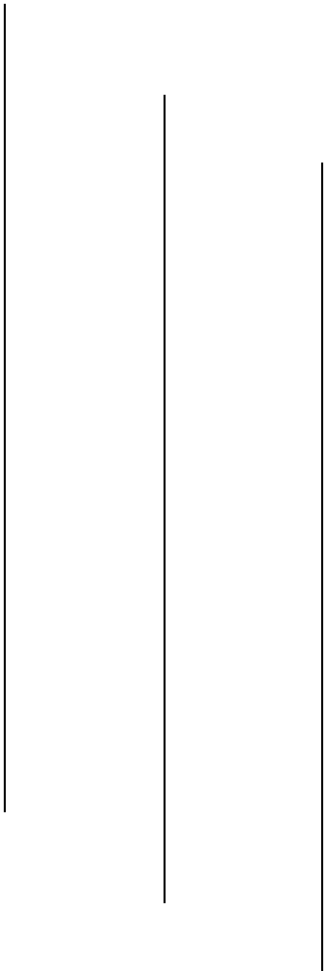
REPORT

SMART T-SHIRT



GROUP MEMBERS :

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1. Introduction

Human-centric problem-solving: Design thinking emphasizes empathy and a deep understanding of user needs as a guide for rethinking challenges/designs, ideation, and iterative solution testing. This approach continues to be the best way to work on whatever requires differentiated and customer-centric solutions. This article presents design thinking stages that were executed to develop SMART T-shirt, a health monitoring device for an elder adult demographic.

Using Internet of Things (IoT) and Artificial Intelligence (AI) technologies, the SMART T-shirt is designed for real-time health tracking, personalized health recommendations, as well as early diagnosis of prospective health issues. This kind of innovation aids those older individuals in enhancing their quality of life while also giving family members and caregivers peace of mind. Using a stepwise understanding of the design thinking stages (empathize, define, ideate, prototype, and test), the report highlights the collaboration, challenges, and solutions that contributed to the development of the SMART T-shirt. It also considers the influence of the design thinking methodology on personal and professional growth in the context of serving a vulnerable population.

2. Detailed Steps and Descriptions in Design Thinking

The design thinking process for the SMART T-shirt project consisted of five key phases—Empathy, Define, Ideate, Prototype, and Test. Each phase was carefully executed using insights gathered from survey questions, user feedback, and iterative problem-solving. Below is a detailed account of the steps taken and the evidence for each phase:

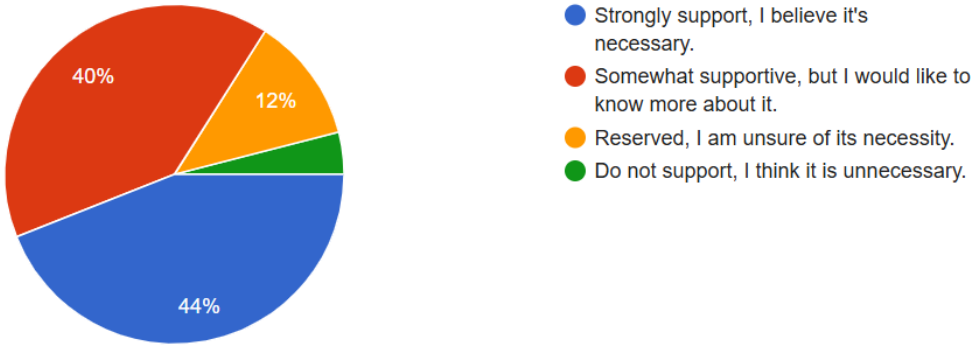
2.1 Empathy

Objective: Understand the needs, challenges, and preferences of potential users, including elderly individuals, caregivers, and families.

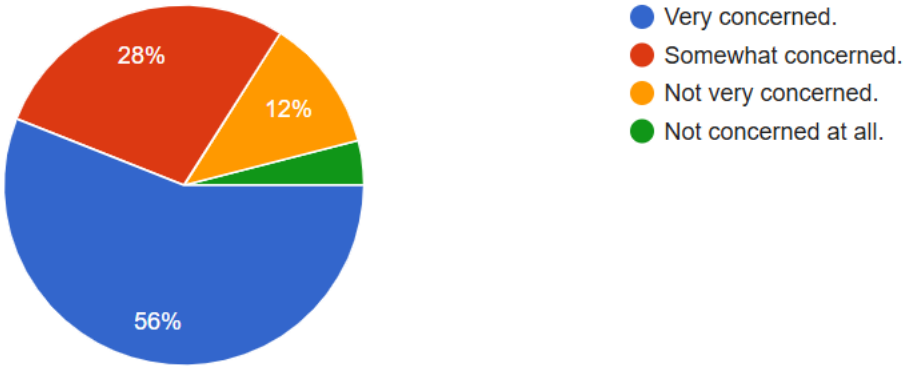
- **Activities Conducted**:
  - **Survey Distribution**: Questions explored opinions on wearable technology, health monitoring features, and data privacy.
  - **Key Findings**:
    - Most respondents strongly supported the idea of wearable health-monitoring devices, seeing them as necessary.
    - Real-time health monitoring and emergency notifications were identified as critical needs.
    - Factors like comfort, accuracy, and data privacy emerged as top priorities.

