INFO3333: Technologically-Advanced Smart Adaptive Clothing

THE UNIVERSITY OF SYDNEY

GROUP50

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Project Charter

Project Title: Technologically-Advanced Smart Adaptive Clothing (TASAC): clothes that automatically adjust to external conditions (hot and cold, wind resistance) with more smart functions.

Project Start Date: 07/03/2022 **Projected Finish Date:** 31/10/2023

Background:
The unpredictability of weather and widespread changes in weather patterns may have intensified in recent years, and these unexpected weather conditions make human beings always feel uncomfortable. Therefore, we are working to address the temperature challenges through the technologically-advanced smart adaptive clothing (TASAC), designed with temperature-regulating fabric and a thermoelectric cooling system.

Project deliverables(Hight level):

- Documentations
    - Team documents
        - Project plans (Cost, quality control…)
        - Meeting minutes
        - Employee training materials
        - Closeout summary
    - Research and Development
        - Research reports
        - Development records
        - Test suites
    - Marketing
        - Survey results
        - Sales results
- Projects:
    - Hardware:
        - Prototype
        - Deliverable products
        - Iterative products
    - Software
        - Unit function
        - System Function
        - User testing

The project would include the following capabilities:

- It is capable of helping keep the body temperature at the ideal core temperature of 37.5 Celsius by reacting to the current temperature.
- It can also be adjusted via our smart and user-friendly application deployed on both cell phones and smartwatches.
- Track data on the user's body condition and visualize it in the smart app.

Main Project Successful Criteria:
The clothing must meet all requirements specified, and pass all tests given in hardware, software, and simulation aspects, without taking longer than 12 months or costing more than the budget.

Timeline/Milestones:

- Requirement establishes and project preparation is done in 2 months
- The prototype will be ready in another 4 months
- Product release in 1 more month
- Sales and further support for 1 year

Because we need to do user testing every season, it takes a year and a half to two years. Also, we can also choose to test in a simulated environment first

Cost:
The selection of clothing materials and sensors is the biggest difficulty of this project. We need to choose lightweight clothing material and tiny sensors so that users can get the best sensor of wear. So we need a budget of $500,000 to $1,000,000

Roles and responsibilities of stakeholders:
Everyone in this team should be responsible for the project, the team leader is responsible for all producers doing their work on scheduled time, and helping the company meet its strategic objectives by contributing their experience and perspective to the project. Everyone also needs to provide the necessary materials and resources.

Name	Role	Responsibility
Cheng Zheng	CEO	Driving profitability
Dongsheng Han	CIO	Manage implementation
Xiao Zhang	Project manager	Communication with stakeholders
Yuye Zhou	Director of IT operations	Developing and testing
Zeyu Liu	Human Resources	Gathering information and marketing

Project Scope Statement

Project Scope Description
Determine clothing materials, choose temperature sensors, heating, and cooling devices, display screens, and design mobile apps so that users can adjust the temperature of clothing and other functions according to their own.

Acceptance Criteria

1. The clothes will make the user feel comfortable at all times by automatically adjusting to the body's comfortable temperature.

2. The TASAC would also have a software system that would be accessed through the built-in touch screen.

3. An associated phone application or other wearable devices, like smartwatches. The system would not only allow the client to set the desired temperature of the clothing but also check data gathered by the TASAC's sensors to have a glaze of one's health condition.

4. The TASAC would come with a wireless-charging hanger, to avoid the inconvenience of finding a charging port and protect the integrity of the clothing to allow water resistance.

5. The clothing must meet all requirements specified, and pass all tests given in hardware, software, and simulation aspects, without taking longer than 12 months or costing more than the budget.

6. Any tracking data from the user should be kept confidential.

7. The application successfully passed the Unit testing, Integration testing, System Testing, and User acceptance testing

8. The software system successfully passed the usability test and accessibility test

9. The project was completed within the scheduled time

10. The cost of the project is kept within budget

11. The project risks are under control

12. One year sales of products can achieve positive profit

Project deliverables
- Timely delivery of WBS, Project Schedule, Cost plan, Communication Plan, Quality management plan, risk register, and other documents

- Report team meeting results per week
- Update employee information per week
- Deliver research report, survey, interview, questionnaire regularly
- Delivery of prototypes at each stage is required to implement the envisioned functionality
- Test the prototype(Unit testing, Integrated testing, System testing, usability testing, reliability testing, accessibility testing). Record and report all test results.
- Deliver the iteration, and deliver the final product.
- Report production status in time
- Report sales status per month

Project constraint

1. The exceptional optical properties of graphene capabilities may not be achieved with conventional materials
2. Timing for completion is not quite sufficient
3. Cost estimate may not be accurate since the materials could not be optimal
4. System maintenance time/cost may fluctuate

Key schedule milestone

1. Produce a detailed project plan before 17/04/2022
2. Get the resource and labour before 13/05/2022
3. All style design including hardware, software and materials before 28/05/2022
4. Finalize all implement development before 26/06/2022
5. Done integration and iterative test before 14/08/2022
6. The final version should be released before 04/09/2022

Literature Review

1. Background:

A new Stanford University study shows rising temperatures in recent years may intensify the unpredictability of the weather in Earth's mid-latitudes. (Josie G, 2021) Widespread changes in weather patterns and increased frequency and severity of extreme weather events are well-documented consequences of global climate change. These departures from old norms can bring storms, droughts, heatwaves and wildfire conditions beyond what people have come to expect.

