusion

MELDOG was a pioneering effort in the development of robotic guide dogs, featuring key technologies such as navigation systems, obstacle detection, and autonomous movement. However, its limitations in technological maturity, sensor range, user interface complexity, battery life, and environmental adaptability restricted its effectiveness. Despite these challenges, MELDOG laid important groundwork for future advancements in robotic assistance for visually impaired individuals.

Assess and Curate:

- Validate the information: Find up-to-date and credible sources
- Critically select what to use

Assess and Curate: Validate and critically select information that justifies the capabilities and limitations of MELDOG

Key features of MELDOG include: obstacle detection, route planning, and object recognition. These functions can solve limitations brought by the white cane, but the inaccuracy of navigation and the bulky design was problematic (Tachi Lab, 2021).

Reference:

Tachi Lab. Tachi Lab - Guide Dog Robot (MELDOG). (2021). Retrieved March 10, 2023, from <https://tachilab.org/en/projects/meldog.html>

Edit: Combine your analysis and GenAI produced ideas

- Uniqueness: Is it possible for us to develop a robotic guide dog that could facilitate outdoor navigation? Can the design of the robotic guide dog provide emotional support?

Set and Prompt

Can existing technology now address the limitations of Meldog and develop a robotic guide dog for outdoor navigation? Be concise and support answer with reference to research.

Yes, existing technology has advanced significantly and can address many of the limitations of early projects like MELDOG, potentially enabling the development of a functional robotic guide dog for outdoor navigation. Here are some key technological advancements and supporting research:

Technological Advancements**1. Artificial Intelligence (AI) and Machine Learning:**

- **Advancement:** AI and machine learning algorithms can now process vast amounts of data in real-time, enabling more accurate object recognition, obstacle detection, and path planning.
- **Research:** A study published in the journal *IEEE Robotics and Automation Letters* demonstrated the use of deep learning for real-time object detection and navigation in dynamic environments.

2. Lidar and Sensor Technology:

- **Advancement:** Modern Lidar systems and advanced sensors provide high-resolution, 3D mapping of the environment, crucial for precise navigation.
- **Research:** Research from the Massachusetts Institute of Technology (MIT) has shown that Lidar combined with other sensors can create detailed environmental maps, improving navigation accuracy.

3. Robust Robotics Platforms:

- **Advancement:** Robotics platforms like Boston Dynamics' Spot and other quadruped robots offer stability and mobility over various terrains, which is essential for outdoor navigation.
- **Research:** A paper in *Science Robotics* highlighted the capabilities of quadruped robots in navigating complex outdoor environments, demonstrating their potential as guide dogs.

4. Human-Robot Interaction (HRI):

- **Advancement:** Improved HRI technologies enable better communication between the robot and the user, including haptic feedback and voice commands.
- **Research:** A study in the *Journal of Human-Robot Interaction* explored effective communication methods between visually impaired users and assistive robots, emphasizing the importance of intuitive interfaces.

Conclusion

Existing technologies in AI, Lidar, robotics platforms, and human-robot interaction have significantly advanced, addressing many limitations of early projects like MELDOG. These advancements make the development of a functional robotic guide dog for outdoor navigation increasingly feasible.

References

1. *IEEE Robotics and Automation Letters*: Research on deep learning for real-time object detection and navigation.
2. *Science Robotics*: Studies on the capabilities of quadruped robots in complex environments.
3. *Journal of Human-Robot Interaction*: Research on effective communication methods between users and assistive robots.

These references can be found through academic databases such as IEEE Xplore, ScienceDirect, and Google Scholar.

Assess and Curate:

- Validate the information: Find up-to-date and credible sources
- Critically select what to use

Assess and Curate: Validate and critically select information that justifies the feasibility of outdoor navigation supported by existing technology.

Findings from Wei, Kou and Lee's 2014 research into guide-dog robot system in an urban setting, and other research areas such as using 3D gully monitoring with GIS (Marzloff & Poesen, 2009) and satellite positioning system to track gait parameters (Terrier & Schutz, 2005), support the feasibility of the proposed idea.

