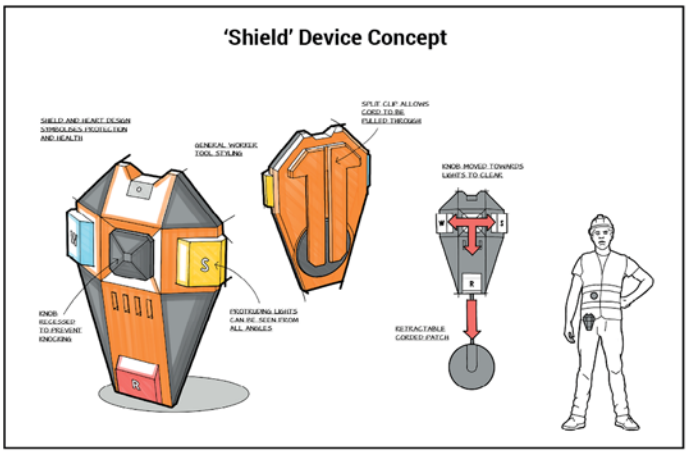
Product Design Studio 5 - Luke Frahn

PROJECT 2: SYNTHESIS AND REFINEMENT REPORT

eCREW Sun and Heat Safety System

The Plan

Project 2 began with the chosen concepts for a worksite sun and heat safety system device and app. The plan for further concept development, prototype creation and usability testing was as follows:



➤ Wearable Device

1. Begin with the chosen concept from Project 1

2. Create a CAD model design in Solidworks intended for soft modelling
   - Make several design improvements considered since earlier
   - Include all interactive elements: the lights, knob, clip and patch
   - Adequately convey physical properties and aesthetic values
   - Work within soft model material and process parameters

3. Construct a behavioural prototype using MDF and extruded foam for testing

4. Plan, conduct and record usability testing of the prototype with several subjects

5. Analyse and synthesise the test results for ideas to improve the design
   - Develop an appropriate and concise user testing procedure
   - Use three participants with relevant work experience
   - Have them simulate and comment on typical device interactions
   - Seek feedback on general device form and styling
   - Video record the testing for easy study and reporting

6. Create a refined CAD model in Solidworks intended for appearance modelling

7. Construct a final prototype using 3D printing for demonstration and presentation
   - Aim for a good surface finish and representation of materials
   - Consider adding feedback elements: illumination, sound and vibration

Mobile App ➤

1. Begin with the chosen concept from Project 1

2. Create a simple GUI design and set of example screens in Illustrator
   - Provide functions: view weather, and add, monitor and prompt workers
   - Convey concepts: worker risk attributes and safety control prompts
   - Work with previously developed icons and text labels
   - Use common mobile app interface elements and interactive strategies
   - Develop better connection and notification features

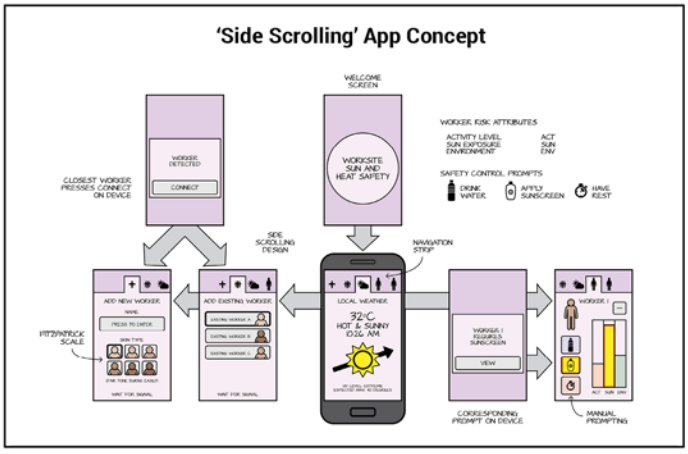
3. Make a basic interactive prototype using freely available software for testing

4. Perform usability testing of the prototype with several subjects

5. Study the test results for ideas to improve the design
   - Use the same participants from device testing
   - Guide them through all areas of the app
   - Seek feedback on any aspect of the design

6. Create a more refined and detailed GUI and screens in Illustrator

7. Make a final prototype for demonstration and presentation
   - Aim for an attractive and professional looking prototype
   - Consider more advanced elements: sounds and animation



