Discussion

Discussion

Design Implications from Literature Review

The following tables have been categories by chapter and list some of the key implications which can lead to *Feature Ideas*.

Finance

Design implications results from the literature review on finance.

Category	Finding and Role	**Design Implications**
Legislation	As a consumer, legislation does not always protect me from being complicit in pollution, even if unintended.	As a consumer, I can get notified by the app about highlights of poor legislation refuted by science.
Greenwashing	As a consumer, sustainability is fragmented and greenwashing is widespread: how can I feel trust, honesty, and transparency?	As a consumer, I can make use of Green Filter, a sustainable shopping, saving, and investing companion.

Category	Finding and Role	**Design Implications**
Greenwashing	As a consumer, reading EU Commission's proposals shared in the news, one might think the politicians have everything under control, we can relax and continue the same lifestyles as before.	Unfortunately, this is not true. As with ESG, while the good intentions may be there, the reality is emissions keep rising, while they should be falling. It's possible to curb greenwashing. For this to happen, we need to design the proper tools to understand what's sustainable.
Education	As an interaction design student who cares about the environment, I ask myself how can interaction design contribute to increase sustainability?	I make the assumption that investing is inherently "good" for one's life, in the same way, that doing sports is good, or eating healthy is good. It's one of the human activities that is required for an improved quality of life as we age. To start investing sooner, rather than later, is best because of the compound interest. Nonetheless, investment also includes higher risk than sports or food. ?
Education	As a designer for a financial product, how to communicate the risk of investing effectively while educating the users?	

Table 2: Design implications arising from the finance chapter.

Category	Sub	Role	Finding	**Design Implications**
Shopping	Legislation	Consumer		As a consumer, I can get notified by the app about highlights of poor legislation refuted by science.
Investing	Metrics	Company		ESG can't be trusted; ESG alone is not a sufficient metric to prove sustainability of a company and needs to be accompanied by other metrics.
Investing	Transparency	Investor		Investors want to know where their money is going. / Visualize what happens with the money.

Category	Sub	Finding Role	Design Implications
Investing	AI Advisor	Investor/Consumer	This applies to both institutional and increasingly retail investors. Sustainable investing is possible due to consumer demand for greener products and services, and new tools such as ESG for measuring sustainable businesses and assets, as well as advancements in large-scale computational technologies to analyze large amounts of tracking data, comparing performance between different assets. Given these developments, might it be possible to create a practical sustainable investing AI advisor for consumers?
Shopping	Greenwashing	Consumer	As a consumer, Sustainability is fragmented. How can billions of people find greener alternatives and build closer relationships with sustainability-focused companies? Greenwashing is widespread, how can we feel trust, honesty, and transparency? A research project for designing a sustainable shopping, savings, and investing companion.
Shopping	Greenwashing	Consumer	As a consumer, Reading EU Commission's proposals, one might think the politicians have everything under control, we can relax and continue the same lifestyles as before. Unfortunately, this is not true. As with ESG, while the good intentions may be there, the reality is emissions keep rising, while they should be falling. It's possible to curb greenwashing!
Shopping	Greenwashing	Regulatory	Many upcoming laws against greenwashing
Investing	Fintech	Consumer	As a consumer, fintechs like a Robinhood stock symbol page for brands including live ESG metrics and ability to register divestment. Same for crypto can be automated? People will start to discuss ESG vs price discrepancy?
Shopping	Quality Info	Consumer	As a consumer, hetkel hinna info liigub aga toidu kvaliteedi info ei liigu roheline filter finding good quality products stock are disconnected from the products companies make
Shopping	Accountability	Consumer	As a consumer, What if we gave consumers the tools to keep companies accountable?

