Sustainability AI copilot: Analyze & ideate at scale to enable positive impact

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Abstract

With the advances in large scale Foundation Models, web scale access to sustainability data, planetary scale satellite data, the opportunity for larger section of the world population to create positive climate impact can be activated by empowering everyone to ideate via AI copilots. The challenge is: How to enable more people to think & take action on climate & Sustainable Development goals?. We develop AI co-pilots to engage broader community for enabling impact at scale by democratizing climate thinking & ideation tools. We demonstrated how ideating with SAI transforms any seed idea into a holistic one, given the relation between climate & social economic aspects. SAI employs Language Models to represent the voice of the often neglected vulnerable people to the brainstorming discussion for inclusive climate action. We demonstrated how SAI can even create another AI that learns geospatial insights and offers advice to prevent humanitarian disasters from climate change. In this work, we conceptualized, designed, implemented & demonstrated Sustainability AI copilot (SAI) & innovated 4 use cases:- SAI enables sustainability enthusiasts to convert early stage budding thoughts into a robust holistic idea by creatively employing a chain of Large Language Models to think with six-thinking hats ideation. SAI can enables non-experts to become geospatial analysts by generating code to analyze planetary scale satellite data. SAI also ideates in multi-modal latent space to explore climate friendly product designs. SAI also enables human right activists to create awareness about inclusion of vulnerable and persons with disability in the climate conversation. SAI even creates AI apps for persons with disability. We demonstrated working prototypes at the project website, https://sites.google.com/view/climate-copilot. Thus, SAI co-pilot empowers everyone to come together to ideate to make progress on climate and related sustainable development goals.

Keywords: *Climate action, Sustainable Development Goals, Persons with Disability, Climate disasters, Humanitarian action, Generative AI, Human Computer Interaction, AI co-pilot, Large Language Models, Geospatial AI, Vision-Language modelling, Multimodal AI*

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1 Motivation

The potential to engage a larger percentage of world population to take action on climate & related goals can be unlocked by democratizing access to various enablers. The challenge is how to enable more people to take initiatives to make holistic progress on climate goals and related socio-economic goals. The opportunity to democratize access to avenues to accelerate progress on sustainable development could be activated by conceiving an AI copilot. This paper envisions such an AI copilot to lead anyone interested to contribute climate initiatives. The paper developed and implemented Sustainability AI copilot (SAI) with various innovative features aimed for democratizing access to enable people. We showcase working demos of SAI on four use cases at the SAI project website. Inaddition to the demonstration on four use cases, SAI also addressed the following challenges.

- *Engage wider set of partners for larger scale of impact by democratization of enablers:*
  - Challenge: How to enable more people to think & take action on climate?. [5,6]
  - We designed & implemented AI co-pilots to engage broader community to enable larger scale of impact by democratizing climate thinking, so everyone including the non-experts can participate in taking initiatives.
- *Nurture your seed ideas to mature ideas for social economic progress with climate action:*
  - Challenge: As users come up with early ideas in their mind, can they use SAI to ideate various ways to improve the idea? [4-6]
  - Ideating with SAI transforms user's seed idea into a holistic one as SAI employs chain of Large Language Models (LLM) to think & enable progress on each of the 17 Sustainable Development Goals (SDG). SAI uses a RCI chain (Recursive Critique Improvement) [23] on 17 SDG goals to continually refine and shape ideas.
- *Inclusive representation for Climate justice:*
  - Challenge: Vulnerable people are most impacted by climate change, but is their voice being heard as one thinks about sustainability initiatives?. How can we involve People from financially poor areas, and person with disability?. [7-12]
  - SAI employs Large Language Models (LLM) to role play, thus represent the "spirit" of vulnerable people in the brainstorming table. [11]
- *Multi-modal brainstorming:*
  - Challenge: Can ideation happen in a combination of visual and language modalities?
  - SAI copilot experiments with multimodal latent space arithmetic [25] to generate sustainable product designs.
- *Enable climate enthusiasts to create AI that gathers climate insights:*
  - Challenge: How can an AI generate another AI project?. Imagine a LLM that understands the causes of a climate disaster from a news article, then creates a geospatial software by code-generation to identify geospatial insights behind a disaster. Is it feasible to create such a copilot?
  - We implemented AI copilot that thinks about the approach to solve a climate problem. The AI not only generates the approach to analyze a climate disaster, but creates algorithm and generate source code to extract insights from satellite datasets and finally advices to prevent humanitarian crisis. Thus, SAI looks at climate problems, and creates AI python code that learns geospatial patterns [19-21] for a specific problem, and forecasts/advices climate related humanitarian risks. Thus everyone (including non-developers) can use SAI to avert humanitarian losses from climate disasters.

SAI is designed as an AI copilot, and it illustrates the potential to engage broader ecosystem to empower wider action on climate & Sustainable Development Goals. Working prototypes of SAI is demonstrated at the project website at this URL, https://sites.google.com/view/climate-copilot.