➢ **Evidence**:

- Survey responses:
  - "What is your opinion on wearable technology that can monitor health status?"
    - Majority chose: *Strongly support, I believe it's necessary.*



  - "Are you concerned about not being able to monitor your parents' or children's health status in real-time?"
    - Majority chose: *Very concerned.*



2.2 Define

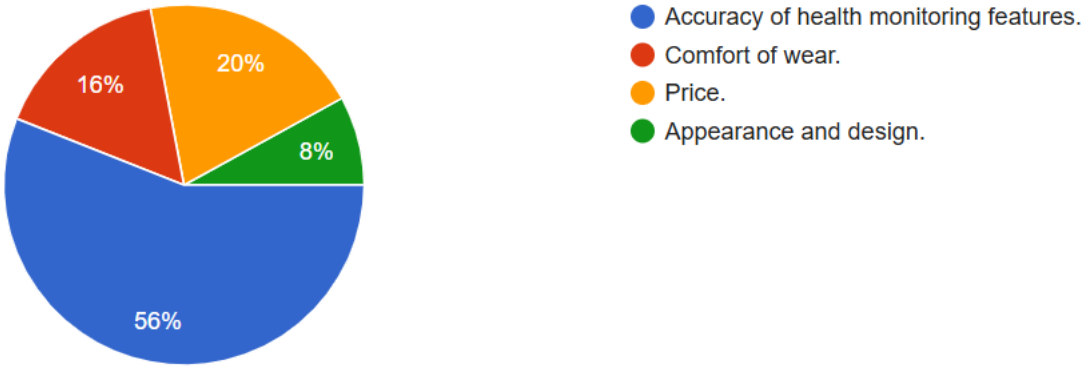
Objective: Reframe the problem based on the empathy findings to focus on specific user needs.

- **Problem Statement**:
  Many individuals, particularly caregivers and families, lack access to comfortable, accurate, and user-friendly wearable technology that can provide real-time health monitoring, emergency notifications, and privacy-secured data management.

- **Insights**:
    - Accuracy and comfort must be prioritized to ensure usability for elderly users.
    - A mobile app should be developed for real-time health updates and notifications.
    - Data security concerns must be addressed with robust protective measures.
- **Evidence**:

  Survey responses:

    - "Which factor is most important to you when choosing smart clothing?"
    - Majority chose: *Accuracy of health monitoring features* and *Comfort of wear*.



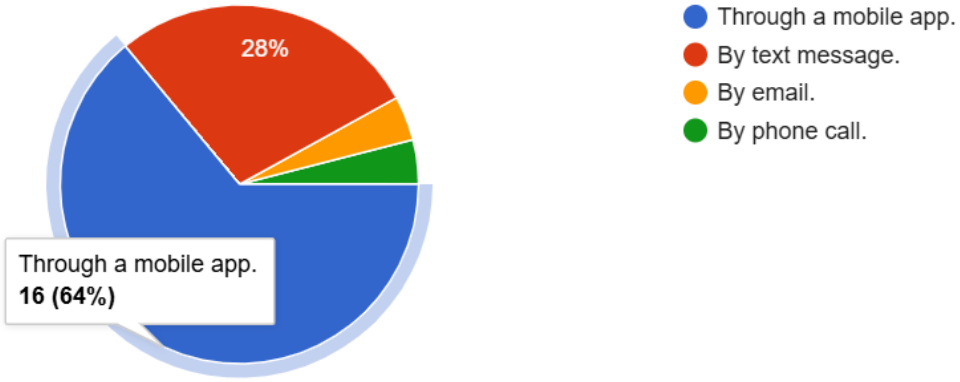
2.3 Ideate

Objective: Brainstorm potential solutions and prioritize ideas based on feasibility and user needs.