Unexpected weather and different body conditions make us always feel differently towards the temperature. Thanks to faster computers, better learning models and more precise measurements, models are still generally able to predict day-to-day weather more reliably than they could in decades past, and get us easier to adapt to unexpected climate change**.** We are working to address the temperature challenges and more by the technologically-advanced smart adaptive clothing (TASAC), designed with temperature-regulating fabric and thermo-electric cooling system.

2. Existing research analysis

A team of scientists from The University of Manchester's National Graphene Institute have created a prototype garment to demonstrate dynamic thermal radiation control within a piece of clothing by utilizing the remarkable thermal properties and flexibility of graphene.

Infrared-blocking covers are ideal to minimize the energy loss from the body, and that is what people used to deal with low temperatures. An emergency blanket is a common example used to deal with treating extreme cases of body temperature fluctuation. In a hot climate, it is desirable to make use of the full extent of the infrared radiation to lower the body temperature which can be achieved by using infrared-transparent textiles. (ScienceDaily, June 18 2020)

Graphene's potential uses are vast and research has already led to leaps forward in commercial products including batteries, mobile phones and aircraft.

The new research published today in the journal *Nano Letters* demonstrates that smart optical textile technology can change its thermal visibility. The technology uses graphene layers to control thermal radiation from textile surfaces.

In 2020, researchers from the Massachusetts Institute of Technology (MIT) showcased washable, garment-woven biosensors for telemedicine and remote patient monitoring. While this is an example of progress, clothing sensors are in the early stages of development. Smart clothing makers are pursuing rugged sensors that generate vital user data for effective health and activity monitoring, thereby enhancing the clothes' durability and appeal.

In 2019, Google started including certain aspects of its Assistant conversational platform on Levi's Commuter Trucker jacket. Users can get directions and receive answers to pre-recorded questions

about the time, weather, and news by making pre-set gestures on the jacket's cuff. (Research, G. D. T., 2021, August 3)

3. Current limitation

Although graphene's potential uses are vast and research has already led to leaps forward, the exceptional optical properties of graphene capabilities may not be achieved with conventional materials. (Coskun K., 2004)

The ability to control thermal radiation is a key necessity for several critical applications such as temperature management of the body in excessive temperature climates. However, maintaining these functionalities as the surroundings heat up or cool down has been an outstanding challenge.

As for Google's AI operations, the use of AI in smart clothing is currently limited to virtual fitness coaching systems. Start-ups like Sensoria offer an AI-based in-app coach that guides wearers of its smart t-shirts to improve running performance using performance analytics performed on garment generated data. The integration between AI and conventional clothes would be an innovative development with great barriers.

4. Possible future directions

Adaptive clothing will evolve into a breakthrough in functional clothing that will change the way we live in the future. At present, developers still face some technical hurdles on clothing fabrics, some of which have not been well resolved, such as the density of the woven fabric, and how to adjust the surface coating to achieve perfection, which still needs to do a lot of testing.

A more significant development for adaptive clothing is how to interact with objects in the real world. Automatically adjusting according to the body's preferred temperature and a large amount of data collected from external weather, such as temperature, humidity, wind speed, and adaptive clothing can interact with more technologies to create a human-free wearing experience.

Another great move for us in the future would be the self-cleaning toward the covid-19 aspect of clothes. People used to "clean" clothes to prevent covid-19, but cleaning which involves only removing dirt from surfaces does not kill the coronavirus. Our project aims to do "disinfection" which is the use of the layer of chemicals operation that kills germs. Disinfecting hard surfaces and textiles after cleaning them can further reduce the risk of spreading infections. Therefore it can help reduce the risk of direct transmission.

5. Our direction

In the past, people always paid attention to clothing styles, bright effects, and dress matching, but few made great breakthroughs in the direction of clothing technology fabrics. We can consider the aspects of technology and users to make this project a breakthrough in user perception. Another major breakthrough in the field of apparel

The specific implementation of temperature sensing technology and supporting adjustment facilities (software application implementation) is the point where our group collided at the beginning. Different members of the group provided different ideas, one is the flexible display embedded in the

sleeve of the clothes, and the other is pure software development that requires other hardware (eg. phone watch) support.