Usability Testing

Behavioural prototypes were made and user testing performed to find ways to refine the design concept. Five participants experienced and critiqued both parts of the product, the notes from which are summarised below:

Device

- Confirmed the general viability of shirt pocket mounting
- Commented that he could manage clothing obstruction
- Suggested patch extending from the top would be better
- Felt lights were visible and knob could be operated well
- Approved of the mounting strategy and interactive elements

App

- Seemed comfortable with side swiping navigation
- Easily identified the purpose of most screens elements
- Suggested a quick tutorial for first time usage
- Questioned Bluetooth and suggested pairing own mobile

Paul (Maintenance Supervisor / Fitter and Turner)

Josh (Design Student / Road Crew Worker)

Device

- Accidentally retracted cord when installing
- Criticised general design for discomfort and catching
- Highlighted the issue of being covered with clothing
- Indicated that wearing to the side was more comfortable
- Suggested the approach of removal for operation

App

- Pointed out the guide was not very clear
- Suggested risk metric labels were hard to understand
- Questioned accessing a larger number of worker screens
- Indicated additional worker icons could be improved

Device

- Presented the issue of clothing interference
- Had difficulty adjusting cord length when installed
- Questioned prompting, action and clearing order
- Approved of general usability, strategies and appearance
- Suggested physical interference issues were acceptable

App

- Pointed out the guide was not very clear
- Suggested risk metric labels were hard to understand
- Questioned accessing a larger number of worker screens
- Indicated additional worker icons could be improved

Beau (Design Student / Welder Fabricator)

Roger (Farmer / Retired Design Teacher)

Device

- Noted the difficulty in adjusting cord once installed
- Showed that above the thigh installation was problematic
- Suggested pant pocket mounting and making a proper clip
- Approved of the general design, usability and aesthetics
- Proposed a concave knob face as an alternative

App

- Understood app screens and elements well
- Brought up the issue of worker prompting compliance and action confirmation

Device

- Noted sharp corners of top of clip touching skin
- Requested a more intuitive knob design
- Agreed that improvements could be made to the clip
- Suggested a more streamlined and curved form

App

- Warned about being careful with text size
- Requested more general depth to the prototype
- Supported the proposed changes to worker icons
- Queried about worker sex value and iconography
- Suggested refining the pairing system

Emile (Design Student)

Insights and Improvements

Testing, staff feedback and class discussion all provided valuable insight into how the system could be improved. Test observations and comments were studied and synthesised, leading to the following ideas for improvement:

General Insights

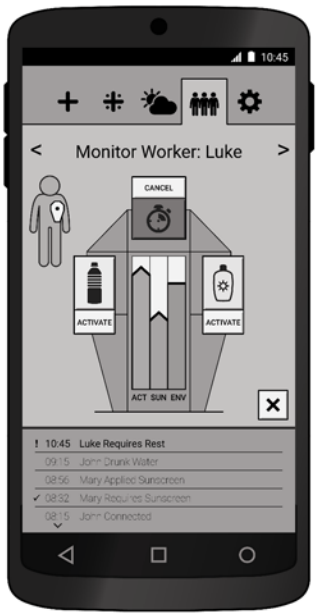
- Different types of feedback can be gained from test subjects with a design background versus those with only outdoor work / tradeperson / labouring experience.
- Testing with a range of designers and target users could be equally useful in both the ideation and concept development, and concept refinement phases.
- It is important to communicate to our peers exactly what design stage we're in and what kind of advice we are seeking when having them critique our prototypes.
- Our teachers will usually support our design work, so long as we can demonstrate our development thoughts and processes, and justify the decisions we've made.