- **Activities Conducted**:
    - **Brainstorming Ideas**:
        - Develop a lightweight, machine-washable T-shirt with embedded sensors for real-time monitoring of body temperature, heart rate, and more.
        - Create an app to send health notifications and alerts to family members or caregivers.
    - **Prioritization**:
        - Based on survey feedback, features like emergency notifications and data accuracy were prioritized.
- **Evidence**:
    - Survey responses:

- "Do you think it is important for smart clothing to automatically notify family members or medical personnel in emergencies?"
    - Majority chose: *Very important, it is an essential feature.*

- "How would you prefer to receive notifications about the wearer's health status?"
    - Most respondents preferred: *Through a mobile app.*



2.4 Prototype

Objective: Create a working model of the SMART T-shirt incorporating user feedback and prioritized features.

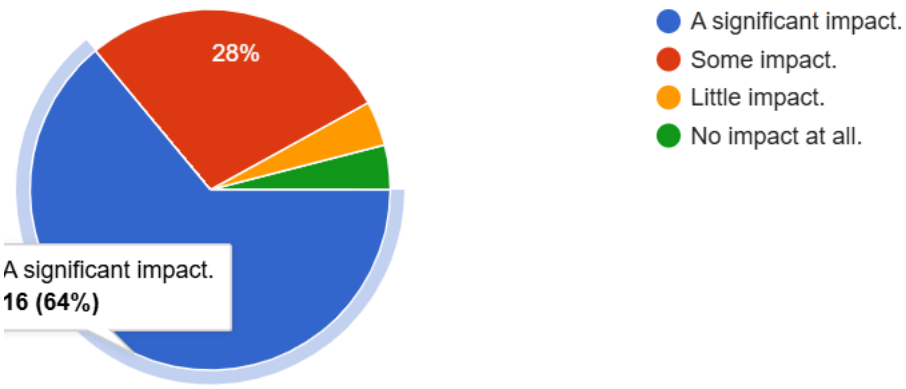
- **Prototypes Developed**:
    - Initial models with sensors to track heart rate, body temperature, and respiratory rate.
    - Integration of Bluetooth for data transmission to a mobile app.
    - Waterproof fabric to ensure durability and user convenience.
- **Evidence**:

- Prototype photos showing the placement of sensors and Bluetooth modules.
- Test logs of the T-shirt's functionality in real-life scenarios, such as daily wear and washing.

2.5 Test

Objective: Validate the prototype with users and improve it based on feedback.

- **Testing Activities**:
  - Testers wore the SMART T-shirt for a week to assess comfort, accuracy, and ease of use.
  - The T-shirt's performance was compared with standard medical devices to verify data accuracy.
- **Feedback and Refinements**:
  - Users appreciated the T-shirt's comfort but suggested improvements in battery life and data transmission stability.
  - Adjustments were made to enhance Bluetooth connectivity and sensor placement.
- **Evidence**:
  - Survey responses:
    - "How much impact do you think smart clothing can have on improving the quality of life for the elderly or toddlers?"
      - Majority chose: *A significant impact.*



  - Testing logs and user feedback forms documenting iterative improvements.

3. Detailed descriptions

Problem:

The biggest problem associated with the proposed solution of the SMART T-shirt is that elderly people have a lot of issues regarding their health, which need to be managed in real-time. They panic, especially those older people who come alone or have chronic diseases, because they do not have a reliable, non-invasive, and easy-to-use device that measures and stores their vital signs such as heartbeats, blood pressure, body temperature, etc. This disconnect leads to delays in identifying health issues, worsening quality of life, and added pressure on caregivers and loved ones. Even worse, the problem is exacerbated by a lack of customized health advice and frictionless integration with healthcare systems.

Solution

The SMART T-shirt generates a graph/chart, creating a new vision of wearable technology using IoT and AI—an innovative complete solution for health monitoring. Key features include:

- **Advanced Sensors:** Built-in sensors can monitor vital statistics such as heart rate, body temperature, respiratory rate, and blood pressure.
- **IoT Incorporation:** Linkage with cell phones or IoT-based devices for immediate data sending and alarms.
- **AI Analytics:** Algorithms that will review your data and give you insights and alerts when your health is at risk.
- **Convenient to Use:** Hydro-resistant, soft, washable great fabrics.

This would empower elderly users to efficiently manage their health while caregivers receive instant reports and a bird's-eye view of their current health status, coupled with timely reminders and alerts that help create a seamless health management ecosystem.