Category	Sub	Finding Role	**Design Implications**
Investing	Education	Consumer	As a consumer, As an interaction design student who cares about the environment, I ask myself how can interaction design contribute to increase sustainability? I make the assumption that investing is inherently "good" for one's life, in the same way, that doing sports is good, or eating healthy is good. It's one of the human activities that is required for an improved quality of life as we age – and started investing sooner, rather than later, is best because of the compound interest. Nonetheless, investment also includes higher risk than sports or food. How to communicate the risk effectively while educating the users?
Investing	Engagement	Consumer	As a consumer, Airbnb for Investments platform for projects linked to your consumption habits. Can provide better products for you as well as invest in these companies. The consumer can feel closer connection to the businesses they interact with through shared values, leads to participatory design and stakeholder capitalism. Platform to understand investment products. Green crowdfunding already allows people to invest into projects to make new green products, for example from recycled materials. but what about getting involved on a deeper level. Bigger than projects, scalable solutions. Kickstarter has green projects section. Startups vs large businesses. The design of the user interface helps the adoption of a new technology. What is the suitable user interface for millennial green investors?
Saving	Fintech	Consumer	*As a user, I can use the app to compare banks available in my country.*
Investing	Transparency	Consumer	As a consumer, How could people apply the same principle (**Know Your Company**) when buying a product or investing? Would building an ESG community help push polluting companies towards greener practices? or starving them from cheap access to capital.
Investing	Metrics	Consumer	As a consumer, We need a dashboard of comparable public indicators about each company.
Investing	Community	Investor	Web3 allows pooling resources in multi-sign wallets. / Make a climate hedge fund with friends.
Investing	Fintech	Investor	Sustainable investing product for young people everyday use Crypto, NFT provide everyday excitement trend of young people in crypto retail investors without needing to pay bank fees
Shopping	Accountability	Consumer	As a consumer, AI alert: "The company you've purchased from 3x in the past month is owned by Unilevel, which is under investigation for poor labor practices and deforestation".

Category	Sub	Role	Finding	**Design Implications**
Investing	Education	User		Help me write me investment thesis first.
Investing	Governance	Investor		Show company board membership in the app product view.
Saving	Anthropomorphism	Consumer		As a consumer, Money anthropomorphism increases saving behavior; mobile money users are better at saving. / Make saving money look like an avatar or piggy bank or another cute character.
Shopping	Payments	Consumer		As a consumer, BNPL/ This suggests users are already used to having more options in the payment flow.
Shopping	Certification	Regulatory		

Design

This chapter has the following design implications.

Several superapps already contain features for payments (shopping), savings, and investing. Yet none thus far integrate Digital Product Passports to understand the products' journey, including the origin and manufacturing conditions, materials, components, CO_{2e} footprint and environmental impact, post-consumer repair, recycling, and end-of-life disposal guidelines.

Table 3: Design implications arising from the design chapter.

Category	Sub	Role	Finding	**Design Implications**
				It's a balancing at: while AI enables generative UIs while users need some type of stability (think: text input stays in the same place but different types of interfaces appear within a clearly defined space).

Category	Sub	Role	Finding	**Design Implications**
Shopping	Health			Aspartame has not been banned or reduced after 2 years; provide warning for possible cancer-causing ingredients in the AI assistant.
Shopping	Greenwashing	Consumer		Personal CO_2eq tracking is ineffective and the focus should be on systematic change towards circular design and zero waste practices.
				As a student, I can set an *Intention* for myself, such as cutting plastic waste or building a climate positive investment portfolio.
Shopping	Accountability	Consumer		Help consumers to demand more
Shopping	Lack of transparency	Consumer		Make open data easy to use in everyday life
Shopping	Transparency	Consumer		The key idea is making CO2 Visible.
Investing	Greenwashing	Investor		Rank companies based on sustainability
Shopping	Guidance	Consumer		Help you to decide: what to buy, how to save, where to invest.
Shopping	Decision Fatigue	Consumer		What if there was a "Green Filter" on every product everywhere?
Saving	Engagement	Consumer		Become a Sustainability-Aware App or Game.
Investing	Education	Investor		Focus on how college students can invest in specific industries?
Shopping	Rankings	Consumer		Where to shop rankings for groceries: list worst offenders in terms of products; shop and invest according to your values.
Saving	Self Tracking	Consumer		What Quantified Self look like for sustainability?