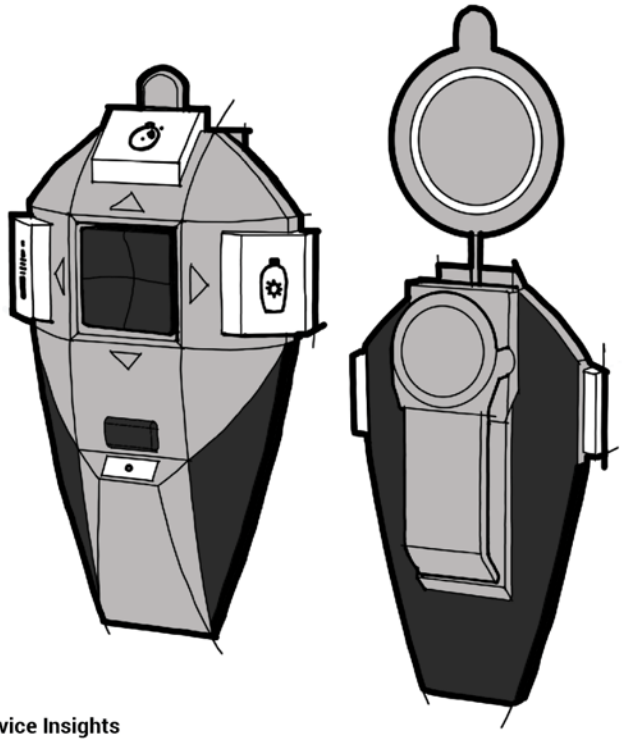
App Insights

- Worker types confirmed that an instructional guide screen was useful, while designers suggested that the current solution needed improvement.
- Several testers questioned how well the sliding tab navigation system would work with large numbers of workers and suggested alternatives.
- All participants wanted more information regarding sensory data processing, risk metrics and prompting calculations.
- People generally understood and liked the worker interface, with some issues regarding the additional icons and the plan to redesign it in a shield formation.
- A range of individual concerns pertaining to: Bluetooth range, worker compliance, device pairing, gendered icons, and welding radiation.

App Improvements

- Change guide screen to clearly explain key elements
- Provide second tier of navigation for worker screens
- Compact weather and expand notification home areas
- Redesign worker screen to incorporate shield motif
- Rethink device pairing strategy
- Refine icons and colour scheme





Device Insights

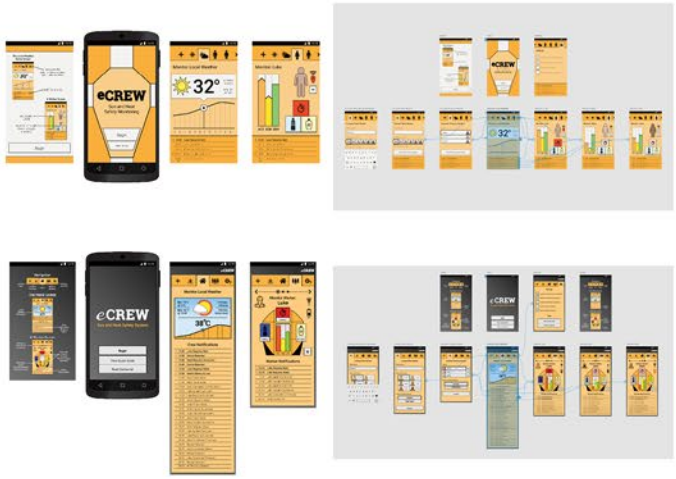
- Test subjects found it straight forward to install the device and patch, but had difficulty both routing and adjusting the length of the connecting cord.
- Most testers found it awkward to wear the device above the front of their thigh, while the shirt pocket, pant pocket and belt side were shown to work well.
- Participants approved of the clip size and position, with the only criticism being that it could potentially be knocked off of the body.
- People had trouble understanding the physical interaction strategy; that the lights were not buttons and that the knob was to be moved in four directions.
- All testers said they could see the lights and operate the knob in situ, but several said wearing both loose clothing and gloves could make these operations difficult.
- Worker types were supportive of the general form, while designers were somewhat critical of the sharp corners, protrusions and planar surfaces.

Device Improvements

- Add curvature and rounded edges to the general form
- Reduce the degree to which the lights protrude
- Use a concave knob and convey how to operate it
- Make the knob and lights operational
- House the patch in the body and have it extend from the top
- Put the cord retraction button on the front
- Redesign the clip to hold on to clothing and allow movement
- Add a pairing icon and dock charging terminals
- Taper sensor module and protect extremities