Teamwork

Design and development is a multidisciplinary process involving engineers, designers, software developers, and project managers who all work together. The key elements of being collaborative are:

- **Roles and Responsibilities:**
    - **Research Team:** Conduct user interviews and compile data about older adults and their limited access to simpler technology.
    - **Development Team:** Prototyping, sensor integrations, and data processing with AI algorithms.
    - **Design Team:** Developed a tastefully designed, ergonomically sound wearable tech.
- **Collaboration:**
    - A weekly meeting to report headway, unveil pain points, and more solutions.
    - Shared access to a virtual space, providing real-time information on tasks and documentation.
- **Challenges and Solutions:**
    - **Main Challenge:** Create a T-shirt that is practical and comfortable to wear. **Solution:** Multiple rounds of iterative prototyping and testing to develop a design focused on the user.
    - **Technical Challenge:** For sending data, a reliable Bluetooth connection must be maintained.
    - **IoT system that becomes unstable for unknown reasons**
      Resolution: Implementing system optimizations in collaboration with IoT industry experts.

We found that our approach of design thinking to our final project created a balance of technical knowledge and creative problem-solving for developing a working prototype to help monitor aged people. We each recounted a version of that process to our mentor, each of which had taken us on different motivational roadblocks but had a lesson to teach about the value of teamwork, outcome, and above all, empathy and user-centric innovation.

4. Assesment Points

4.1 During the End of the Project Demonstration

Upon project completion, the assessment focuses on ensuring that the solution meets its intended goals and user expectations:

Evaluate Overall Functionality:
- Confirm that the Smart T-shirt performs core tasks such as real-time health monitoring, seamless data sharing, and alert notifications.
- Test the accuracy of sensors for vital metrics including heart rate, body temperature, and ambient air temperature.
- Verify the functionality of IoT and AI systems in generating actionable health insights and delivering personalized recommendations.

Collect User Feedback:
- Engage end-users, specifically elderly individuals and caregivers, to evaluate usability, comfort, and effectiveness.
- Gather qualitative feedback on satisfaction with design elements, interface, and key features such as waterproofing and machine washability.

Assess Implementation Success:
- Ensure the T-shirt's durability and performance under real-world conditions, such as during physical activity and after washing.
- Validate the reliability of Bluetooth connectivity for real-time data transfer.

4.2 During Transitions Between Design Thinking Phases

At each phase transition, systematic reviews ensure that the project remains user-focused and aligned with its objectives:

Empathy:
- Validate that insights from interviews and surveys are accurately translated into a clear problem statement.
- Ensure the problem statement addresses genuine user needs, such as accessible health monitoring and family connectivity.

Ideate:
- Confirm that the refined problem statement aligns with findings from the empathy phase.
- Evaluate brainstorming sessions to ensure ideas effectively target defined challenges, focusing on user-friendly and technically feasible solutions.

Ideate to Prototype:

- Assess the feasibility of selected concepts from brainstorming sessions, ensuring they address the problem statement.
- Test early-stage mockups for alignment with technical requirements and user expectations.

Prototype:

- Validate prototypes against predefined success metrics, such as sensor accuracy, durability, and usability.
- Ensure that feedback from initial testing leads to iterative improvements aligned with user needs.

5. Design Thinking Evidence

The SMART T-shirt project relied heavily on user insights collected through a detailed survey designed to gather opinions on wearable technology and health monitoring features. Below is the evidence from each phase of the design thinking process:

5.1 Empathy

Objective: Understand the perspectives, concerns, and preferences of potential users, including families, caregivers, and elderly individuals.

Evidence:

- **Survey Questions**:
  - "What is your opinion on wearable technology that can monitor health status?" Responses indicated strong support for the concept, with the majority recognizing its necessity.
  - "Are you concerned about not being able to monitor your parents' or children's health in real-time?" A significant portion expressed high levels of concern, reinforcing the need for such a product.
  - "Which factor is most important to you when choosing smart clothing?" Top priorities included accuracy of health monitoring and comfort of wear, influencing design choices.

5.2 Define

Objective: Reframe the problem based on insights gained during the empathy phase.

- **Problem Statement**:
  Families and caregivers require a reliable, non-intrusive wearable device that offers accurate health monitoring, ensures data privacy, and provides emergency notifications.
- **Insights**:
  - Real-time health data and automatic notifications were deemed essential features.
  - Comfort and data privacy are significant concerns for users.
- **Evidence**:
  - Questions like "Do you think it is important for smart clothing to automatically notify family members or medical personnel in emergencies?" demonstrated that most users considered this feature crucial.

5.3 Ideate

Objective: Brainstorm and prioritize ideas to address user needs effectively.

Evidence:

- Brainstorming was guided by survey responses such as:
- ➢ "How would you prefer to receive notifications about the wearer's health status?"
  Most users preferred mobile app notifications, influencing the decision to develop an app interface.
- ➢ "How much impact do you think smart clothing can have on improving the quality of life for the elderly or toddlers?"
  High optimism about the impact validated the project's focus on these demographics.

