Generative AI as a Co-Pilot in the Development of a Secondhand Marketplace Application Using Design Thinking

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Abstract.
Waste management has become a growing environmental concern in this modern era, particularly due to the increasing amount of waste generated by household activities. In 2020, Indonesia generated approximately 67.8 million tons of waste, with 37.3% originating from households. This study aims to design a prototype of ReVive, an application for buying and selling reusable second-hand goods as an alternative approach to reducing household waste accumulation. The study employed the Design Thinking method with the assistance of generative artificial intelligence (AI), specifically ChatGPT, through five stages: empathize, define, ideate, prototype, and test. The resulting ReVive prototype provides functionalities for buying and selling reusable second-hand goods. The prototype was evaluated using the System Usability Scale (SUS) involving prospective users. The evaluation resulted in an average SUS score of 74.88, indicating that the prototype achieved an excellent level of usability. The findings also indicate that generative AI can support and facilitate activities throughout the Design Thinking process, particularly during the development of design ideas and prototypes. ReVive therefore offers an alternative digital solution for promoting the reuse of household goods and reducing the potential accumulation of household waste.
Keywords: *Design Thinking, Generative AI, Prototype and SUS.*

I. INTRODUCTION

In the modern era, waste has become one of the most concerning environmental issues. Inefficient management of goods, such as household furniture, has the potential to cause waste accumulation that damages ecosystems. This issue is further highlighted by data from the Indonesian Ministry of Environment and Forestry (KLHK) in 2020, which reported that Indonesia generated 67.8 million tons of waste, of which 37.3% originated from household activities [1]. This situation is alarming and demonstrates the importance of effective waste management efforts. It is also a consequence of the implementation of the linear economy model, which follows the principle of "take, make, and dispose." Under this model, industries process raw materials into products, which are then consumed and eventually discarded by consumers. This process accelerates waste generation and depletes natural resources. Therefore, a transition toward a new concept, namely the circular economy, is necessary as a solution to extending product lifespans, maximizing the utilization of used goods, and minimizing the amount of residual waste released into the environment [2].

The implementation of circular economy principles at the community level can be achieved through transactions involving the buying and selling of reusable secondhand goods, as well as social donation activities. In principle, communities demonstrate environmental awareness through the reuse of secondhand goods. However, they often encounter difficulties due to the limited availability of channels or platforms capable of facilitating these needs [3]. As an alternative solution, this study focuses on designing a secondhand marketplace application platform using the Design Thinking methodology. This methodology is a problem-solving approach oriented toward human needs (human-centered approach). The process begins with the empathize stage, which aims to gain an in-depth understanding of human needs and challenges without involving personal assumptions [4]. Subsequently, the information collected is processed during the define stage to identify and formulate the core problems from the application users' perspectives. The next stage is ideate, which involves generating as many creative ideas as possible to address the identified problems. The selected ideas are then transformed into visual representations during the prototype stage in the form of an initial application interface model before being directly evaluated by users during the test stage.

Nevertheless, a specific challenge in the conventional Design Thinking process is that it often requires considerable time, substantial costs, and significant cognitive effort, particularly during the stages of idea exploration and prototyping [5]. Therefore, this study incorporates generative artificial intelligence, particularly ChatGPT, as an assistant in the application development process. Generative AI is a

computational technique capable of producing new outputs, such as text, images, audio, and other forms of content, based on machine training data [6]. This technology can also assist in generating critical ideas and insights based on human instructions. Previous research has explored the use of artificial intelligence in one stage of the Design Thinking process, namely visual design development [7]. However, that study had limitations in its implementation, as it focused exclusively on the design stage and did not specifically examine the integration of AI throughout the entire Design Thinking process, particularly in the social and environmental domains. Therefore, investigating "Generative AI as a Co-Pilot in the Development of a Secondhand Marketplace Application Using Design Thinking" is important for advancing technological research, particularly in the application of artificial intelligence. This study aims to investigate how continuous collaboration between human thinking and AI can produce digital solutions capable of addressing market needs.

