LINK NECKLACE

A Product for People's Close Relationship Over Distances

MSc PDE Major Project
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Summary

People move worldwide to find opportunities, and it's common for a couple to live in a different place for some time. Compared to the couples who live together, the couples who live over a distance have limited time and communication methods to exchange their partners' life. Based on research, couples exchange their life details for helping maintain and strengthen their relationship. Otherwise, it will cause mistrust and misunderstanding between couples. Even the lead broke up in the end. Thus, the product design concept helps couples record their life details and share the footage with their partner.

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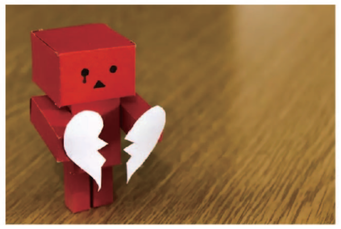
Insight

Insight Problem

I notice this problem base on my own experience. I moved to the big city after I graduated from college and furthered my education in Glasgow this year. I suffered a lot from long-distance communication. I find it's **hard to express my true feeling**, getting strength from my parents and girlfriend.

Define Problem

According to the Chinese 7th population survey in 2020, **376 million** Chinese people **leave their hometowns** to find more opportunities in developed areas, which takes up one-fourth of the population. In America, **28%** of people left their hometown. In the UK, the number is **31%**.



Thus, it is widespread for some couples to have to live in different places for a specific time. But long-distance have a significant negative impact on the couple's relationship. From the research, **81% of couples will be broken** because of the long distance.

We have three close relationships:
1. The close relationship of parents and child.
2. The close relationship of the couple.
3. The close relationship of good friends.

From the research, **the couple's relations are at the centre place**.

The couple's relationship is a central place.
The communication frequency: **couple > parents > friends**.
The communication content: **couple > parents > friends**.

Couple: almost every day, talk about **nearly everything**.

Parents: around twice a week, talk about **good things or something important**.

Friends: once per month, talk about **things interesting**.

User Define: Five stages of a Couple's Relationship

1. The passionate beginning of a relationship:
Everything in this stage is sweet.

3.Disillusionment:
1. End the relationship;
2. Settle for mediocrity,
3. Push past it.

People start making a difference together.

2. Things start to get serious in the relationship:
People begin to build a life together and start thinking about the vision of this relationship.

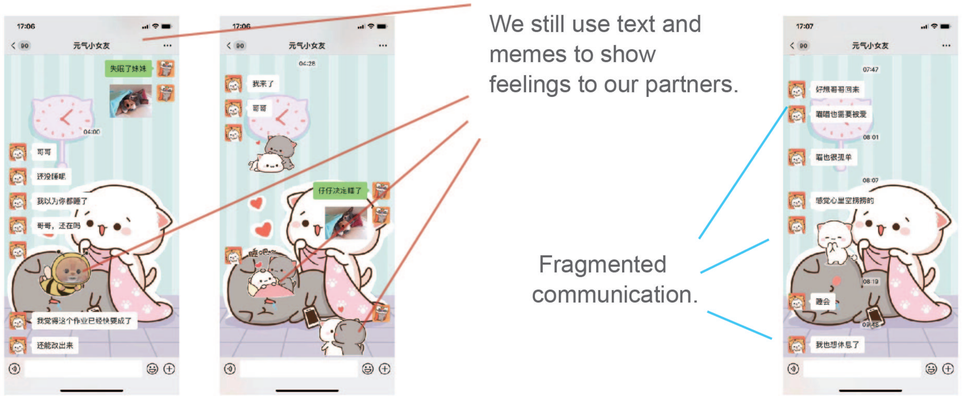
4. In Real Love:
People know their partner's flaws and imperfections, but they choose to love their partner anyway.

The couple that hasn't gone through stage three hasn't formed a stable relationship. They haven't decided to spend a long time with their partner. So I choose my product to serve **the couple through stage three**. And the couple who are on the stage, but they are trying to push past it.

Research

Auto-ethnography

To start, I conduct auto-ethnography. My girlfriend and I have been through five years. My self-value is that we are the couple in stage four. Like the interviewees in previous research, my girlfriend and I use multiple communication methods: WeChat to send texts and pictures and make video phone calls and memes to express our feelings.



Our communication has two components: **1. Exclusive time; 2. Fragmented communication.** The only time mostly depends on the video phone call. In fragmented touch, we know we can't get feedback very quickly, but we still use text and memes to show feelings to our partners.

Online Research

Couple living together

I research a stage four couple's life online to look deeper. Here are the pictures I gathered from the internet. We can see the couple doing daily activities together.

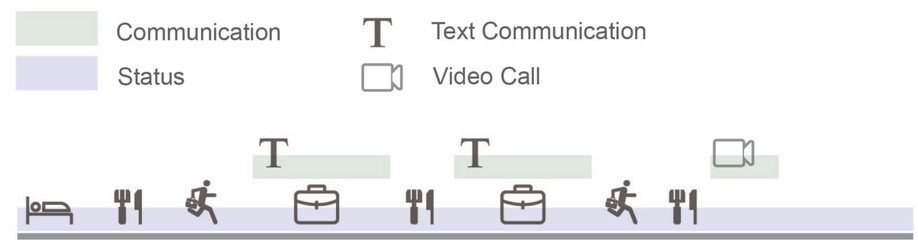
Couples live long distances

And here are the pictures of how the couples live long distances. The significate difference between the couple living together is limited communication time and method. Their communication is fragmented.