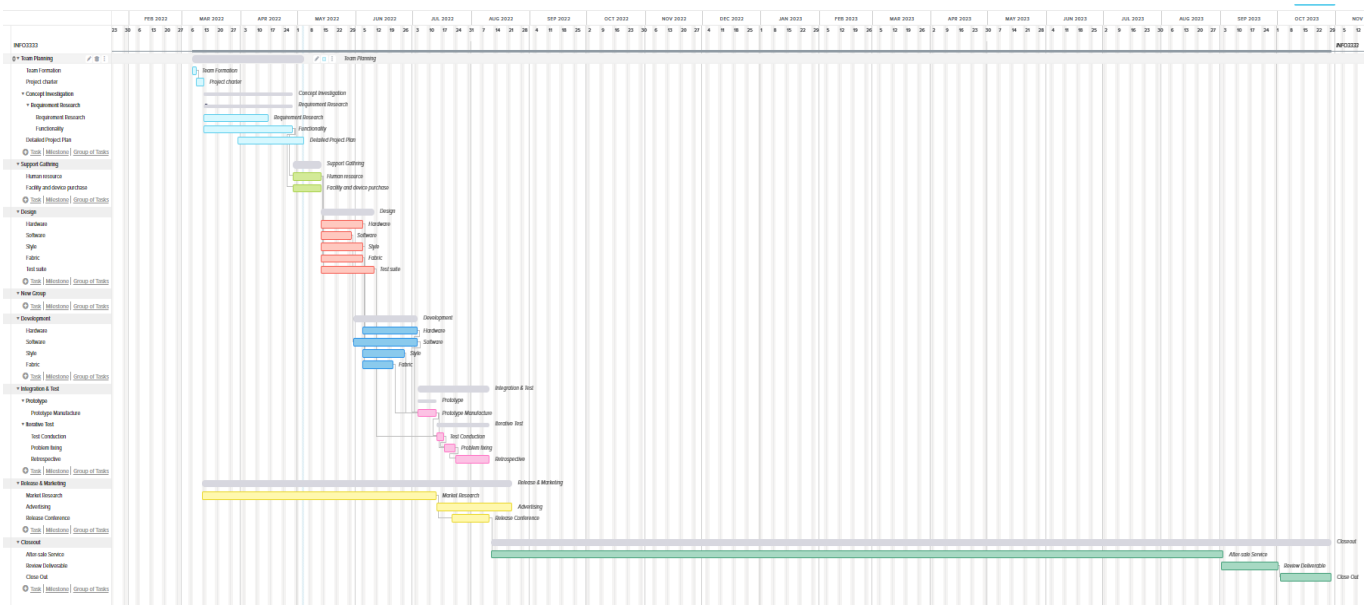
For the development of supporting software facilities, our group agreed that the second method is more practical through discussion. The reasons are as follows. The group leader proposed that the method of embedding flexible screens on the sleeves of clothes is not feasible in practice. Through collecting investigation and demonstration, our team member confirmed that if a screen is embedded in the clothes, it will greatly reduce the service life of the clothes and limit the practicality of the clothes in extreme weather.