II. METHODS

This study employs the Design Thinking methodology. This methodology is an iterative framework that emphasizes understanding users' needs without involving personal assumptions in order to identify alternative solutions that may not be immediately apparent at the initial level of understanding [4].

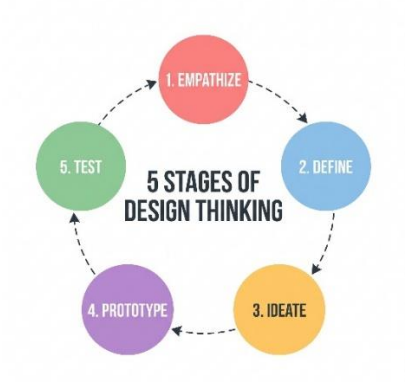


Fig 1. Five Stages of Design Thinking

Referring to the research by Dam and Siang, this study adopts the Design Thinking methodology developed by the Hasso Plattner Institute of Design at Stanford, which consists of five stages, as illustrated in the figure above. The first stage is empathize, which aims to understand and experience what people go through [4]. At this stage, the researcher conducts observations and interviews as data collection methods. Before conducting the interviews, the researcher first consults ChatGPT to identify potential users and develop interview questions. Following the interviews, the collected data are organized into an empathy map for each category of potential users. An empathy map is a method used to describe the characteristics of individual users, with the purpose of gaining a deeper understanding of their perspectives and identifying their needs [8]. An empathy map consists of at least four variables: Feel (what users feel), Think (what users think), Say (what users say), and Do (what users do). The second stage is define. After gaining an understanding of the interview participants through the interview process, the researcher analyzes the collected data with the assistance of ChatGPT by categorizing the identified problems. Following this categorization, a User Persona is developed to represent each participant category. A persona is a fictional representation designed to help understand the needs, behaviors, and goals of potential users [9]. A persona consists of basic profile information, including Behaviors, Goals, Pain Points, and Needs.

The next stage is ideate, which involves brainstorming to develop the most appropriate solutions to address the identified problems. The researcher consults ChatGPT to develop proposed solutions in the form of features to be implemented in the application. These features include item selling, item recommendations, delivery and tracking services, and other functionalities. Once the features have been determined, the next step is to develop a prototype. This stage requires design software, namely Figma, to create the application's user interface. The prototype is developed using Figma AI, a generative AI feature capable of generating user interfaces based on user prompts. Before the design process begins, the researcher consults ChatGPT to

formulate the prompts that will be used by Figma AI to generate the application interface. The final stage is test. Once the user interface has been completed, the researcher tests the prototype with several potential users, who are asked to interact with the application prototype and provide evaluations. The testing method employed is the System Usability Scale (SUS), which is used to measure the usability level and users' subjective perceptions of an application through a 10-item questionnaire using a five-point Likert scale, ranging from strongly disagree to strongly agree. This method is selected due to its simplicity and high reliability [10]. SUS scores are classified into different ranges and categories, as presented in Table 1 below.

Table 1. SUS Score Interpretation

Score Range	Category
0-25	Awful
25,1-51,6	Poor
51,7-62,6	Ok
62,7-72,5	Good
72,6-84,0	Excellent
84,1-100	Best Imaginable

III. RESULT AND DISCUSSION

This section discusses the research process, which begins with the Design Thinking methodology, covering the stages from empathize to test. Each stage is carried out systematically, with ChatGPT serving as a discussion and brainstorming assistant to provide suggestions and potential solutions that address the problems faced by prospective users. All ideas generated by AI serve solely as suggestions or recommendations, while the final decisions are made entirely by the researcher, who remains the primary decision-maker throughout the study.

3.1 Empathize

The first stage is Empathize, which focuses on understanding users. Designers need to understand the individuals who will use their products. A deeper understanding of users can broaden perspectives and ensure that the designed product is better aligned with their needs [11]. The first step is to establish the criteria for potential users. The researcher consults ChatGPT to identify potential users of the marketplace application. Based on the discussion, two user categories are selected: buyers and sellers. After establishing these criteria, the researcher develops interview questions for each category based on suggestions provided by ChatGPT. The interview results reveal that respondents frequently experience difficulties when selling secondhand goods due to challenges in finding suitable buyers. Several respondents representing the buyer category also encounter problems when purchasing secondhand goods because the actual condition of the items does not match the descriptions provided by sellers. All information and experiences shared by the respondents are then organized into an Empathy Map by identifying what they say, think, feel, and do based on the interview findings. The following figure presents an example of one of the Empathy Maps.