They WeChat to share their life details, make video phone calls and prepare a little surprise for their partner. Here are pictures of the girl using their memory to celebrate her boyfriend's birthday over long distance.

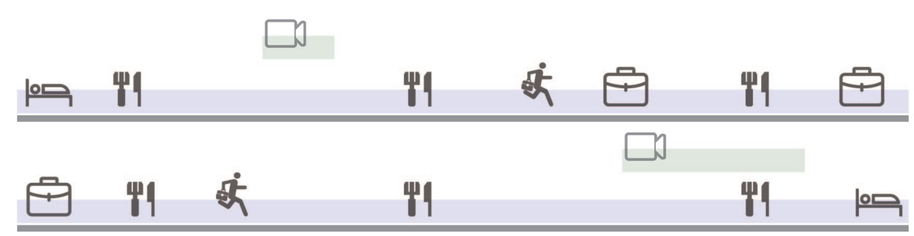
Interview

I interview three people, asking them how they make communication with their couple. Here are their storyboards: How they communicate with their lover.



My girlfriend's friend. She is 28 years old; working in the private sector.

My friend. He is 27 years old, and he is an architect.

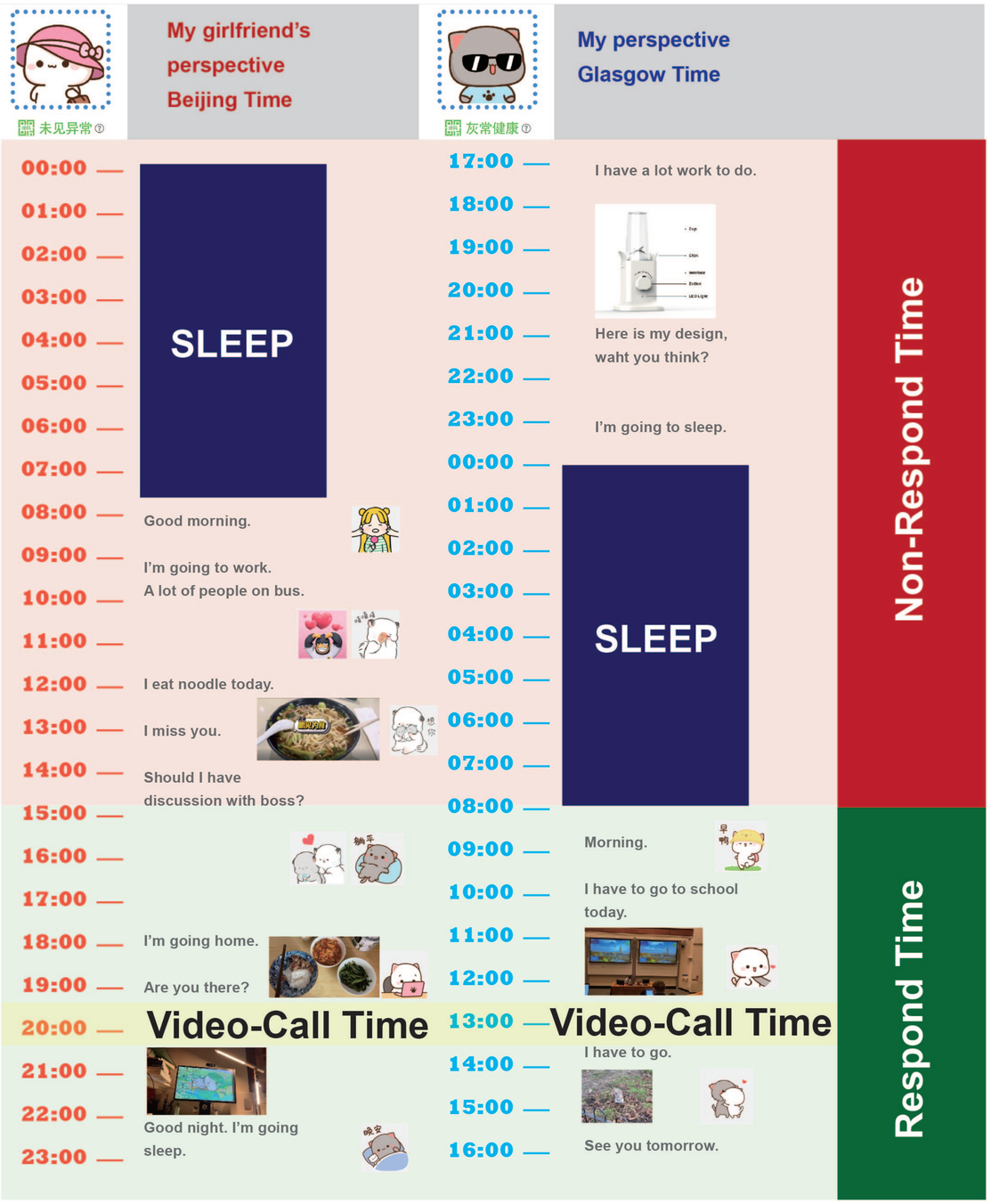


My girlfriend's sister. She is a nurse and 27 years old.