5.4 Prototype

Objective: Create a functional prototype that incorporates user preferences.

Evidence:

- Prototypes were designed to focus on:
  - Accurate sensors for health monitoring (based on the demand for accuracy).
  - Comfortable, lightweight fabrics (in response to comfort being a top priority).
  - Integration of Bluetooth connectivity to send health data via mobile apps.

5.5 Test

Objective: Evaluate the prototype with users and refine it based on feedback.

Evidence:

- Users tested the prototype's ability to monitor body temperature and heart rate in real-time.
- Features like emergency notifications and app-based health updates were assessed for reliability.
- Feedback logs highlighted user satisfaction with the accuracy but suggested improvements in battery life.

Summary of Evidence

The survey responses provided valuable guidance in every phase of the design thinking process:

1. **Empathy**: Identified user concerns, such as real-time monitoring and data privacy.
2. **Define**: Focused on creating a reliable, comfortable, and privacy-conscious solution.
3. **Ideate**: Prioritized mobile app notifications and essential features like emergency alerts.
4. **Prototype**: Designed a wearable device aligned with user preferences for accuracy and comfort.
5. **Test**: Refined the product based on real-world testing and user feedback.
   This comprehensive evidence ensured the SMART T-shirt was user-centered and aligned with the needs and expectations of its target audience.

6. Reflections:

Mohamad Adrian Syahirin Bin Mohd Faizal:

Goal/Dream: Invent new health-tech that combines IoT and AI and allows easier access to health services.
Impact of Design Thinking: Fostered a user-first mindset and honed problem-solving skills to create solutions that add real-world value.
Improvement Plan: IoT and artificial intelligence certifications.

Muh Khairil Mursyad:

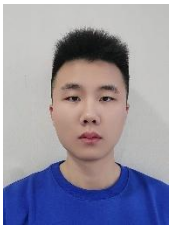
Goal/Dream: To lead multidisciplinary teams in developing wearable health technologies that enhance people's lives.
Impact of Design Thinking: Emphasized the importance of teamwork and the iterative design process in creating impactful products.
Improvement Plan: Strengthen project management and leadership skills by participating in team-based projects and workshops

Liu Yuehui:

Goal/Dream: To create user-friendly wearable technologies that empower individuals to monitor their health independently.
Impact of Design Thinking: Fostered empathy for users, particularly the elderly, ensuring the SMART T-shirt design is both practical and accessible.
Improvement Plan: Focus on UX/UI design to improve product usability and collaborate with designers on future projects.

Huang Yingkai:

Goal/Dream: To innovate in wearable technology to improve early health issue detection and preventive care.
Impact of Design Thinking: Highlighted the importance of feedback in refining solutions to meet user expectations.
Improvement Plan: Build a portfolio of prototypes and participate in hackathons to showcase problem-solving capabilities.



Liang Tianqi:

Goal/Dream: To innovate in wearable technology to improve early health issue detection and preventive care.
Impact of Design Thinking: Highlighted the importance of feedback in refining solutions to meet user expectations.
Improvement Plan: Build a portfolio of prototypes and participate in hackathons to showcase problem-solving capabilities.

7. Tasks for Each Member

1. Muh Khairil Mursyad (Research and Data Collection)

- Interview classmates, family, or elderly people to find out what they need in a health-monitoring device.
- Create a survey using Google Forms to collect opinions about wearable technology.
- Write a summary of what users want and share it with the team.

2. Liang Tianqi (Technical Development)

- Learn how sensors work by watching tutorials or reading articles.
- Write simple code to connect sensors to a smartphone using Bluetooth.
- Test the sensors to make sure they collect accurate data, like heart rate or body temperature.

3. Huang Yingkai (Design and Prototyping)

- Draw sketches of how the SMART T-shirt might look, showing where sensors will be placed.
- Use basic materials like fabric, tape, or glue to make a model of the T-shirt.
- Improve the design based on team feedback and make a final prototype.

4. Mohamad Adrian (Testing and User Feedback)

- Ask friends or family to wear the prototype and tell you what they think about it.
- Check if the sensors work properly by comparing their results with a medical device (if available).
- Write down all the comments and ideas from testers to share with the team.

5. Liu Yuehui (Documentation and Presentation)

- Take pictures of every step, like brainstorming, making the prototype, and testing it.
- Write a report explaining what the team did in each design thinking phase.
- Make a slideshow for the final presentation to show the SMART T-shirt's features.