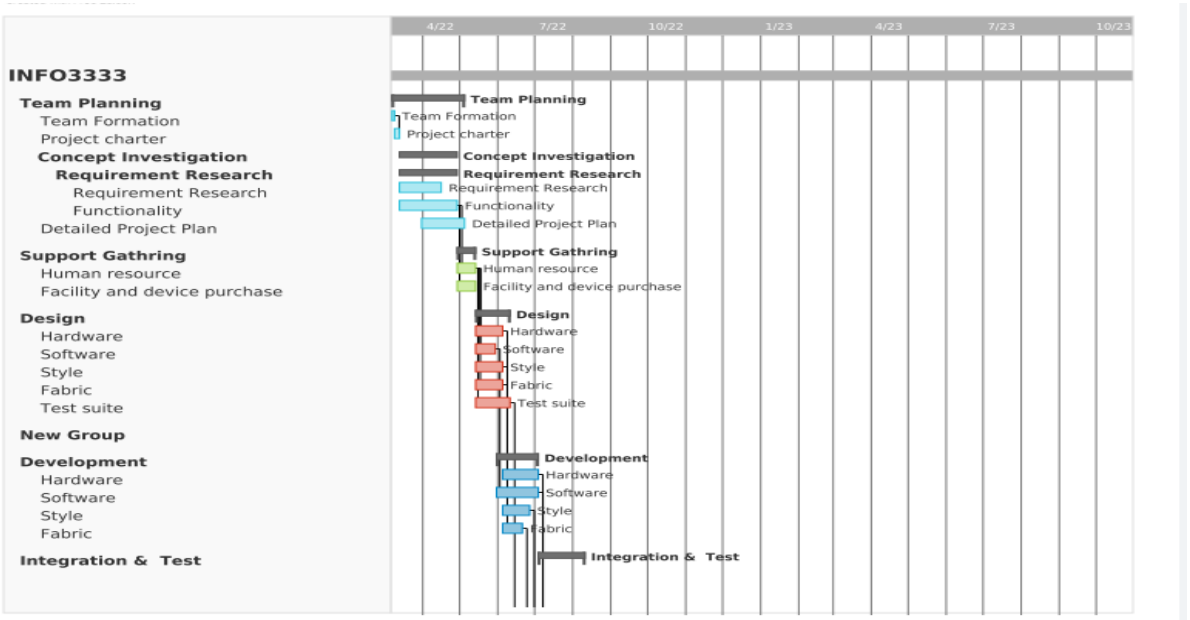
6. Contribution

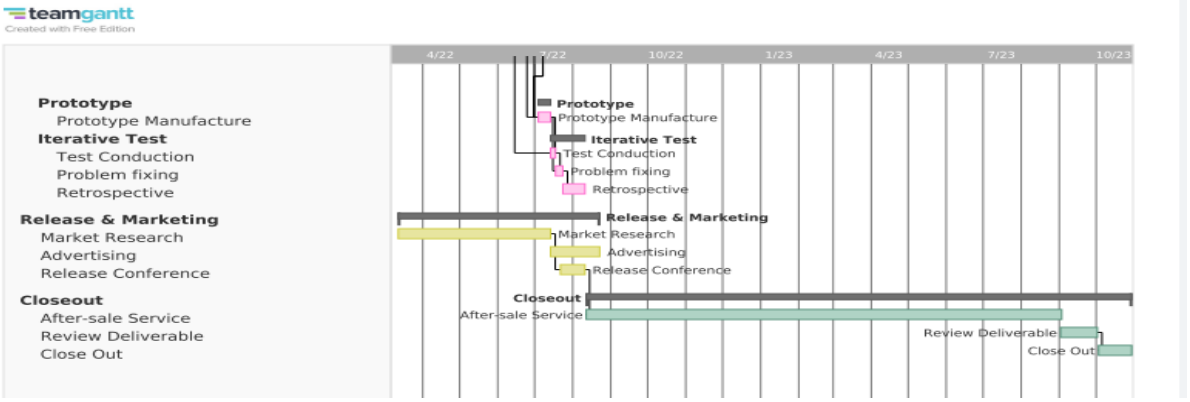
Previous research was more focused on self-controlling temperature by its own materials, therefore basically there's no nothing to do with users. What our team wants to achieve is to make more operations controlled by users for humanization, so it's smarter.

In the context of the current covid-19 epidemic, we have come up with a new idea for our project. The clothes do not easily get dirty and even bacteria like normal clothes and may be able to clean themselves, therefore saving the human labor and preventing some cases of spreading infection.

Time Estimate







Work Breakdown Structure (WBS) Description

In this project, the team decided to use a top-down approach to break down the project's tasks into smaller components and form the WBS, which is very important as guidance to cost and schedule management. The WBS dictionary contains each WBS item's description and gives details about the work packages included to unify the understanding of the item among all project members. Our WBS breaks the project into 3 levels through 7 packages, which are the stages the project should enter roughly through time. This layout should allow the team to have a better understanding and arrangement of both time and cost, ergo achieving a better-efficiency execution. The WBS should be maintained along with the progress of the project as demonstrated in the following by adding extra requirements of the charging hanger.

Work Breakdown Structure

1. TACAS Project
    1. Start Point
        1. Form project team
        2. Produce project charter
        3. Concept Investigation
        4. Produce a detailed project plan
    2. Support Gathering
        1. Human resource management
        2. Facility and device purchase
    3. Design
        1. Hardware design
        2. Software design
        3. Style design
        4. Fabric design
        5. Test design
    4. Development
        1. Hardware development
        2. Software development
        3. Style development
        4. Fabric development
    5. Integration and Test
        1. Prototype development
        2. Iterative testing and problem fixing
    6. Release and Marketing
        1. Market research
        2. Advertising
        3. Release conference
    7. Closeout
        1. After-sale service
        2. Review Achievement/Deliverable
        3. Closeout

WBS Dictionary

1.1 Start Point

WBS Dictionary Entry Mar 7
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.1.1
WBS Item Name: Form project team
Description: This is the starting point of the whole project. To have the project running and complete successfully, we gather people who will involve in the management of the project and form a project team. The project team should consist of managers, monitors and stakeholders. Then we should assign different roles to each individual to clarify their responsibilities in managing the project.

WBS Dictionary Entry Mar 9
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.1.2
WBS Item Name: Produce project charter
Description: After forming the group, the whole project's idea should be settled, and a general schedule and concepts should be formed. The project charter should document the essence of the project(objectives), key dates and milestones of the project, budget, roles, responsibilities and power of the project team members and the success criteria so that these could be reviewed and referenced in the later processes of the project.

WBS Dictionary Entry Mar 13
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.1.3
WBS Item Name: Concept Investigation
Description: The idea of the project should have been settled, however so far the content is entirely based on the thoughts of the team members and have no guarantee on satisfying customer's need. Therefore, we need to further investigate the requirements of the customers by sending out online surveys and conducting street interviews, etc. And then we should decide on the final functionality of our project that meets the ideas decided in the project charter as well as the customers' needs, which can be finished within budget and time in the project charter.

WBS Dictionary Entry Mar 31
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.1.4
WBS Item Name: Produce a detailed project plan
Description: After settling on the needs and management of the project, we should be able to produce a detailed project plan including project charter, scope statement, literature review, WBS, quality control plan, time schedule, budget control plan, risk management plan, resource management plan and communication plan.

1.2 Support Gathering

WBS Dictionary Entry Mar 29
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.2.1
WBS Item Name: Human resource management (HR management)
Description: After deciding on the features (WBS item 1.1.3), we should be able to identify what needs to be accomplished and what kinds of technicians we need to complete the task. In this particular project, we'll need software engineers to design and develop the software of the clothes, clothing designers to design the style of the clothes that is fashion while allowing hardware to be implanted, hardware engineers to invest and design the fabric used, the design develops the sensors needed in this project, test engineers to design and implement the tests, etc. And after identifying, we also need to hire and give basic training to make sure the employees can perform assigned tasks.

WBS Dictionary Entry Mar 29
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.2.2
WBS Item Name: Facility and device purchase
Description: Similarly to the HR management in item 1.2.1, we also need to acquire the required facility and devices after identifying the requirement of the project to ensure relative work could take place.