References:

Marzloff, I., & Poesen, J. (2009). The potential of 3D gully monitoring with GIS. using high-resolution aerial photography and a digital photogrammetry system. *Geomorphology*, 111(1-2), 48-60.

<https://www.sciencedirect.com/science/article/pii/S0169555X09001421>

Terrier, P., & Schutz, Y. (2005). How useful is satellite positioning system (GPS) to track gait parameters? A review. *Journal of neuroengineering and rehabilitation*, 2(1), 1-11. <https://pubmed.ncbi.nlm.nih.gov/16138922/>

Wei, Y., Kou, X., & Lee, M. C. (2014, July). A new vision and navigation research for a guide-dog robot system in urban system. In *2014 IEEE/ASME International Conference on Advanced Intelligent Mechatronics* (pp. 1290-1295).

IEEE. <https://ieeexplore.ieee.org/document/6878260>

Is it possible to design a robotic guide dog that makes it feel like a real dog and can provide emotional support to the blind? Support your answer with reference to research.

Is it possible to design a robotic guide dog that makes it feel like a real dog and can provide emotional support to the blind?

Designing a robotic guide dog that can provide emotional support and mimic the feel of a real dog is a complex but increasingly feasible goal, thanks to advancements in robotics, artificial intelligence, and human-robot interaction research.

Realistic Design and Technologies

1. Tactile and Sensory Feedback:

- **Research:** Advances in haptic technology can simulate the feeling of fur, warmth, and even the heartbeat of a real dog. For example, researchers at the University of Bristol have developed soft robotics that can mimic the texture and warmth of animal fur.
- **Application:** Incorporating these technologies into a robotic guide dog can make it feel more lifelike, providing tactile comfort to visually impaired users.

2. Behavioral Mimicry:

- **Research:** AI and machine learning algorithms can be used to program robotic dogs to exhibit behaviors similar to real dogs, such as wagging their tails, responding to touch, and following commands. Boston Dynamics' Spot robot, for instance, demonstrates advanced behavioral capabilities.
- **Application:** These behaviors can help create an emotional bond between the user and the robotic guide dog, similar to that experienced with a real dog.

3. Emotional AI:

- **Research:** Emotional AI can enable robots to recognize and respond to human emotions. Companies like Affectiva are developing AI systems that can read facial expressions and vocal tones to gauge emotional states.
- **Application:** A robotic guide dog equipped with emotional AI could provide appropriate responses to the user's emotional needs, offering comfort and companionship.

4. Voice Interaction:

- **Research:** Natural language processing (NLP) technologies, such as those used in virtual assistants like Amazon's Alexa or Google's Assistant, can facilitate meaningful interactions between humans and robots.
- **Application:** Integrating NLP into a robotic guide dog can enable it to engage in simple conversations, respond to commands, and provide verbal comfort, enhancing the emotional support it offers.

Supporting Research

1. Paro Therapeutic Robot:

- **Study:** Research on the Paro therapeutic robot, which mimics a baby seal, has shown that robotic pets can provide emotional support and reduce stress and anxiety in users, including the elderly and those with disabilities (Wada et al., 2004).
- **Implication:** This suggests that a well-designed robotic guide dog could similarly offer emotional benefits to visually impaired individuals.

2. Sony's Aibo:

- **Study:** Sony's Aibo robotic dog has been studied for its impact on emotional well-being. Research indicates that interactions with Aibo can evoke emotional responses similar to those elicited by real pets (Kerepesi et al., 2006).
- **Implication:** These findings support the feasibility of creating a robotic guide dog that provides emotional support.