Combining the research above, three ways can help the long-distance couple to strengthen their relationship: **1. Share their life details with their partner. 2. Set a surprise from time to time. 3. Build their good memory.**

Problem & Opportunity

Problem Scenario

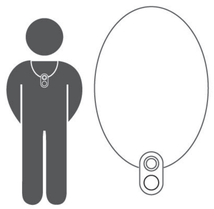


The left chart is the communication timeline of my girlfriend and me. It's a typical problem scenario met by the couple over distance because of the time difference, different lifestyle habits or different schedules. At most times of the day, the couple couldn't get a response from their loved ones. Take my girlfriend and me, for example; for **two of the third day, we can't get an answer from each other**, and we begin **not to share our life detail** in that time. But from previous research, sharing life detail have an excellent help for couples to strengthen their relationship. Thus, I choose to design a product to help couples to record and share their life detail during Non-respond time.

Design Proposal

A wearable product is easy for users to carry around, with three main functions: Statue function, capture function and auto-capture function.

After a whole day's recording, the product can auto-form a short video and send it to your lover through your smartphone.



Wearable

Main Functions

Statue function

Different Feelings

Statue function: Users can use the touch screen to record their present statues or feelings.

Capture function

Capture function: Users can use the hidden camera to capture their daily life or something interesting.

Auto-Capture function

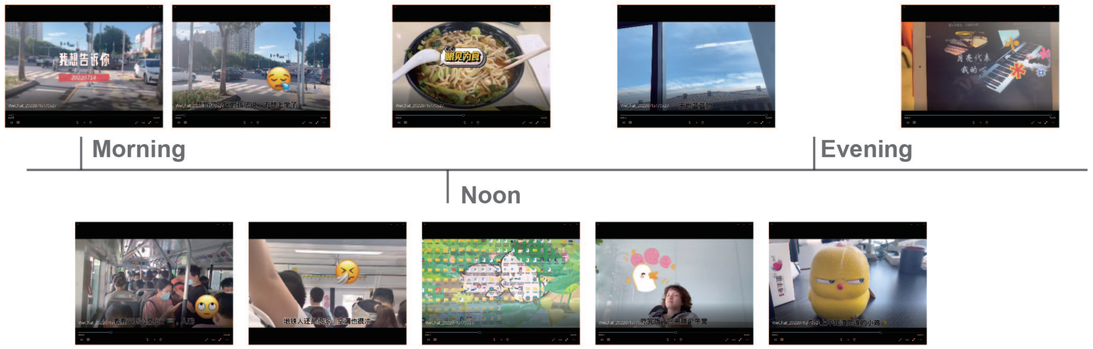
Auto recording function: When users are dedicated to something, such as: working, studying, or reading a book. Users can transform the product into a static camera. The product can auto-record a 10s video per hour.

Simulate Concept

User Simulate

After setting up my design concept, I share my idea with my girlfriend. I asked my girlfriend to use her smartphone to simulate my design concept to test the design concept. She takes four days of tests; here are her test results:

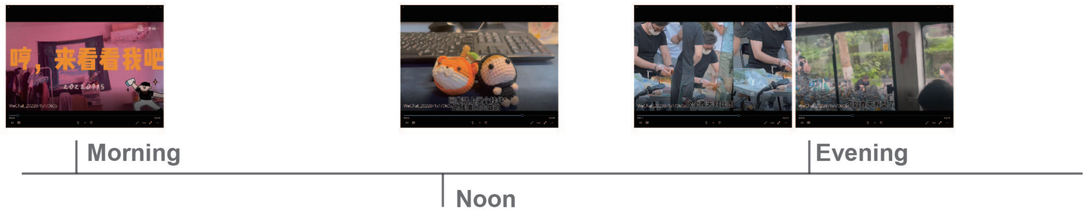
Day one, 14/07/2202, workday



Video size: 134M
Video length: 41 seconds
Using statue function: recording her feeling seven times
Using capture function: short recording video nine times
Using auto recording functions: auto record her siesta, two times

The Colour block represents once use

Day two, 15/07/2202, workday



Video size: 57M
Video length: 27 seconds
Using statue function: recording her feeling three times
Using capture function: recording short video four times
Using auto recording functions: none

The Colour block represents once use

Day three, 16/07/2202, closed day

Video size: 187M
Video length: 90 seconds
Using statue function: recording her feeling three times
Using capture function: short recording video six times
Using auto recording functions: none
Addition: She also recorded something she wanted to say to me.

The Colour block represents once use

Day four, 17/07/2202, closed day

Video size: 56M
Video length: 29 seconds
Using statue function: recording her feeling two times
Using capture function: short recording video five times
Using auto recording functions: none

The Colour block represents once use

I discussed this test with her after she finished three days of recording. The product concept **positively impacts our relationship**; the short video also helps us **develop more topics in a video call**. Then, She complains about the inconvenience of using the smartphone to simulate the auto recording function. Thus she only mimics the auto recording function on the first day.