Category	Sub	Role	Finding	**Design Implications**
Saving	Coaching	Consumer		Empowering people to live a sustainable day
Shopping	Decision Support	Consumer		What if there was a “Green Filter” on every product everywhere?
Saving	Engagement	Consumer		Become a Sustainability-Aware App or Game.
Saving	Guidance	Consumer		Guidance could help young people beat climate anxiety by taking meaningful action.
Saving	Mental Health	Consumer		The app is just as much about helping people deal with climate anxiety as it is with solving the climate issue.
Saving	Metrics	Company		List of metrics that should be tracked to enable useful analytics. Ex: % of beach pollution, air pollution, water pollution (I had this idea while meditating). In essence, “green filter” is a central data repository not unlike “Apple Health for Sustainability”.
Saving	Health Fitness	Consumer		Health and fitness category apps
Saving	Coaching	Consumer		Using “green filter” you can get a personalized sustainability plan and personal coach to become healthy and nature-friendly.
Saving	Personalization	Consumer	All green categories	Green hub Ask the user to prioritize

Category	Sub	Role	Finding	**Design Implications**
Investing	AI Advisor	Investor / Consumer		In my "green filter" AI advisor app's scenario, the AI is scanning for opportunities matching the user's sustainable investment appetite and risk profile, using different methods of analysis, including alternative data sources.
				Traditionally, financial analysts only looked at traditional data, such as company reports, government reports, historic performance, etc., for preparing advisory guidance to their clients. With the advent of AI and big data analysis, many other options of research data have become available, for example, accurate weather predictions for agriculture can affect guidance, because of expected future weather disasters in the area. Other examples include policy predictions, pollution metrics, etc.
Investing	Fintech	Investor / Consumer		Professional financial advisors use automated tools to analyze data and present it in human form to clients. Today's ubiquitous mobile interfaces, however, provide the opportunity to 'cut out the middleman' and provide similar information to clients directly, at a lower cost and a wider scale, often without human intervention. Additional (more expensive) "human-judgment- as-a-service", a combination of robots + human input, can help provide further personalized advice for the consumer, still at a cheaper price than a dedicated human advisor. Everyone can have a financial advisor.
Saving	Narrative Design	Consumer		Narrative design brings together film school storytelling experience with design.
Saving	Narrative Feed	Consumer		Rebuilt the app as a personalized, narrative lifestyle feed.
Investing	Community	Consumer		How the design can connect people to sustainable outcomes while shopping and investing? Perhaps even forming a community of sustainable action. What I showed in class looks like an app but it could also be a physical object (a speculative design). From the presentations I saw most students seemed to be interested in form and light (many lamps) and a couple were about medical uses. I don't remember seeing one that could be compatible with the environmental sustainability focus unfortunately…

Category	Sub	Role	Finding	Design Implications
Saving	Guided Sustainability	Consumer		**Guided Sustainability** refers to using technology to help users make more sustainable decisions and track progress toward goals. “using technology, such as AI and machine learning, to help individuals and organizations make more sustainable decisions and take actions that promote environmental and social sustainability. This can include things like analyzing data on resource usage and emissions, providing recommendations for reducing the environmental impact of operations, or helping to identify and track progress towards sustainability goals. The goal of guided sustainability is to make it easier for people to understand their impact on the environment and to take steps to reduce that impact.”
Saving	Data Ownership	Consumer		Young people are stuck inside platforms. You do not own the data you put on TikTok.
Shopping	Transparency	Consumer		With this perspective of scale, what would a shopping experience look like if one knew at the point of sale which products are greener and which are more polluting?
Investing	AI Advisor	Investor / Consumer		AI Financial Advisors will need to go further to motivate users; they are prone to mistakes based on the data they ingest.
Investering	Generative AI	Company		Allow producers to make use of Speculative and Participatory design to test out new product ideas.
Saving	Process	Company		Processes sustain things: implication for design: build an app.
Shopping	Choice Architecture	Consumer		If sustainability cannot be automated, give the user buttons to choose a sustainable option.
Shopping	Defaults	Consumer		The power of defaults. Make the sustainable option the default option.
Shopping	Alerts	Consumer		Your shopping products mostly come from Protector and Gamble and Nestle. These conglomerates have a massive CO_2eq footprint. Build an index to find alternatives.