Fig 2. Empathy Map

3.2 Define

The next stage is Define, which involves thinking about and analyzing the problems and needs identified during the Empathize stage [12]. At this stage, interview results and other findings are analyzed to

identify patterns and determine the core problems that need to be addressed. The outcome of the Define stage is a clearly and specifically formulated problem statement, which serves as the foundation for developing ideas and solutions in the subsequent stage. Before formulating the Problem Statement, the researcher develops a User Persona, which is a representative user profile based on interview data. Its purpose is to gain a deeper understanding of users. ChatGPT assists the researcher in analyzing the interview results and organizing information from each respondent into the persona variables. These variables describe the respondents' behaviors, goals, challenges, and needs. The following figure presents an example of a User Persona based on one of the respondents, as shown in Figure 3.



Fig 3. User Persona

The overall findings from the interviews, Empathy Maps, and User Personas indicate that many respondents still encounter difficulties when buying and selling secondhand goods, particularly through online platforms. From the sellers' perspective, the main challenges include difficulties in finding suitable buyers and experiences of being misled after agreeing on a price, only for prospective buyers to become unresponsive or disappear. Sellers also sometimes feel uncertain about the profiles of prospective buyers due to concerns about potential scams. From the buyers' perspective, respondents also expressed hesitation when purchasing secondhand goods online because they had previously experienced situations in which the actual condition of an item did not match the seller's description. Buyers felt that the descriptions provided by sellers often failed to accurately represent the actual condition of the items.

3.3 Ideate

The next stage involves formulating solutions in the form of application features. The researcher consults ChatGPT to identify appropriate and innovative features to address each problem identified in the previous stage [13]. Based on the discussion, several potential features are identified to address users' needs, including account registration, item search and filtering, delivery tracking, item listing uploads, and reviews. The following table provides an explanation of the features to be developed in the secondhand marketplace application.

Table 2. List of Application Features

No	Feature	Description
1	Account registration	Users can register an account by providing their name, email address, password, address, and other required information to access the application's features.
2	Item listing upload	Sellers can upload items by completing a form containing photos/videos, descriptions, a condition checklist, an overall condition percentage, and repair history.
3	Item search and filtering	Users can search for specific items and apply filters based on price, location, and item category.
4	Payment	Buyers can select their preferred payment method after choosing the item they wish to purchase.
5	Chat	Sellers and buyers can communicate with each other through this feature to facilitate the transaction process.
6	Item shipment	Buyers can select a delivery method according to their needs.
7	Reviews	Buyers can provide reviews to help improve trust among users.

The list of features presented in Table 2 represents the final set of features to be developed into a prototype in the subsequent stage. A prototype is an initial visual representation of an application's interface and functionality, designed to illustrate how the application will work. The development of the prototype aims to translate the previously identified solutions into a tangible visual form. It also provides an opportunity to evaluate the application's interface and user experience before proceeding to the testing stage. Through this process, potential users can gain a clearer understanding of the application's features and provide feedback on its design and functionality.

3.4 Prototype

At this stage, the researcher transforms the ideas generated during the *Ideate* stage into an interactive application prototype [14]. In this study, the application interface is developed using Figma software by utilizing its AI feature, which generates user interfaces, page structures, navigation, and interaction flows based on user prompts. The prototype is designed to provide an overview of how the application operates before it is developed into a fully functional application. This design also serves as the foundation for conducting user testing in the *Test* stage. The expected outcome of this process is an interface and user experience that effectively address users' needs and solve the identified problems. Before designing the interface, the researcher conducts brainstorming discussions with ChatGPT to formulate prompts or instructions for Figma AI. These prompts are intended to guide Figma AI in transforming the predetermined features into a comprehensive application system that can be navigated and used by users. The following section presents an example of a prompt used to design the application.