Product Using Time Estimate

Based on my girlfriend's four days simulation, I estimate the user maximum use time of the product:
Statue function: 20 time/day × Light screen 10 s/time = 200 s
Capture function: 10 time/day × camera 20 s/time = 200 s
Auto function: 10 hours × 5 s/hour = 50s
Edit & upload video: 120 s
Product total maximum working time: 200 s + 200 s +50 s + 120 s = **570 s**

Technical Path

Similar Product Research

My design concept is similar to the Go-Pro camera in the function aspect. So I researched the Go-Pro camera. And I am making a comparison with my design concept.

Interaction

GoPro HERO 10 has two physical buttons: Mode Button and Shutter Button, for the user to capture the footage and switch the modes. GoPro HERO 10 also has two LCD screens: the front screen is only used for preview. The back screen is a touch screen; users can use it to control the camera.

Power Supply

GoPro HERO 10 has a powerful interior battery that could supply the camera work for two hours. It's a 1720mAh lithium-ion battery. The size of the battery is 36*31*11mm, and the weight of the battery is 26g. The volume of the battery almost takes the half volume of the product. And the battery is a removable design; users can replace a new entire batter to prolong the camera use time.

Footage Quality

As a professional camera, GoPro HERO 10 highly demands footage quality. It has a powerful processor and uses stabilisation technical to improve the quality.

Footage storage & transfer

GoPro HERO 10 uses an SD card to store footage and has three ways to transfer the footage: 1. Automatically upload footage to the cloud. 2. Wireless offloads to its APP. 3. Using cable.

Spec Selection

The priority two things I need to control are the size and the product's weight. Thus, I set the goal for my design product: the size of my product can't be more significant than **40*60*30mm**, and the weight can't be heavier than **50g**.

Size no larger than 40*60*30mm

Weight no heavier than 50g

Camera unite

To decrease the size and the weight of my design proposal mainly from the two parts: the camera unit and battery. As my design product is only used to record life detail, a **1080P camera** is enough. I don't need to choose a powerful camera unit like GoPro, and a 1080P camera unit can be much smaller than a GoPro camera.

5.3 K → **HD (1920*1080)**

Power supply

To the battery part, from my girlfriend's simulating use, none of her day video recording lengths was over 2 mins. Compared to the GoPro camera can work around two hours, I can choose a much smaller battery to decrease the size and weight of the product. But the battery must be large enough to power the product to **work the day**.

1720mAh → **200mAh ? Need Caculation**

Interaction

Users mainly through LCD touch screens to control the product. I use the virtual button rather than entity keys to decrease the size concern. But a switch of the machine button is necessary.

The virtual button of the iPhone camera's diameter is **20mm**, so my LCD screen size is at least more significant than this size.

Diameter is 20mm

Footage storage & transfer

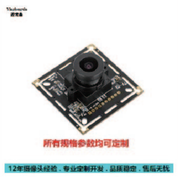
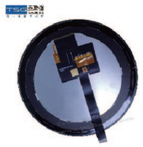
From the user use storyline, users only upload their recording after back home. During the whole day, the product doesn't need access to the Internet, so a Wi-Fi module is enough for this product. A removable SD card unit will take a large volume. And based on the test result, my product doesn't need ample memory storage. A **built-in memory chip** is enough for this product.

Built-in memory chip

Component Selection & Design Process

Major component

After I have decomposed the functions, the spec of the significant component is clear. Based on the principle: of being small, light and cheap, here are the major component I found on the internet:

Name	Picture	Size	Specs	Price
Camera unit		Volume: 28 × 28 × 10 mm Weight: 16 g	Voltage: 5V Power: 0.8W FOV: 80°	4£
LCD Touch Screen		Volume: 32 × 51 × 1.7 mm Weight: 7 g	Voltage: 3.2V Current: 20 mA	7.8£
Wi-Fi Unit		Volume: 25 × 15 × 1.5 mm	Voltage: 3.3V Current: 300 mA	0.7£
CPU		Volume: 10 × 10 × 1 mm	Process speed:72MHz	3£
Memory Chip		Volume: 20 × 10 × 1 mm	Storage: 32G	2£
Wireless Charge Unit		Volume: 16 × 8 × 1.2 mm	Current: 1mA	0.5£
Mic		Volume: Φ 4.0 × 1.3 mm	Respond frequency: 50 Hz – 16kHz	0.1£

Battery capacity calculation

In the battery capacity calculation parts, I meet some problems. I found it hard to estimate the power consumption of my product, as I don't have electronics engineer background to draw an actual circuit board and calculate the power consumption. Thus, I choose the alternative way I choose GoPro HERO 10 power consumption to estimate the battery capacity. GoPro HERO 10 has two LCD screens and a much more powerful camera; I have the confidence to assume that the electronics engineer can design lower power consumption in my product.