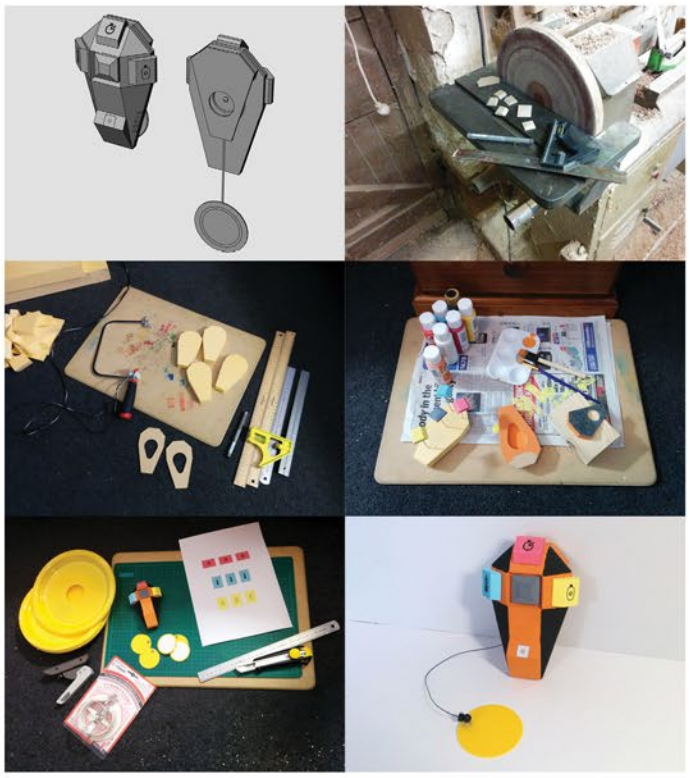
Prototype Creation

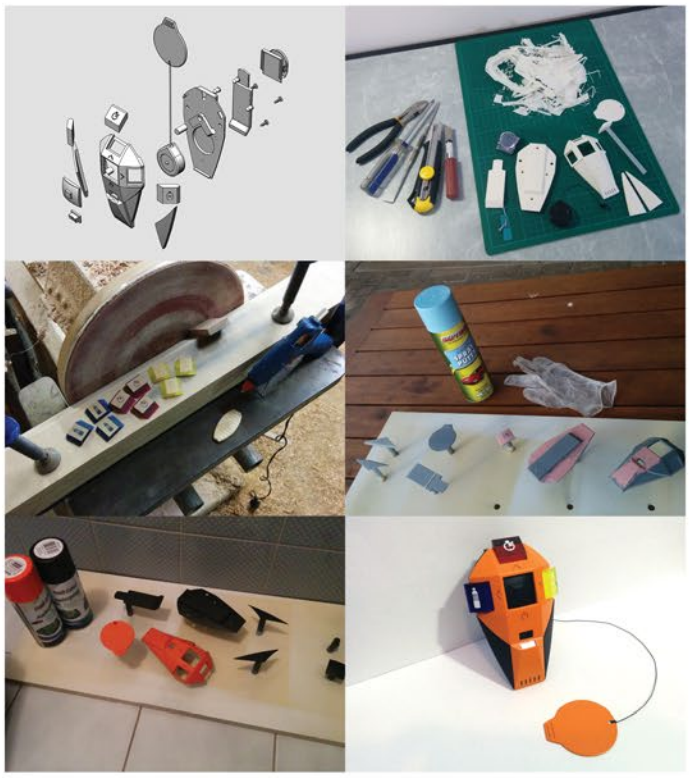
Two prototypes; one for testing and one for presentation, were made for both the device and app. This involved using a range of different materials, processes, tools and software, as shown here:



Making the testing and final app prototypes involved:

- Creating graphics in Adobe Illustrator
- Working in RGB colours and pixel units
- Logo and icon design and refinement
- Adding screen interaction using Adobe XP





Making the testing device prototype involved:

- Size testing using cardboard templates
- CAD modelling of the chosen drawn concept
- Making template guides using Illustrator
- Cutting and sanding the MDF back and lights
- Sculpting the front from extruded styrofoam
- Making the clip from sheet metal and the patch from a plastic plate
- Assembling with various glues, and painting with acrylic craft paints

Making the final device prototype involved:

- CAD modelling of the final design in Solidworks using a range of solid and surface modelling features and techniques.
- Solvent welding, laser cutting and etching, chamfering, polishing, and painting coloured acrylic sheet to create the lights.
- Printing, tidying up, test fitting, priming, puttying, sanding and painting of the 3d printed body, clip, patch and button components.
- Final gluing and assembly of all parts including the cord winder, clip spring, button spring, LEDs and screws.