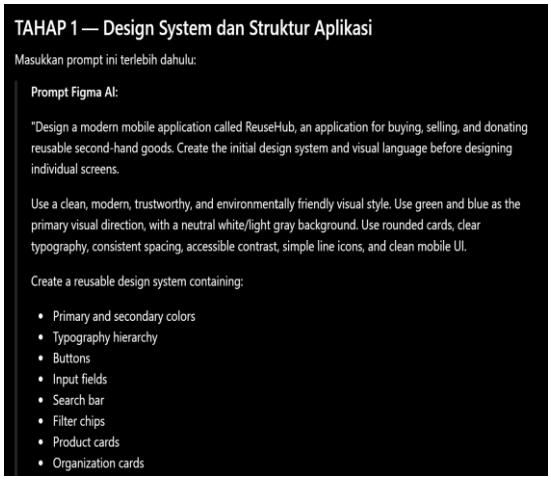


Fig 4. Prompt Example for Figma AI Generated by ChatGPT

Based on Figure 4, ChatGPT recommends developing the application features incrementally rather than implementing them all at once through a single, large prompt, as excessive complexity may cause the system to crash. The development process consists of several stages, beginning with the design of the system and application structure, followed by feature integration. After all prompts have been successfully executed by Figma, the researcher adjusts the application interface and fixes bugs identified in certain features. The following figures present the application interface after the refinement process and bug fixes for each developed feature.



Fig 5. Account Registration Page

In Figure 5, users are required to register an account by providing their full name, email address, phone number, and password. After completing all the registration forms, the system sends a One-Time Password (OTP) verification code to the registered email address. Users must enter the correct verification code to complete the registration process and gain access to all application features. Once an account has been registered, users can simply log in using their email address and password or sign in through their Google or Apple accounts.

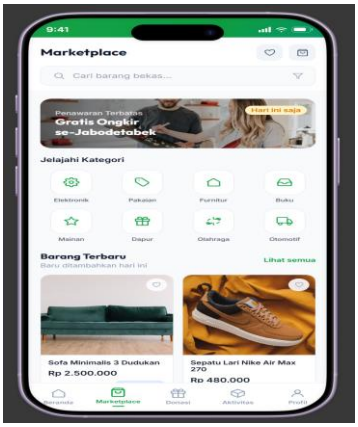


Fig 6. Marketplace Page

Figure 6 illustrates the prototype of the Marketplace page. On this page, users can explore or search for their desired items by applying filters based on location, item category, and price. Items uploaded by sellers are displayed on this page to increase their visibility and make it easier for sellers to reach potential buyers.

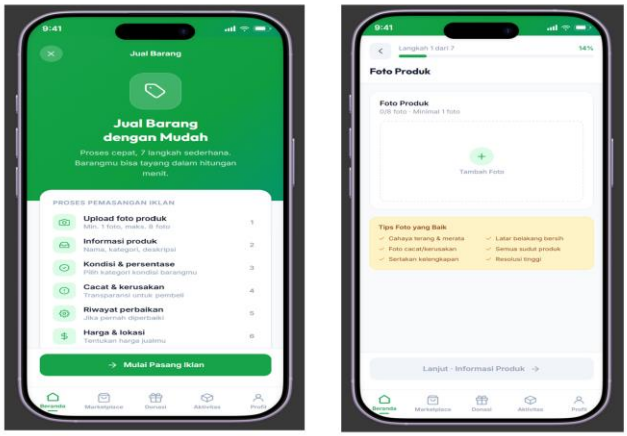


Fig 7. Item Selling Page

Figure 7 illustrates the item-selling page. Users can upload items they wish to sell by completing the provided form, which includes item photos, a detailed description, price, address, overall condition percentage, and repair history, if applicable. Once the form has been completed and submitted, the listed items will appear on the homepage and Marketplace page, making it easier for buyers to find available products. Users can also remove their listed items through the profile page.