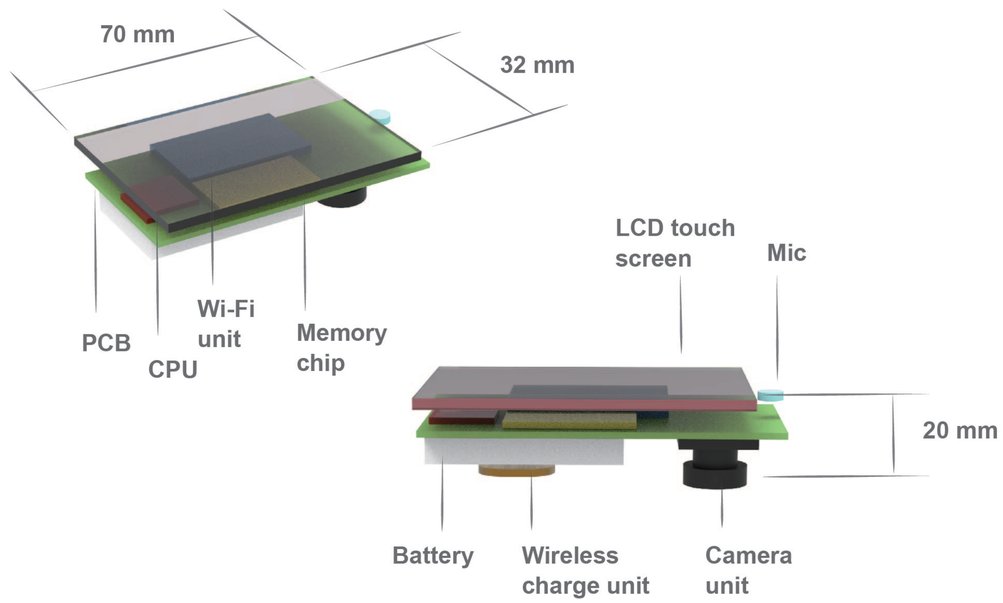
To estimate battery capacity, I equal my product power consumption to GoPro HERO 10. GoPro HERO 10's battery capacity is 1720mAh, and it can power GoPro works 2 hours = 2*60*60 = 7200s. And my product working time maximum estimate: 200s+ 200s +50s + 120s = 570s. So my product battery capacity should be larger: 1720mAh * (570s / 7200s) = 136mAh. Hence my product battery capacity could choose **200mAh**, leaving more buffer for the product.

Name	Picture	Size	Specs	Price
Battery		Volume: 4.0 × 20 × 300 mm Weight: 16 g	Capacity: 200 mAh	0.1£

First Iteration

Part stacking

I use the confirm component-making part stacking to decide the product's volume and the component's relationship. For private concern, I placed the camera unit at the back of the product, so that camera won't point to others and causes disgust.

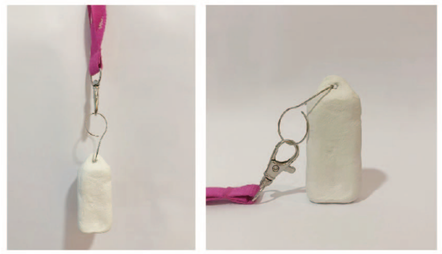


Design Process

First Iteration

Model making

I use the clay to make a quick model and simulate how users use this product. The model size is based on part stacking.

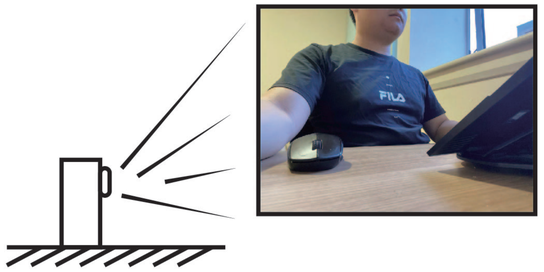


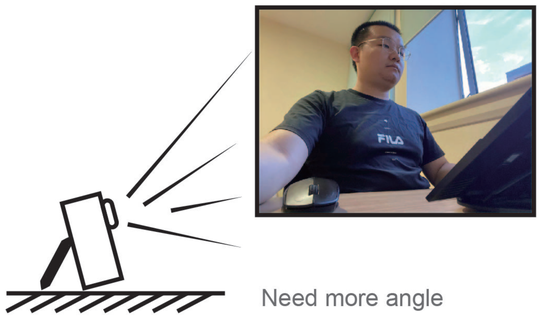
Model One

Model Two

Model Three

Model Four





Need more angle

Uncomfortable Use

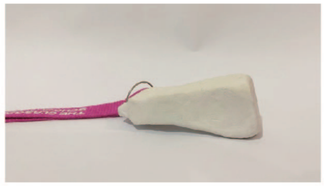
I found placed the camera at the back product is not a good choice:

1. The capture function is uncomfortable as the user wears the product as a necklace.
2. When the user wears the product, the camera unit will friction with cloth, damaging the camera unit.
3. Because the product is not fixed, the back of the product also could face others.
4. When the user uses the auto-capture function, the product needs an accessory to have a suitable angle.

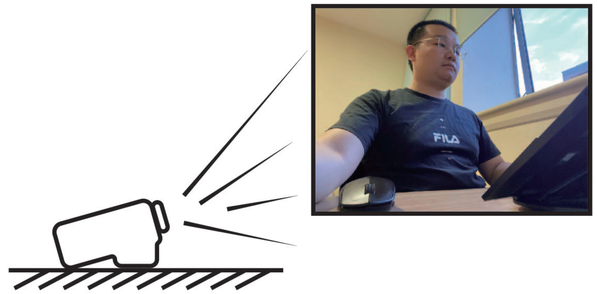
Second Iteration

Model making

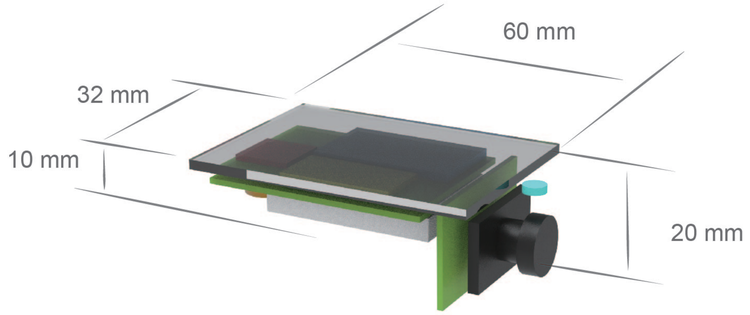
Then I made a new model, and I found I placed the camera unit at the bottom of the product could solve these problems.