Conclusion

It is possible to design a robotic guide dog that feels like a real dog and provides emotional support to the blind, thanks to advancements in tactile feedback, behavioral mimicry, emotional AI, and voice interaction technologies. Research on therapeutic robots like Paro and Sony's Aibo further supports the potential for such a device to offer significant emotional benefits. However, achieving this goal will require continued innovation and user-centered design to ensure the robot meets the emotional needs of visually impaired individuals effectively.

Assess and Curate:

- Validate the information: Find up-to-date and credible sources
- Critically select what to use

Assess and Curate: Validate and critically select information that justifies the feasibility of a realistic robotic guide dog that provides emotional support.

- PARO Realistic Therapeutic Robotic Seal (Hung et al. 2019)
- Thermoelectric and Peltier devices (Wavelength Electronics, 2020) can be used to maintain a warm temperature.
- Soft robotic shell design could also enhance the realistic touch (Osawa, 2021).

References:

- Hung, L., Liu, C., Woldum, E. *et al.* (2019). The benefits of and barriers to using a social robot PARO in care settings: a scoping review. *BMC Geriatr* **19**, 232. <https://doi.org/10.1186/s12877-019-1244-6>
- Osawa, Y., Kinbara, Y., Kageoka, M. *et al.* Soft robotic shell with active thermal display. *Sci Rep* **11**, 20070 (2021). <https://doi.org/10.1038/s41598-021-99117-y>
- Wavelength Electronics. (2020, February 11). *Temperature Controller Basics*. Wavelength Electronics. Retrieved March 6, 2023, from <https://www.teamwavelength.com/temperature-controller-basics/>

Edit: Combine your analysis and GenAI produced ideas

After following Dr. Kleiman's S.P.A.C.E. Framework, the group then drafted an overview of their proposed idea.

<p>Target Group: Visually impaired community in Hong Kong</p> <p>Proposed Idea: A prototype for a robotic guide dog that can assist with outdoor navigation and provide emotional support.</p>	
<p>Real Problems/ Needs <i>(embedded source links)</i></p>	<ol style="list-style-type: none"> 1. Navigation and Mobility: Complex urban environment, inadequate tactile paving, inconsistent audio signals at crossings, insufficient public transportation accessibility, etc. (Labour and Welfare Bureau, 2022). 2. Emotional well-being: Numerous studies have established a strong correlation between vision impairment and depression (Demmin & Silverstein, 2020).
<p>Need/Demand <i>(embedded source links)</i></p>	<ol style="list-style-type: none"> 1. Hong Kong Guide Dog Association (2023): In 2021-22, there were more than 199,000 people with visual impairment in Hong Kong, but only 34 guide dogs were in service. 2. Hong Kong Blind Union 2022-2023 Annual Report: Visually impaired individuals are open to trying new technologies and the government as well as NGOs in Hong Kong are supporting the research and development of innovative and technological solutions. 3. News.gov.hk. (2023, May 21): Smart Government Innovation Lab co-operated with a local startup to develop an indoor guiding robot. The robot will be tested in shopping malls and is expected to assist the blind more conveniently than guide dogs in indoor areas.
<p>Feasibility <i>(embedded source links)</i></p>	<p><u>Outdoor Navigation</u></p> <p>Technology and development of indoor navigation robots:</p> <ul style="list-style-type: none"> • Indoor navigation robot developed by Smart Government Innovation Lab (news.gov.hk, 2023) • MELDOG (Tachi Lab, 2021) <p>Existing Technology:</p> <ul style="list-style-type: none"> • Wei, Kou and Lee's 2014 research of guide-dog robot system in an urban setting • Using 3D gully monitoring with GIS (Marzloff & Poesen, 2009) and satellite positioning system to track gait parameters (Terrier & Schutz, 2005) <p><u>Emotional Well-being Support</u></p> <ul style="list-style-type: none"> • PARO Realistic Therapeutic Robotic Seal (Hung et al. 2019) • Thermoelectric and Peltier devices (Wavelength Electronics, 2020) can be used to maintain a warm temperature. • Soft robotic shell design could also enhance the realistic touch (Osawa, 2021).