Category	Sub	Role	Finding	**Design Implications**
Shopping	Transparency	Consumer	App shows traceability.	

College

College Students Need Tools for Action. Environment shapes action.. create an environment where college students can influence companies.

Table 4: Design implications arising from the college chapter.

Category	Sub	Role	Finding	Design Implications
Saving	Community	Consumer	Taiwanese students are highly influenced by the actions of their peers	The app should show what other people are doing. In terms of a specific Feature, this could become “Group Purchases”, “Find Your Composting Community”, “Create a Group Chatroom”.
Saving	–	Consumer		People exist in relation to other people.
Investing	–	Investor	Psychology of ‘fundraising clubs’ vs individual investing differs greatly.	Provide a community for pooling money with like-minded investors.
Investing	–	Investor		(“UkraineDAO Is Bidding on Ukrainian Flag | PartyBid,” n.d.) Ukraine DAO to support Ukraine through web3.
Shopping		Consumer		These social movements are small and require too much effort to be feasible for the app? Most college students are not zero waste or minimalist.

Category	Sub	Role	Finding	Design Implications
Saving	Climate Anxiety	Consumer		How to support the youth? Design to reduce climate anxiety? Is getting people to go to nature more a good way to increase ecological awareness? Empowered by Design. Youth empowerment: The design should empower young people.
Shopping	–	Consumer		Consumer branded carbon credits like angry teenagers?
Saving	–	Consumer		Invest time not money, student don't have money?
Saving	Social Trust	Consumer		**Show Success Scenarios!**
Saving	–	Consumer		Ask how much time you want to contribute.
Saving	–	Consumer		Match with other people based on time.
Saving	–	Consumer		Use AI to help out with tips.
Saving	–	Consumer		Ask university students what do they study and match with that industry to become expert and sustainability leader in this field.
Saving	–	Consumer	People want to help and make a difference.	Give people things to do. The (Don't Look Up, n.d.) part of the ***Don't Look Up*** movie's social campaign provides 5 user models / roles for the audience to follow: Consumer, Investor, Activist.
Saving	–	Consumer		Choose Your Climate Solutions.
Saving	–	Consumer		Younger people show higher motivation (participants in climate protests). How to be relevant for a younger audience?
Saving	–	Consumer		Yet action remains low.
Saving	–	Consumer		Targeted and gated to college students.

Category	SubRole	Finding	Design Implications
Saving	Company	FB, Gas, etc, all had the same launch strategy: start with students.	
Investing	Investor		Kuzminski (2015) ecology of money
Saving	Consumer		Young people are mobile-first
Shopping	Consumer		Persona: I care mostly about… fashion, art, …
Saving	Consumer		Young people like to follow trends.
Shopping	Consumer		Food ordering apps are popular.
Shopping	Consumer		Monoculture to regenerative food forests Oil to electric cars / bicycles.
Saving	Consumer		Social Educational Edutainment Fun
Saving	Consumer		aespa (2020): Karina from Korea. It makes sense your sustainability assistant would talk to you. Studies show gen N is speaking to computers all the time. Interacting with the user is on the rise. For example, Chime makes tipping suggestions on the place of purchase.
Investing	Investor		The demographics that stand to win the most from the green transformation of business are the youngest generations, with more years of life ahead of them, and more exposure to future environmental and social risks. It would be advisable for Generation Z and their parents (Millennials) to invest their resources in greener assets, however, it's still difficult to pick and choose between 'good' and 'bad' financial vehicles to invest in.
Investing	Company		This creates an opportunity for a new generation of sustainable investment apps, focusing on the usability and accessibility of ESG for a mainstream audience. Generation Z and Millennials expect a consumer-grade user experience.