Model Five

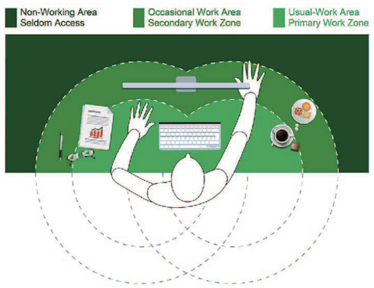


Part stacking modify

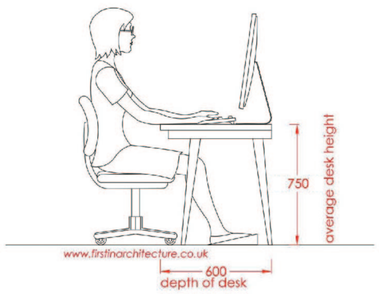


Angle calculation

For my product, users generally use the auto-capture function while they study and work, putting this product position near the edge of the secondary work zone. Thus I need to calculate the human's secondary work zone edge. The average desk height is 750mm.

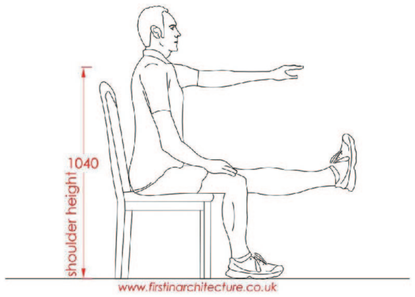


Secondary Work Zone

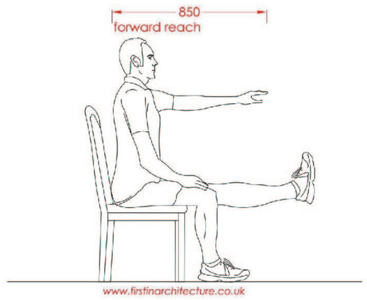


Average Desk Height

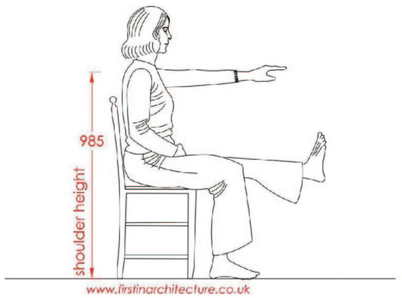
Design Process



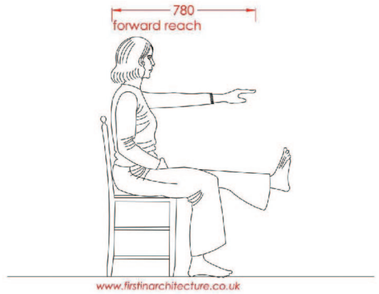
Average Female Shoulder Height



Average Female Forward Reach



Average Female Shoulder Height



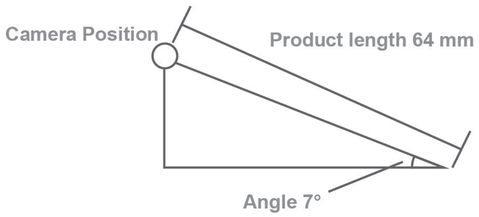
Average Female Forward Reach

To male: average shoulder height 1040mm, average forward reach 850mm. The edge of the secondary work zone: ((850)^2-(1140-750)^2)^1/2= 755 mm

To female: average shoulder height 985mm, average forward reach 780mm. The edge of the secondary work zone: ((780)^2-(985-750)^2) ^1/2= 743 mm