1.3 Design

WBS Dictionary Entry May 14
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.3.1
WBS Item Name: Hardware design
Description: In this work package, the hardware design team should produce the implementation plan of the sensors and devices needed to satisfy the users' need. In this project, the plan should include the systems of temperature modification, status monitoring, and power modules. [UPDATE] **There should also be a plan for the charging hanger of the clothes as some users required.**

WBS Dictionary Entry May 14
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.3.2
WBS Item Name: Software design

Description:

In this work package, the software design team should produce the implementation plan of the software system that would allow the cloth to work as expected. In this project, the plan should include the UI design of the phone app of the smart cloth, the system embedded in the cloth, and the system used to communicate between the cloth and the phone app.

[UPDATE]

There should also be a plan for the charging hanger of the clothes as some users required.

WBS Dictionary Entry May 14
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.3.3
WBS Item Name: Style design
Description: In this work package, the style design team should produce the design of the cloth based on previous research on demands. The design should give some additional thoughts on how the hardware may be embedded into the cloth. [UPDATE] **There should also be a design for the charging hanger of the clothes**

WBS Dictionary Entry May 14
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.3.4

WBS Item Name: Fabric design
Description: In this work package, the fabric design team should investigate and decide which/what kind of fabric we should be using by doing research on previous similar products, reading relative articles. [UPDATE] **The fabric should also allow the clothing to work with the wireless charging hanger.**

WBS Dictionary Entry May 14
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.3.5
WBS Item Name: Test design
Description: In this work package, the test design team should investigate and design the test cases required for this project. Including functionality tests, environment-resist tests, usability tests, [UPDATE] **The fabric should also allow the clothing to work with the wireless charging hanger.**

* All 1.3 Items should be done after the human resource management (Item 1.2.1)

1.4 Development

WBS Dictionary Entry June 5
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.4.1
WBS Item Name: Hardware development
Description: After designing the hardware of the project, the hardware team should manufacture the monitoring sensor module, the temperature modification module and the powering module of the clothes. As well as integrate the module into a harmonious system that can be built into the clothes. [UPDATE] **The wireless charging hanger should be also made and able to work with the powering module in the clothes.**

WBS Dictionary Entry May 30
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.4.2
WBS Item Name: Software development

Description:

After designing the software of the project, the software team should program the UI design of the phone app of the smart cloth, the system embedded in the cloth, the system used to communicate between the cloth and the phone app. The system embedded in the cloth would be used to control the temperature modification module and the powering module of the clothes.

[UPDATE]

The wireless charging hanger should be taken into account and considered in the development of the software.

WBS Dictionary Entry May 30
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.4.3
WBS Item Name: Style development

Description:

After designing the style of the clothes, the style design team should manufacture and further test the design of the clothes style. In this package, the style design team should also communicate and cooperate with the hardware design team to make sure the clothes and the hardware system would be able to build and work together.

[UPDATE]

The wireless charging hanger should be taken into account and ensured it would work together.

WBS Dictionary Entry June 5
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.4.4

WBS Item Name: Fabric development
Description: After designing the fabric of the clothes, the fabric team should manufacture the fabric into material that could be used by the style design team. Also, in this package, the fabric team should work closely with the style design team to make sure the material produced is ideal. This package should be done after the design of the fabric and style (Item 1.3.4 and item 1.3.3). [UPDATE] **The wireless charging hanger should be taken into account and ensured the material would not interfere with the charging function.**

1.5 Integration and Test

WBS Dictionary Entry July 4
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.5.1
WBS Item Name: Prototype development
Description: After all the design and development work, a prototype should be produced. In this package, all teams should work together and produce a functional prototype that should represent the ideal product of the project. Any integration problem should be identified and fixed in this package. [UPDATE] **The wireless charging hanger should also be made.**

WBS Dictionary Entry July 14

Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.5.2
WBS Item Name: Iterative testing and problem fixing
Description: With a prototype designed, developed and produced in the previous work packages, the team should now implement and conduct the tests designed before and check if there's any problem that should be fixed before the final launch of the product. If the prototype is good enough to work flawlessly and there is spared time, improvements in manufacturing that help reduce the cost can be investigated in this package. [UPDATE] **The wireless charging hanger should also be tested.**

1.6 Release and Marketing

WBS Dictionary Entry March 12
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.6.1
WBS Item Name: Market research
Description: In this package, the team should check for previous similar products, look for target customers and send out questionnaires that mainly focused on business with some aspects about functionalities. In this package, the team should identify the potential customer, the customers' focus, the appropriate price range and other marketing information. This package can be done along with the concept investigation in Item 1.1.3.

WBS Dictionary Entry July 21
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.6.2
WBS Item Name: Advertisement
Description: In this package, the team should utilize the information harvested in the previous item and advertise the product to the target customers while propagating the information about the release conference. This should be done after the development and production of the prototype.

WBS Dictionary Entry July 21
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.6.3
WBS Item Name: Release conference
Description: In this package, the team should prepare and hold the release conference. In the release conference, the team should introduce the product's functionality to interested audiences and release the tested and fixed product. This marks the end of the development of the project.

1.7 Closeout

WBS Dictionary Entry Sep 9, 2022
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.7.1
WBS Item Name: After-sale service
Description: In this package, the team should gather feedback from the customers, help the customers with any problem that can be solved with current development and research. The team should also gather the things that could not be solved right now and keep the information as deliverables that might be useful in later or other projects.