The Final Concept

In addition to the prototypes, the final design was realised through CAD renders and a poster. This poster necessitated that the complexity of the product be described in a concise way, as repeated below:

eCREW

Sun and Heat Safety System

The eCREW system aims to reduce the likelihood and severity of sun burn and heat illness in outdoor workplaces. It consists of a mobile application used by a supervisor, and wearable devices worn by his or her workers.

The system uses sensors for environmental temperature, humidity and UV radiation (housed in the device body), and for core body temperature and heart rate (using the retractable patch).

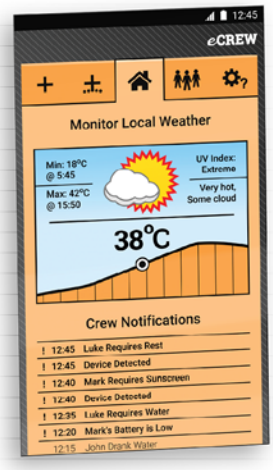
Sensory data is sent to the app via Bluetooth, processed to provide individual 'risk metrics' (activity, radiation and environment), and used to prompt simple control measures ('drink water', 'apply sunscreen' and 'have rest').

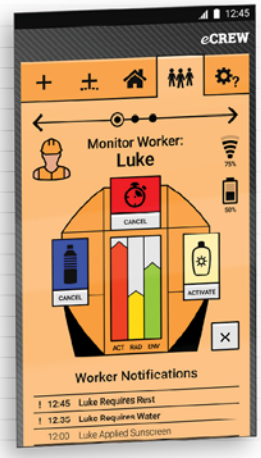
Additional App Notes

- The app interface uses a consistent graphical style, well thought out iconography and clearly defined interactive elements.
- The worker screen incorporates the device shield shape, lights and icons.

Additional Device Notes

- The large lights on the device can be easily seen by both the worker and all other parties.
- The knob is recessed to prevent it from being knocked, while shaped to allow for operation when wearing gloves.
- All device sensors are appropriately located, including that for UV radiation facing the sky.





The app provides worker monitoring, event notification, manual prompting, local weather information and a device connection system.

View the app prototype at: https://tinyurl.com/ya4mgpc6

The device has large lights for prompting (along with creating sound and vibration), a joystick style knob for operation, and a clip on the rear. It has been styled to look like both a protective shield and a typical power tool.

Appendix: Testing Procedure

NAME: Luke Frahn PRODUCT: eCREW System DATE: May 2016

PRODUCT UNDER TEST
What's being tested? What are the experience goals of the product?

We are testing the eCREW Sun and Heat Safety Monitoring smart device and mobile app. The experience goal is to provide a simple system for a work crew to monitor and control their sun and heat exposure. It is to help workers focus on their duties, while providing useful information and functionality to their supervisor.

RISKS/BENEFITS
Why are we doing this test? What are the benets? What are the risks of not testing?

We are doing this test to find ways to improve the design concept, in terms of usability and aesthetics. By not testing, we miss out on potentially valuable user feedback, and run the risk of making serious oversights.

TEST OBJECTIVES
What are the goals of the usability test? What specific questions will be answered? What hypotheses will be tested?

We want to test and get feedback on:

The Device:

How easy is it to install the device; using the clip and retractable antenna?

How easy is it to interact with the device; by way of the lights and knob?

How easy is it to perform device operations within connecting and prompting scenarios?

How suitable is the general form factor and styling for the chosen scenario and application?

The App:

How intuitive is the general screen sequence and navigation?

How intuitive is the notification system, worker monitoring screens and prompting functionality?

How suitable is the general interface and interaction design for the chosen scenario and application?

PARTICIPANTS
How many participants will be tested? What are their key characteristics?

We hope to test 3 participants. Each is to have had a significant amount of experience performing labouring tasks and working outdoors.

EQUIPMENT
What equipment is required? How will you record the data?

The test will require: the device model, (including an antenna patch) a mobile phone (running the app prototype), a video recording device, and this testing form.

TEST TASKS
What are the test tasks?

Have the test subject perform and comment on:

The Device:

*Clipping the device to belt or top pocket

*Routing and attach the antenna to body

*Simulating the connect procedure

*Simulating a prompting procedure

*Simulating a unsolicited action

*A critique of the form and appearance

The App:

*An initial exploration of the app.