CategorySub	RoleFinding	Design Implications
Investing	Investor	What would that experience look like? I've chosen these demographics with the assumption that if given the right tools, the emotional demand for sustainability could be transformed into action. The exploration of systems of feedback to enable consumers to apply more direct positive and negative pressure to the businesses and consumers signal consequences for undesirable ecological performance is a major motivation of this study.
Investing	Company	The current environmental upheaval, led by Gen-Z and Millennials, and the business adaptation (or lack thereof) to sustainable economic models, taking into account the hidden social and environmental costs we didn't calculate in our pricing before.
Investing	Company	We also need to consider environmental effects (E in ESG). We haven't taken into account the whole cost of production, leading to the wrong pricing information. To achieve this, we need expert governance (G).
Saving	Researcher	I was unable to find similar research on university and post-graduate level students in Taiwan.
Saving	Researcher	Taiwanese college students and SDGs (Ho et al., 2022).
Saving	Researcher	College students in tourism and related fields … and sustainability
Shopping	Company	Consumers may be turned off by mentioning AI in product description. Cicek et al. (2024)
Saving	Researcher	Progress in other areas of environmental protection has not made similar progress.
Shopping	Researcher	There are documentaries about oil product
Shopping	Researcher	Plastic production documentary
Saving	Researcher	I've seen several.. find and cite them to show the progression of the environmental movement in Taiwan ADD CITATION
Saving	Regulatory	The Taiwanese Green party
Saving	Researcher	Contact SOAS?

Sustainability

Design implications arising from the sustainability chapter.

Table 5: Design implications arising from the sustainability chapter.

Category	Sub-Category	Role	Design Implications
			Start with the most polluted regions as priority?
Shopping	Transparency	Consumer	In unison, the reviewed technologies and practices move us closer to enabling *realtime ESG*: up-do-date transparent information about how our product are produced.
Shopping	Speed	Consumer / Investor	Realtime ESG is a building block to enable consumers and investors make more accurate, real-world purchase decisions.
Shopping	Actionability	Consumer	Simplify action
Shopping	Pollution	Consumer	*People live in the polluted areas are so used to it. What app to wake them up? "You live in a highly polluted area. Here's the TOP 10 companies causing pollution. Here's what you can do."*
Saving	Health Tracking	Consumer	Blood testing and biomarkers allow people to track their health. I'm introducing the concept of 'eco-markers' to follow the sustainability of human activities.
Investing	Circular Economy	Company	AI can help us make sense of the vast amounts of sustainability data generated daily.
Investing	EPR	Company	ERP and CDP data should be part of Green Filter.
Shopping	Eco-Design	Consumer	How to find eco-designed products?
Investing	CE and EPC	Company	Encouraging Sustainable Design
Governance	Politics Matter	Regulatory	

Category	Sub-Category	Role	Design Implications
Governance		Regulatory	Call for GOP contributors' transparency
Governance		Researcher	"triple turn"
Governance		Company	Lack of transparency
Shopping		Consumer	Sustainability is part of product quality. If a product is hurting the environment, it's a low quality product.

AI

This chapter looked at AI in general since its early history and then focused on AI assistants in particular.

Table 6: Design implications arising from the AI chapter.

Category	Role	Design Implications
Ambient Computing	Company	AI companions could combine sensor data from human bodies with the ability to reason about human speech, to provide increasingly relevant, in-context assistance. Because of the conversational nature of LLMs, they are very useful for affective computing. OpenAI is developing such device.
Anthropomorphism	Company	Literature suggests adding an avatar to the AI design may be worthwhile.
Voice Assistants	Company	There are many distinct ways how an algorithm can communicate with a human. From a simple search box such as Google's to chatbots, voices, avatars, videos, to full physical manifestation, there are interfaces to make it easier for the human communicate with a machine.