WBS Dictionary Entry Sep 2023
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.7.2
WBS Item Name: Review Achievement/Deliverable
Description: Before the close of the project, the team should review the deliverables and achievements of the project, identify the successes and failures in the project and make a report to summaries the project.

WBS Dictionary Entry Nov 1 2023
Project Title: Technologically Advanced Smart Adaptive Clothing
WBS Item Number: 1.7.3
WBS Item Name: Closeout
Description: This package includes all tasks that require closing the project, including the public announcement of discontinuing support, gathering all deliverables, managing non-reallocated resources, etc. **Finishing this package marks the end of the project**

Cost Estimate

Adaptive Adjustable Clothes Cost Estimate					
items	hours	cost/hours	subtotal	total	
1 start point				5150	
1.1 form project team	10	100	1000		
1.2 produce project charter	13	150	1950		
1.3 concept investigation	10	150	1500		
1.4 produce detailed project plan	10	70	700		
2 support gathering				28000	
2.1 human resource management	4	200	800		
2.2 facility and device purchase	16	1700	27200		
3 design				81800	
3.1 hardware design	15	1700	25500		
3.2 software design	30	1900	5700		
3.3 style design	12	1800	21600		
3.4 fabric design	15	1000	15000		
3.5 test design	40	350	14000		
4 development				249000	
4.1 hardware development	20	3400	68000		
4.2 software development	30	1000	30000		
4.3 style development	20	200	40000		
4.4 fabric development	30	3700	111000		
5 integration and test				31500	
5.1 prototype development	10	1500	15000		
5.2 iterative testing and problem fixing	15	1100	16500		
6 release and marketing				92000	
6.1 market research	20	100	2000		
6.2 advertising	40	2000	80000		

6.3 release conference	10	1000	10000		
7 closeout				99000	
7.1 after-sale service	40	700	28000		
7.2 review achievement/deliverable	30	2000	60000		
7.3 closeout	10	100	1000		
total					586450

Cost type and briefly description

1. **Development costs**
   The development cost mainly involves the design part of the overall product, the software development part and the fabric research and development cost. It is mainly composed of salaries paid to developers and raw materials that have been used for scientific research, and a part is also used for software development(excluding testing part)

2. **Operation and maintenance costs**
   The operation and maintenance cost is to maintain the normal operation of the after-sale service, after-sale the defective products that have been sold, ensure the quality of the products, and part of the wages paid to the employees

3. **Propaganda costs**
   Entrepreneurial sponsorship, advertising. The publicity fee is mainly used to collect a large amount of data in the early stage of the project and hire professionals to consult, attract venture capital, and advertise the project after completion, bringing users an excellent experience

4. **Other costs**
   Other costs include company premises and the cost of purchasing and maintaining equipment, and include spending on hosting customers

Cost Baseline

Adaptive Adjustable Clothes Cost Estimate														
WBS item	1	2	3	4	5	6	7	8	9	10	11-18	19	20	total
1 start point														5150
1.1 form project team	1000													
1.2 produce project charter		1950												
1.3 concept investigation		1000	500											
1.4 produce detailed project plan		300	400											
2 support gathering														81800
2.1 human resource management				800										
2.2 facility and device purchase				27200										
3 design														81800
3.1 hardware design				10000	15500									
3.2 software design				4000	1700									
3.3 style design				10000	11600									
3.4 fabric design				4000	11000									
3.5 test design				1000	14000									
4 development														249000
4.1 hardware development					18000	40000								
4.2 software development					20000	10000								
4.3 style development					10000	30000								
4.4 fabric development					100000	10000								
5 integration and test														31500

5.1 prototype development							11000	40000						
5.2 iterative testing and problem fixing								16500						
6 release and marketing														92000
6.1 market research		300	100	200	100	200	100	300	700					
6.2 advertising										80000				
6.3 release conference										10000				
7 closeout														99000
7.1 after-sale service											28000			
7.2 review achievement/deliverable												60000		
7.3 close out													1000	
total														586450

Quality Management Plan

1. Purpose of The Project Quality Management Plan

Quality is a framework of culture, behaviors, processes and tools that support consistently meeting the commitments. The project quality management process includes Plan Quality Management, Perform Quality Assurance and Control Quality. As for quality management, the ultimate goal of us is to meet the expectations and requirements by planning and building it into a process from inception.

2. Quality planning

2.1 Define project quality

Quality planning is the method of deciding what's most important to the project, the roles or responsibilities that should be performed and we should identify the acceptance criteria through the timeline.

Standards - ISO 9001:2015

1. It's the degree to which a set of inherent characteristics fulfils requirements
2. Following the ISO standards can make sure we are on the right track, and improve the trust of enterprises.
3. With an effective plan, this standard can standardize the action and improve the profit.

Team's expectation

1. The cooperation between team members is friendly and effective, and there should not be any potential conflicts.
2. Conflicts or complaints from clients are supposed to be addressed in team meetings.
3. The project should achieve the client's expectations, which is our ultimate goal.

2.2 Measure project quality

1. Tracking:
   We use Gantt charts to track the development progress and maintenance, and to ensure the project will be on time and on budget.