3.5 Test

The final stage is the testing process. Testing involves evaluating the application and collecting feedback from users for further improvements [15]. The selected respondents consist of potential users of the secondhand marketplace application, including university students, housewives, employees, and others. The evaluation is conducted using the System Usability Scale (SUS), a method for assessing the usability of an application. This method is selected due to its ease of use and high reliability. The SUS questionnaire consists of 10 alternating odd- and even-numbered statements, using a five-point Likert scale ranging from 1 to 5. First, users are required to interact with the ReVive application prototype by following a testing scenario that covers the entire process, from account registration to buying and selling transactions. After completing the testing scenario, users are asked to fill out the questionnaire based on their experiences while using the prototype. The following is Table 4, which presents the SUS evaluation results for each respondent.

Table 3. SUS Score Result

Code	Question Number										Description		
	1	2	3	4	5	6	7	8	9	10	Total	SUS Score	Final Score
R1	2	1	2	1	3	1	0	1	2	1	14	35	74,88
R2	2	3	3	4	0	4	3	4	3	4	30	75	
R3	4	4	4	4	4	2	4	4	3	2	35	87,5	
R4	3	3	3	3	3	1	2	3	3	1	25	62,5	
R5	4	3	3	4	4	1	3	3	2	1	28	70	
R6	4	4	4	3	4	4	4	4	4	3	38	95	
R7	4	3	3	4	3	3	4	4	4	4	36	90	
R8	3	3	4	3	3	3	3	3	3	1	29	72,5	
R9	3	3	4	4	4	3	4	4	3	4	36	90	
R10	3	2	4	1	3	1	3	3	3	1	24	60	
R11	3	0	4	4	4	1	4	4	4	4	32	80	
R12	3	3	3	3	3	3	3	3	2	1	27	67,5	
R13	4	4	4	4	4	4	4	4	4	4	40	100	
R14	4	3	4	0	4	3	4	3	4	0	29	72,5	
R15	4	4	4	4	4	2	3	3	3	3	34	85	
R16	3	3	3	3	3	3	2	3	3	2	28	70	
R17	3	3	3	3	3	3	4	3	3	3	31	77,5	
R18	3	4	3	4	3	3	3	3	3	3	32	80	
R19	3	3	3	3	3	3	3	3	3	3	30	75	
R20	3	2	3	0	3	2	2	3	3	0	21	52,5	

Based on the questionnaire results presented in Table 3, the final SUS score is 74.88. This score indicates that the application has good usability and is acceptable to most respondents. Several respondents provided feedback regarding inconsistencies in the interface across different pages, missing button icons, and other aspects. Each user had a different experience when interacting with the application, and the results are not necessarily perfect. This score will serve as a basis for future evaluation and improvements.

IV. CONCLUSION

This study successfully developed the ReVive application prototype, which facilitates the buying and selling of secondhand items. The study employed the Design Thinking method, with ChatGPT serving as an assistant throughout the process. The combination of these two approaches resulted in a good SUS score of 74.88. This indicates that AI has proven effective in assisting the application design process, from the initial stage to the final stage. Nevertheless, this score is not perfect and can serve as a basis for future evaluation and improvement. One aspect that needs to be improved is the way researchers communicate with AI. To obtain high-quality responses, discussions should involve effective prompting techniques and provide clear context so that AI can better understand the intended requirements.

Furthermore, the findings demonstrate that Generative AI can support various stages of the Design Thinking process, particularly when generating ideas, exploring potential solutions, and developing the application prototype. ChatGPT can help researchers explore different perspectives and consider features that address users' needs. However, AI-generated suggestions still require careful evaluation to ensure their relevance to the research objectives and user requirements. Therefore, AI should be positioned as a supporting tool rather than a replacement for the researcher's role in analyzing findings and making decisions.

For future research, the ReVive prototype can be further developed by improving the consistency of the interface across pages, providing more complete button icons, and refining other aspects based on feedback from respondents. Further testing involving a larger and more diverse group of respondents is also recommended to obtain a broader understanding of the application's usability. In addition, future studies could explore the implementation of the prototype into a functional application and evaluate its performance through direct user interactions. These improvements are expected to provide a more comprehensive evaluation of the application's usefulness and the role of Generative AI in supporting the Design Thinking process.

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