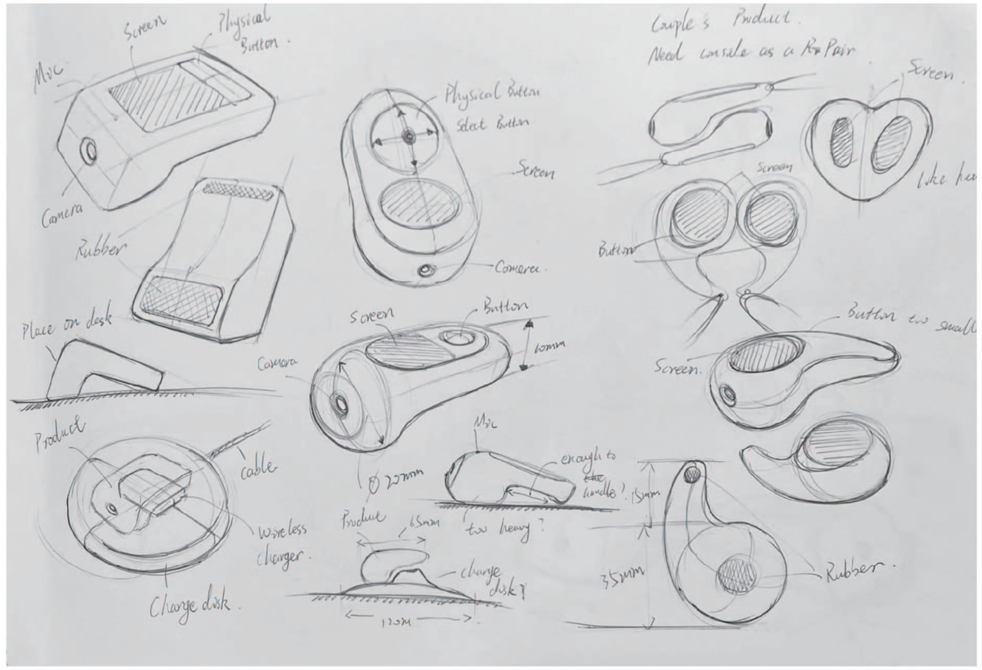
We can see there is not much difference between male and female' secondary work zone edge. We can assume users typically put this product at the position away them 700mm while they use the auto-capture function.

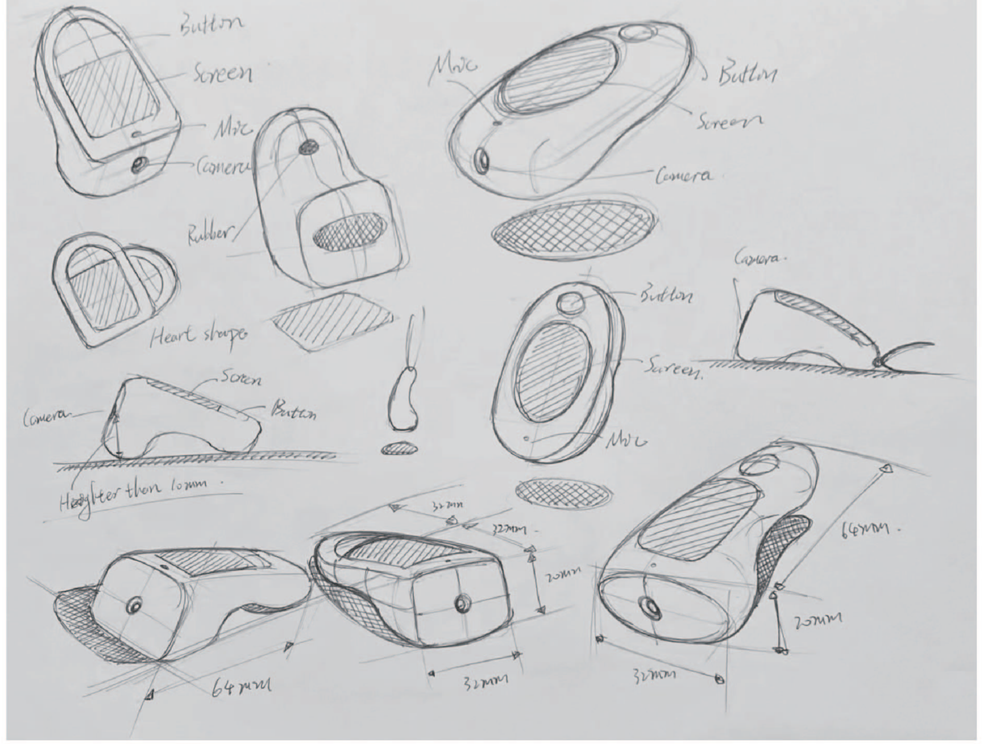
Users want to capture all figure images. Thus, the product capture height should be higher than the user's head height. The average female height is 1280mm, and The average male height is 1170mm. We can set the product capture height is 1500mm. arctan = (1500-750) / 700 = 47°. The camera FOV is 80°. Product Back Surface Tilt Angle: 47° - (80° / 2) = 7°



Sketches

Using sketches to develop ideas, find a suitable product form.





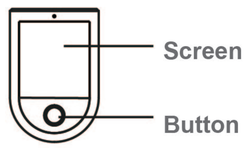
UI Design

UI Logic Design

Then I make the UI logic design, which contains: how users pair this product to their smartphone; how they use the statue; capture and auto-capture functions.