2. Process:
   We follow a five-phase improvement process called DMAIC from Six Sigma, that is Define, Measure, Analyze, Improve and Control.

3. Performance:

- The final goal of six 9s of quality is to serve 99.9999% availability for our production systems.

- Achieve the goal that 99.9999% of clients can use the system smoothly
- Measure our system quality to be only 1 fault in 1 million operations.

3. Quality Assurance

Quality assurance is one of the main procedures to ensure the smooth progress of the project by checking the project requirements to ensure the product meets the project requirements.

3.1 Analyze project quality

The quality assurance of the project focuses on the process used in the operating system. The iterative plan will be placed throughout the system development, where the iterative process includes gathering client preference/feedback, analyzing system processes and improving the system following the plan iteratively.

The main thing to analyze in the project is also one of our primary goals where TASAC wants to achieve all functionality, reliability and usability.

Apply analysis

Functionality goal is to deploy the functionality in the different functional units which carry out various components of the project where each unit is responsible for completing a particular component. For instance, cool units should be independent of the warm units, which makes each unit have the flexibility in controlling its own functions, and come with reliability when some units fail.

Reliability can be achieved by testing the system without some important components, i.e. testing the main system with the failure of every single component. Running several major possible failures can not only improve the confidence of the team but the client's reliability. Last but not least, safety is the most important thing to test in the process.

Usability is done after all those quality assurances. Once the new updates are deployed, the system should inform clients of the latest update information on users' screens. The instructions can help users get started quickly.

3.2 Improve project quality

- The main quality plan should completely follow time/cost management
- The assurance reviews should result in process improvement by the team
- All efforts including communication should be documented and implemented when changes are adopted.
- Strengthening the team's advantages and minimizing defects with shorter testing cycles can improve efficiency and avoid failed time and cost spending in the early stages.

Risk Register

Risk No.	Risk name	Risk Description	Risk Owner	Category	Mitigation Plan (What to do to avoid the risk occurring)	Impact Level	Description of impact	Likelihood of occurrence	Contingency Plan (what to do if the risk occurs)
R03	Wrong Consumer	Because our product is a new type of clothing. The popularity in the market is relatively low. Therefore, the initial stage of product promotion, the sales department may choose the wrong target users. This will result in poor sales of our products.	Sales Manager	Market risk	In the initial stage of product promotion, we need to do market research, interview, questionnaire, usability test, accessibility tests, personas, etc. Let the sales department know more about the type of consumers they are targeting. Choosing the right people will increase sales. (Risk mitigation)	4 (0-5, 0 is unlikely and 5 is certain)	If a to-C product fails to sell well due to the wrong target group, the capital chain will be broken. That's a huge blow for a startup. Many startups only have enough money to fund one or two rounds of new product development, and if they don't get their money back, they'll go out of business	3 (0-5, 0 is unlikely and 5 is certain)	If initial sales are poor, risk should be reported to management and project manager in a timely manner. Let the relevant departments make adjustments in time. For example, retargeting users, and reducing or increasing advertising costs depending on effectiveness.
R06	Factory or contractor delays	In the production process, because the factory or contractor error, resulting in product delivery. This usually happens when machines break down, workers go on strike, and money is scarce	Project Manager	Process risk	Include in the contract penalties for late delivery, such as late penalties. Leave some room in the schedule to avoid delays. Communicate with the factory regularly to check the progress. Make sure the money is available on time (Risk transference)	4	If the factory fails to deliver the product on time, it will result in us not being able to deliver the product to our buyer within the specified time. That could lead to a number of buyers returning the goods. This may lead to our products being produced by the time the buyer has already returned. This will lead to problems in the company's capital chain	2	Report the situation to the project sponsor and project manager in a timely manner, so that they can communicate with the factory and make compensation according to the contract terms.

R04	Lack of communication led to confusion between different departments	The communication mode, frequency and content have not been established between departments. Each department of the company may operate independently. This can lead to inconsistent progress from department to department and even the wrong direction of work.	Project Manager	People risk	Develop a communication plan early in the project. Determine the frequency, content, and target of communication. Communicate with relevant departments as early as possible to avoid problems. Identify communication channels, such as emails, messages, and phone calls. In an emergency, use effective means of communication, such as face-to-face or on the phone. (Risk Avoidance)	3	In project cooperation, if the communication between different departments is not frequent and efficient, it is likely to lead to slow progress of product research and development or even a detour. For example, if there is no communication between the product department and the sales department, the sales department cannot have a good understanding of the core competitiveness of the product, thus affecting the sales of the product	4	Correct misunderstandings and clarify unclear areas as problems arise. If coordination between departments is not possible, seek help from the project manager or project sponsor
R07	The departure of project team members	Personnel changes may occur during product development. People on the project team quit or were fired.	Human resources and Project Sponsor	People Risk	Prepare study guides for product projects and ensure that new hires are up to speed on the project. Ensure that the project manager has the most up-to-date and detailed information on the project scope and schedule. In this way, timely decisions can be made when important personnel changes are made. (Risk mitigation)	2	Changes in team members can affect product development cycles. For example, the turnover of the software team may result in the failure to complete the software development within the specified time. The departure of some key personnel may result in a delay in the completion of the whole project.	4	In the case of personnel changes, it is necessary to let the departing staff do a good job handover. Recruit new employees as soon as possible, and familiarize them with the project to take over the work.
R01	Price rise of raw	In the process of	Project Manager	Financi	Rising raw material prices are	4	If the team doesn't have	4	After the price increase of raw