Category	Role	Design Implications
Sustainability	Consumer	While I'm supportive of the idea of using AI assistants to highlight more sustainable choices, I'm critical of the tendency of the above examples to shift full environmental responsibility to the consumer. Sustainability is a complex interaction, where the producers' conduct can be measured and businesses can bear responsibility for their processes, even if there's market demand for polluting products.
Sustainability	Consumer	Personal sustainability projects haven't so far achieved widespread adoption, making the endeavor to influence human behaviors towards sustainability with just an app – like its commonplace for health and sports activity trackers such as Strava (fig. 9) –, seem unlikely. Personal notifications and chat messages are not enough unless they provide the right motivation. Could visualizing a connection to a larger system, showing the impact of the eco-friendly actions taken by the user, provide a meaningful motivation to the user, and a strong signal to the businesses?
Machine Learning	Company	All of the interfaces mentioned above make use of machine learning (ML), a tool in the AI programming paradigm for finding patterns in large sets of data, which enables making predictions useful in various contexts, including financial decisions. These software innovations enable new user experiences, providing an interactive experience through chat (chatbots), using voice generation (voice assistants), virtual avatars (adds a visual face to the robot).
Character Design	Company	"I'm a digital companion, a partner, an assistant. I'm a Replika." said Replika, a digital companion app via GitHub Copilot, another digital assistant for writing code, is also an example of how AI can be used to help us in our daily lives.
Psychology	Researcher	Humans respond better to humans?
Psychology	Researcher	Humans respond better to machines that take into account emotion?
Open Source	Regulatory	For public discussion to be possible on how content is displayed, sorted, and hidden, algorithms need to be open source.
User Experience	Company	User experience design (AI UX) plays a crucial role in improving the consumer-to-investing journey. The missed opportunity to provide an even more interactive experience in line with user expectations.

Category	Role	Design Implications
LLMs	Company	Prompt-engineering findings have significance for "green filter" as it validates the idea of creating advanced prompts for improved responses. For "green filter", the input would consist of detailed user data + sustainability data for detailed analysis.
Cuteness	Company	Cuter apps have higher retention
Transparency	Consumer	Understanding algorithm transparency helps humans to regard the AI as a machine rather than a human
Anthropomorphism	Company	AIs should disclose they are AIs.

Design Implications from the User Survey

General theory about Taiwanese society suggests that it's low-context and people need groups to do activities. But my survey about my sustainability app shows that people don't pick the features for joining groups. Joining groups was one of the least interesting choices in the survey.

Design Factor	Potential Explanation for Group-Related Features
Survey framing effect	Survey respondents may feel the way I framed the survey question for "joining groups" made it sound like an extra commitment they didn't want to make.
Group fatigue	Survey respondents may already have too many group obligations to attend to (school, work, family, etc). Joining another new group may feel like a burden, not a benefit.
Fear of awkwardness	Survey respondents may feel joining strangers in online group is risky, uncomfortable or unnecessary.
Desire for personal achievement and changing cultural trends	Survey respondents may be more motivated by *individual achievement* to personally feel they are making a difference instead of waiting for the group. Possibly they are more individualistic than my expectations in their behavior (particularly in a digital context) and the traditional "group society" stereotype is weakening.

Design Factor	Potential Explanation for Group-Related Features
Are "group" and "sustainability" concepts related enough?	Survey respondents may not clearly understand the benefit for sustainability from their joining a group.

Research Limitations

First, this work is focused on integrating sustainability into user experience design and does attempt to make a contribution to economics, finance, on any related technical field - in the context of this work, these fields are sources of inspiration for design.

Second, finance is a highly regulated industry and the proposed user experience designs may be limited by legal requirements. This study does not take such limitations into account, rather focusing only on the user experience.

Third, up to date ESG data is expensive and thus couldn't directly be used in this research. ESG needs data to give us an accurate understanding of the realities inside companies and the user experience design does not address the underlying data quality problem further than by providing a link to the data source.

Fourth, I don't have access to users' financial data, which would be useful for design research.

Future Research

Some ideas for fruitful research directions:

- Perceptions of pollution levels among Taiwanese college students.
- Does the specialized interface for AI offer any advantages of a general-purpose UIs such as ChatGPT, Claude, Gemini, Mistral, and others?
- While many people are working on AI models, there's a lack of people working on Human-AI interaction in the context of sustainability.

If you do decide to pursue any of these questions or were otherwise inspired by my thesis, please do reach out. As I have interest in these areas of research, I would happy to help in any way I can. Thank you.