*Simulating connecting a new worker

*Simulating following notifications

*Simulating manually prompting

*A critique of the interface and graphics

RESPONSIBILITIES
Who is involved in the test and what are their responsibilities?

Just the designer and the respective test subjects will be involved in this test. The designer hopes to perform the video recording in addition to verbal prompting and questioning.

ETHICAL CONSIDERATIONS
What measures must we take to respect the rights and freedoms of participants?

Test subjects will be asked for permission to be recorded and assured that only stills will be shown to others.

LOCATION & DATES
Where and when will the test take place? When and how will the results be shared?

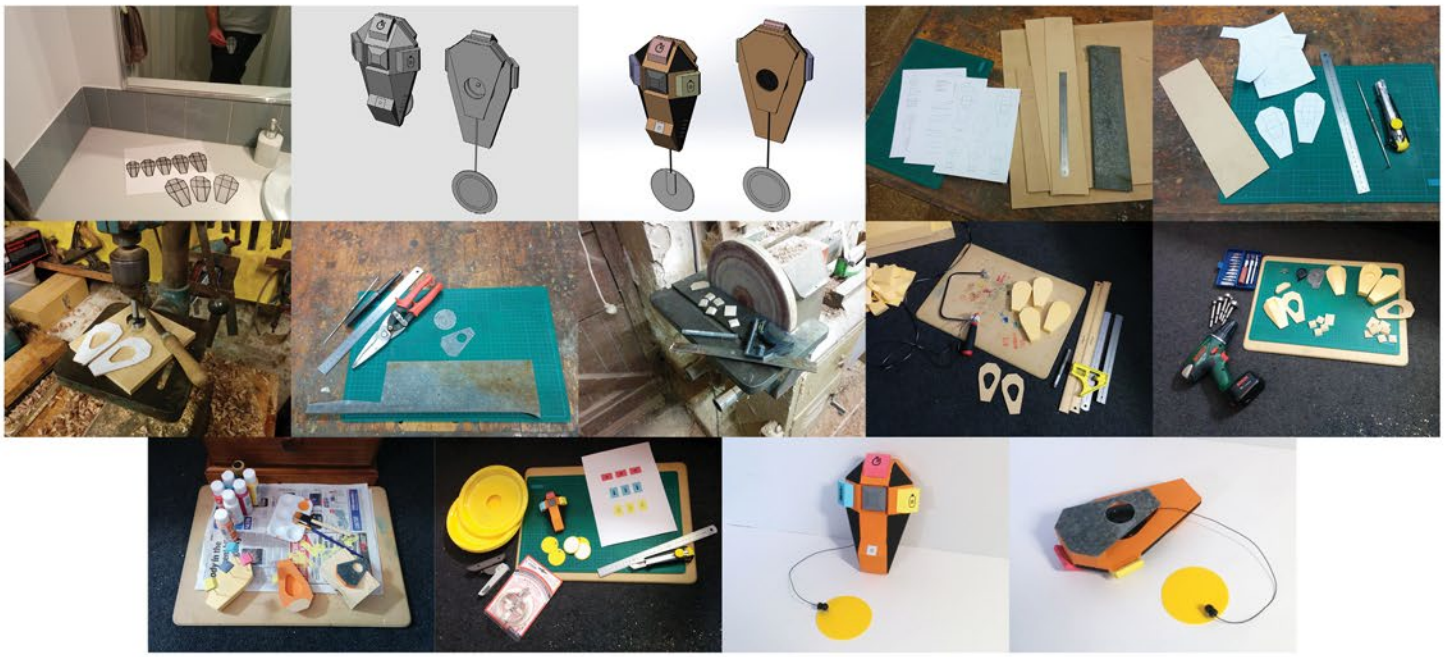
The testing will occur in an indoor environment, at a time suitable for the respective test subjects.

PROCEDURE
What are the main steps in the test procedure?