First Use

Unbox



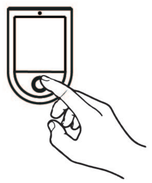
Control Methods

Long Press Button

Close to smart phone and Establish pairing

Main Interface

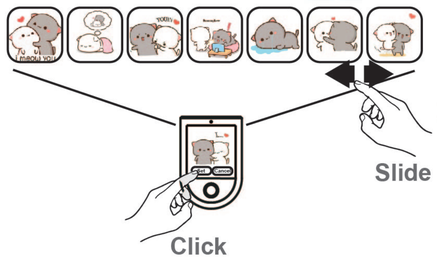
Statue Function



Weak the Product

Main Interface

Slide to Choose the Mode

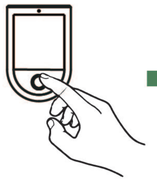


Click

Back to Main Interface

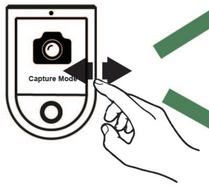
20s Back to Sleep

Capture Function

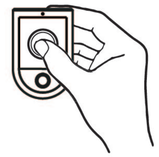


Weak the Product

Main Interface



Slide to Choose



Click: Take a picture

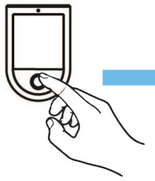
Press: Take video as long as press

Constant playback

Back to Main Interface

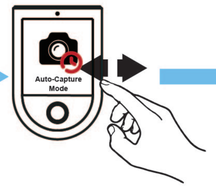
20s Back to Sleep

Auto-Capture Function



Weak the Product

Main Interface

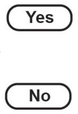


Slide to Choose the Mode

Click: Start

Record
Pause

Constant playback

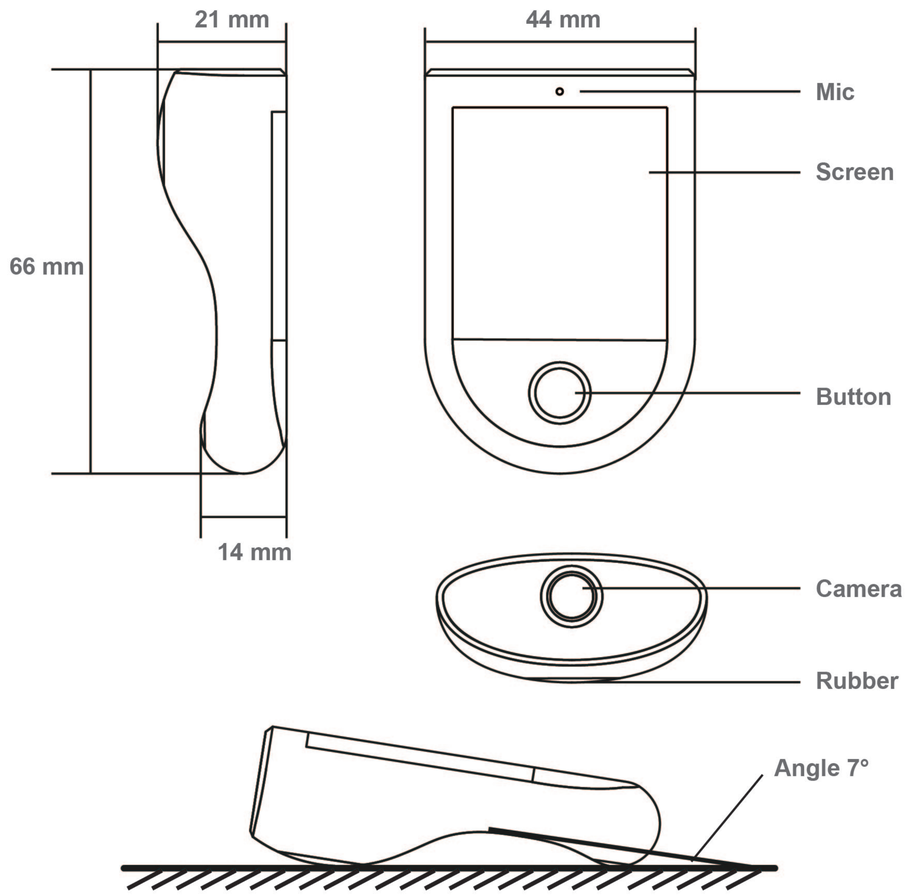


Back to Main Interface

20s Back to Sleep

Final Design

Spec



Additional Spec

Product waterproof level: **IP 54**

Product shell material: Acrylonitrile butadiene styrene (ABS)

Product shell manufacture: **Injection Molding**

The total cost of the product: 41.62 (£)

Product selling price: **62.43 (£)**

For calculation details, please see Xuexiang Xu's Technical Report.

Product benefit

1. The product is small and light enough that users can carry it around easily.
2. Three functions make it easy for users to record their daily life and felling.
3. Pair with the user's smartphone; users can send and check their recording footage.
4. Couples over long distances can receive a sweet video from their loved one every day, rather than a few ' Greetings ' from the chat software.
5. More details from each other's lives will be more trust and understanding.
6. Couples have more topics when they take video-call.

Conclusion & References

Further Work

The missing part of the current design process is a workable prototype. Subject to the time limit, only estimate calculation of battery capacity. The ideal way to decide the battery capacity is to use a workable prototype and test the power. Also need the prototype to simulate every function, and find out what problem scenarios may meet. Refine the product UI, making the product more user-friendly.

Another missing point is the product package design. What's the product package volume? How to protect the product during its delivery? And what's the product's delivery cost? All these need to finish in further work.

Epilogue

Writing the final word of my major project journal also means one year's study is ending. Looking back, it's not an easy journey. I want to thank my parents support me in furthering my education. I want to thank my girlfriend for her unconditional help in pursuing my dream. I want to thank every tutor in my one-year study; they were all patient and professional impart knowledge.

Before I came to Glasgow, I always asked myself: What is product design? How to make a good design? Now, I get a clearer answer. And I will keep my way to being a good product designer. That is my way of making the world to be a better world.

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