	materials	production, raw material shortages and price increases may be caused by various factors. This directly affects the project budget and the speed of production	or Project Sponsor	al risk	almost inevitable. We can only choose to accept the risk. Therefore, the preparation of the budget and the establishment of project cost management, it is necessary to establish a certain reserve to deal with emergencies (Risk acceptance)		enough reserves to cope with rising raw material prices, then we have to stop production or raise the price of the product. This could result in us not delivering the product on time or losing some users.		materials, the project sponsor should convene a general meeting to discuss with stakeholders, shareholders and relevant persons in charge. Look for alternatives on the market, or decide whether to increase the budget or suspend production.
R02	Risk of scope variations in software development	In software development, it is necessary to change existing features or add new ones because of requests from customers or other stakeholders.	IT Manager	Technology risk	Agile development mode can be adopted, iterative development. This allows the team to adapt to changes in demand. In addition, when designing Time Management, some emergencies should be taken into account to avoid failure to complete software development within the specified Time	3	The programmer's workload will inevitably increase as the scope of functionality is constantly changed by customers or stakeholders. This change poses serious risks to software projects. Software projects may not be completed on time.	5	In the event of a requirement change, the IT manager should be communicated in a timely manner. Communicate additional time and resources needed with the project manager or sponsor. Adjust Time and Cost in Time. Minimize the damage.
R08	Loss of important project data and company information	Some important software code, data information, or a large amount of product inventory may be stolen or lost	Project Manager	Financial Risk	Data loss or theft is uncommon though. But it's hard to completely stop it from happening. We can only minimize his risk or transfer the risk as much as possible. For example, by signing a confidentiality agreement with all employees, if data or products are lost due to the employee's reasons, the	5	Loss of software information or production materials can lead to loss of company revenue. And it will cause the company's product development progress to slow down, and in serious cases, the product will not be delivered to users normally. Teams may also need to	1	When data or company information is lost, the project manager or project sponsor should be notified as soon as possible. Ask the project manager to lead the team to investigate. Find the person in charge of the lost data in time, and hold her or his

					employee needs to bear the corresponding responsibility. Register all inventory data, and company property, and check regularly to avoid loss.		devote more energy and time to litigation. Therefore, when the company information is lost, the loss may be extremely huge.		accountable according to the relevant contract to transfer the risk. If the data or material is lost, the police should be reported in time, the criminal suspect should be tracked down, and the data should be recovered as soon as possible to reduce losses.
R05	The risk of poor code quality	There are many reasons for poor code quality. For example, a lack of developme nt time causes developers to rush to finish the code and ignore quality. Or because the developer is not competent.	IT Manager	Techno logy risk	Poor code quality is hard to avoid completely, but it can be improved as much as possible. Such as conducting code reviews, setting coding standards and requiring programmers to develop according to those standards. And conduct code testing (Unit testing, System testing, etc.) (Risk mitigation)	3	Bad code can make it harder for others to read, which in turn makes it harder to review and change. Poor quality code can also affect project agility and make iterative development difficult. It can even slow down the project later in the project.	3	Ensure the quality of each part of the code through periodic testing. If some low-quality code is found, we need to modify the code in time to prevent the low-quality code from affecting the entire system. Timely modification of low-quality code can also prevent the accumulation of too much low-quality code that can't be fixed

Communication Plan

List of stakeholder	Level of interest in project	Description of interest or concern	Document name	Communication medium	Frequency of communication	Contact person	Communication owner
Customer management	High	Practicality of the project work	Weekly status report	telephone	Weekly	Xiao Zhang	Project manager
Customer business staff	High	Practicality of the project work	Weekly status report	email	Weekly	Xiao Zhang	Project manager
Internal management	High	Practicality of the project work	Weekly status report	email	Weekly	Xiao Zhang	Project manager
Internal business and technical staff	High	Technical details of the project work	Weekly status report	telephone	Weekly	Yuye Zhou	Director of IT operations
Training subcontractor	Low	Commercial value of the project work	Training plan	Slack	Monthly	Zeyu Liu	Human Resources

Reflections Of Leadership Practices On Teamwork

Member A: At the beginning of the project, I completed the Project Charter with my team together, and divided the roles for each member. Communicate with other team members in a timely manner and organize meetings as needed. participated in the completion of part of Project Charter, Scope, and WBS. Independently complete Risk Management content.

Member B: Well done in project measurement and team communication, having good leadership in team cooperation.

Member C: Actively engage in brainstorming at each group meeting, being able to come up with constructive ideas and implement them. I am also able to listen to other people's ideas and participate in thinking, complete the assigned tasks very well, and play a key and positive role in the operation and development of the project.

Member D: Attend every meeting, discuss with other group members, and can efficiently complete my own works(communication plan and some research) on time. Also, when I search for some useful cases online I will give some references for team members so that we can come up with more new ideas. All in all, it was a nice group work.

Member E: Worked on WBS and time schedule. Assisted with document modifications. Participate in group meetings. Coordinate between different aspects of the project plan and members. Help keep the project running.

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