2 Design & implementation of Sustainability AI co-pilot prototypes

Sustainability AI copilot (SAI) is designed and implemented for 4 use cases in this paper. Working demos of these 4 solutions are showcased at the SAI project website at https://sites.google.com/view/climate-copilot. We also open-source the contributions. By democratizing, larger percentage of users can be encouraged to think about new ideas and nurture them. While SAI presents a simplified user experience to enable mainstream users, SAI taps into the advances in AI such as Large Language Models (LLM), Deep Learning on planetary scale geospatial data, chains of multiple LLMs, Multimodal LLMs, vision-language models, LLM code-generation. We demonstrated SAI on the following four use cases.

1. *SAI enables more climate enthusiasts to ideate & develop new ideas:* By combining a chain of LLMs to review & refine a budding idea for different points of view of across SDG, we get the set of LLMs to think collectively to refine an primitive idea into a robust idea (initiative) as per the six thinking hats brainstorming methodology. (e.g. "Your idea is good, but your idea can be refined this way, so that it also positively impact both SDG#1 & SDG#13"). In addition, SAI employs the power of Large Language Models (LLMs) and langchain tools to understand sustainability reports published by various companies and identifies the documented best practices with Retrieval Augmented Generation (RAG) [27] by scanning through sustainability reports with vector search. As companies are required to report out their sustainability plan in machine readable format in CSRD, best practices can be distilled by analyzing CSRD reports [1-3]. Also, SAI uses OpenAI's Function Calling functionality to identify agents to delegate workload based on type of task in hand, and maps common messages across multiple sources using conversational chat memory. A video demonstration of SAI is contributed at the project website.
2. *Humanitarian volunteers may use SAI to auto-generate AI solutions to act swiftly to prevent loss of human lives during climate disasters:* Climate community can use SAI to protect vulnerable populations from natural disasters. In the SAI project website, we demonstrate how SAI generates AI solutions in-turn that learns geospatial patterns from one disaster, then leverage those patterns to find other risk areas. SAI creates "AI generated climate investigations" to support climate adaptation & humanitarian action to protect vulnerable people by auto-generating the approach, algorithms, source code [26] for Deep Learning analysis of geospatial data [19-21]. SAI's RAG looks up climate disaster related news on the web, and then suggests areas of investigation to climate researchers. In the SAI project website, we demonstrate how SAI reads articles about recent floods caused by Glaciers lake outbursts, and then suggests investigations using geospatial datasets to identify future flood risks. A video demo is presented in project website.
3. *Multimodal brainstorming by SAI copilot to create sustainable product design ideas:* By applying multimodal latent space arithmetic, ideation can happen in a combination of vision and language modality [15,16]. SAI employs multimodal latent space addition across vision and language modality to enable multimodal ideation & refinement. Inaddition, SAI also employed a combination of GPT3.5 and DALL-E to create visualizations of sustainable designs. The project website also demonstrates this feature of SAI.
4. *SAI copilot for innovating solutions for persons with disability & enable disability inclusive climate action:* SAI copilot can ideate by empathizing with the needs of vulnerable persons with disability, and then create "AI app prototypes" to create innovative solutions. To enable persons with visual impairment, SAI generated a prototype of AI solution to identify emergency exits during emergencies using Visual Question Answering (VQA) using Vision Language PreTrained Transformers (VLM) with ViLT/GiT [15-18]. To enable persons with low vision, SAI empathized the need, and generated source code for prototyping AI apps with grounded visual document question answering using large scale vision language models (LVLM) with QWEN-VL [15-18].

3 Summary & Future

As the challenge on climate requires enormous collective will by a broad set of stakeholders, this paper created novel AI copilot to involve and engage a wider set of mainstream population across countries. The strategy we employed is to democratize enablers for wider participation. In this paper, we conceptualized, designed and implemented AI based copilots to guide anyone (including newbies) to brainstorm & create ideas and initiatives to make progress on climate goals, corporate sustainability goals, and make holistic progress on UN Sustainable Development Goals. A copilot can engage broader participation. We envisioned Sustainability AI copilot (SAI) and demonstrated the following in this paper.

- We demonstrated how SAI can turn seed ideas into mature ideas. We demonstrated how SAI ideates for holistic progress on climate action & related social economic factors. By chaining a set of LLMs, and by having a LLM critique the current version of idea across SDG factors, and then refine the ideas to be holistic, the climate community can collaborate with AI to make progress on climate and related Sustainable Development Goals. With prompting strategies, LLM "wear" various color hats as per six thinking hats framework.
- We demonstrated how SAI enables inclusive climate action by refining ideas based on the needs and aspirations of the vulnerable such as financially poor and persons with disability. LLM role plays as person with disability to develop the ideas into initiatives that are inclusive. The project website demonstrate how ideas are nurtured to make progress on both climate and social economic factors.
- We demonstrated how SAI think in multimodal space, thus brainstorming ideas in a combination of text and visual modality to create sustainable product designs.
- We demonstrated how SAI can generate "AI solutions" that solve climate challenges. In the specific example demonstrated in the project website, we showed how AI learns geospatial patterns on Glacier Lake Outburst flooding, and then provide advices to avert future humanitarian losses.
- We demonstrated how SAI can create novel AI solutions for enabling persons with disabilities by empathizing with different personas and then solve their challenges.

All these innovations are demonstrated at the SAI project website. The project website is https://sites.google.com/view/climate-copilot/.

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Appendix

Figure 1 (A):