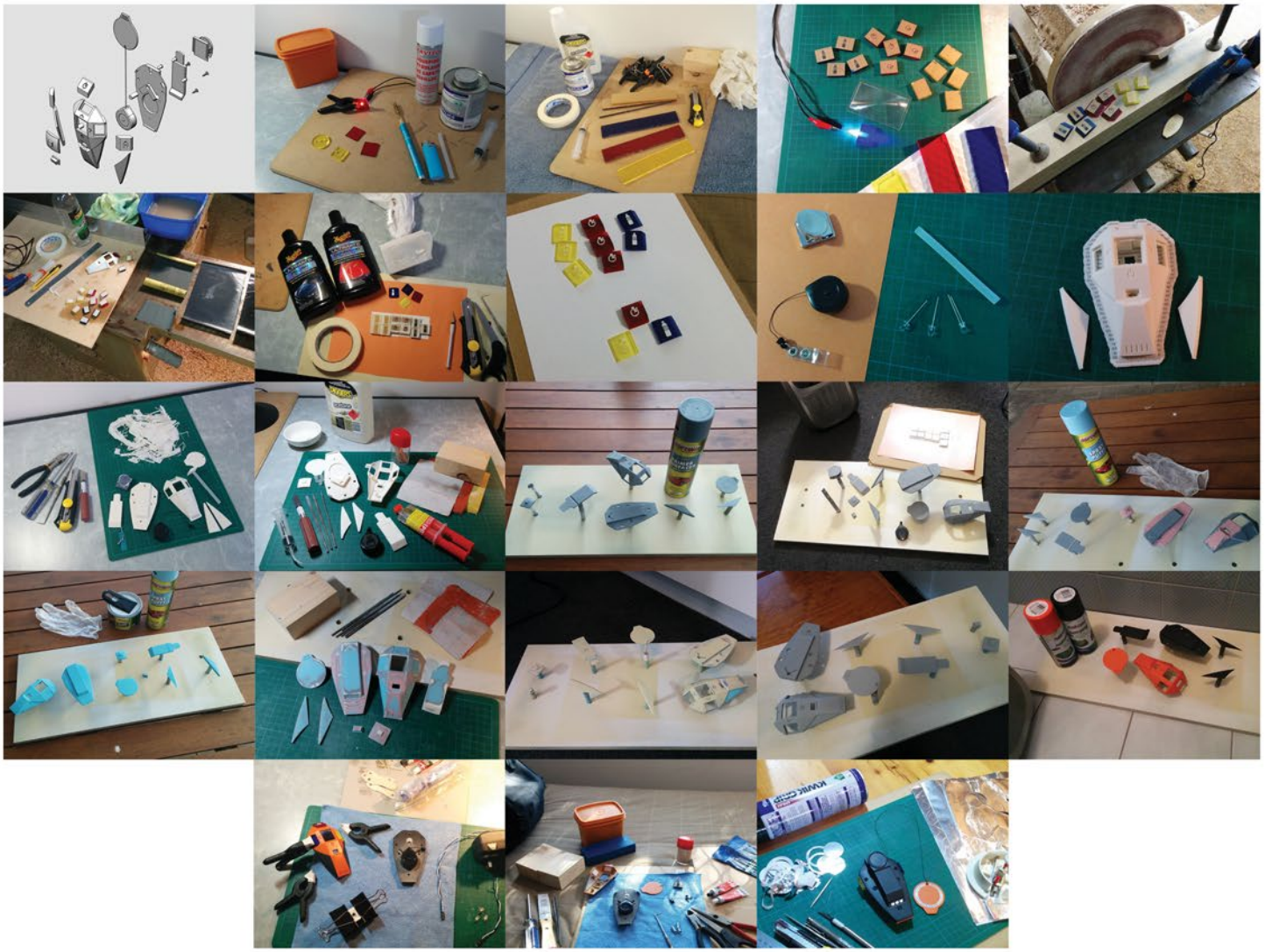
2.5 Minutes	10 minutes	5 Minutes	2.5 Minutes	5 Minutes	5 Minutes
Provide the test subject with a simple overview of the system and product. Explain the context of the test procedure; personas and scenario.	Have the test subject install the device, simulate interactions and procedures, and provide feedback on all aspects of usability.	Seek and discuss both general comments and specific ideas for improving the form and function of the device.	Provide the test subject with a limited verbal explanation of the app functionality and navigation strategy.	Have the test subject explore the mobile app, identify key elements, simulate typical operations, and provide feedback.	Seek and discuss both general comments and specific ideas for improving the design and appearance of the app.

Appendix: More Process Photos

Making the Testing Device Prototype

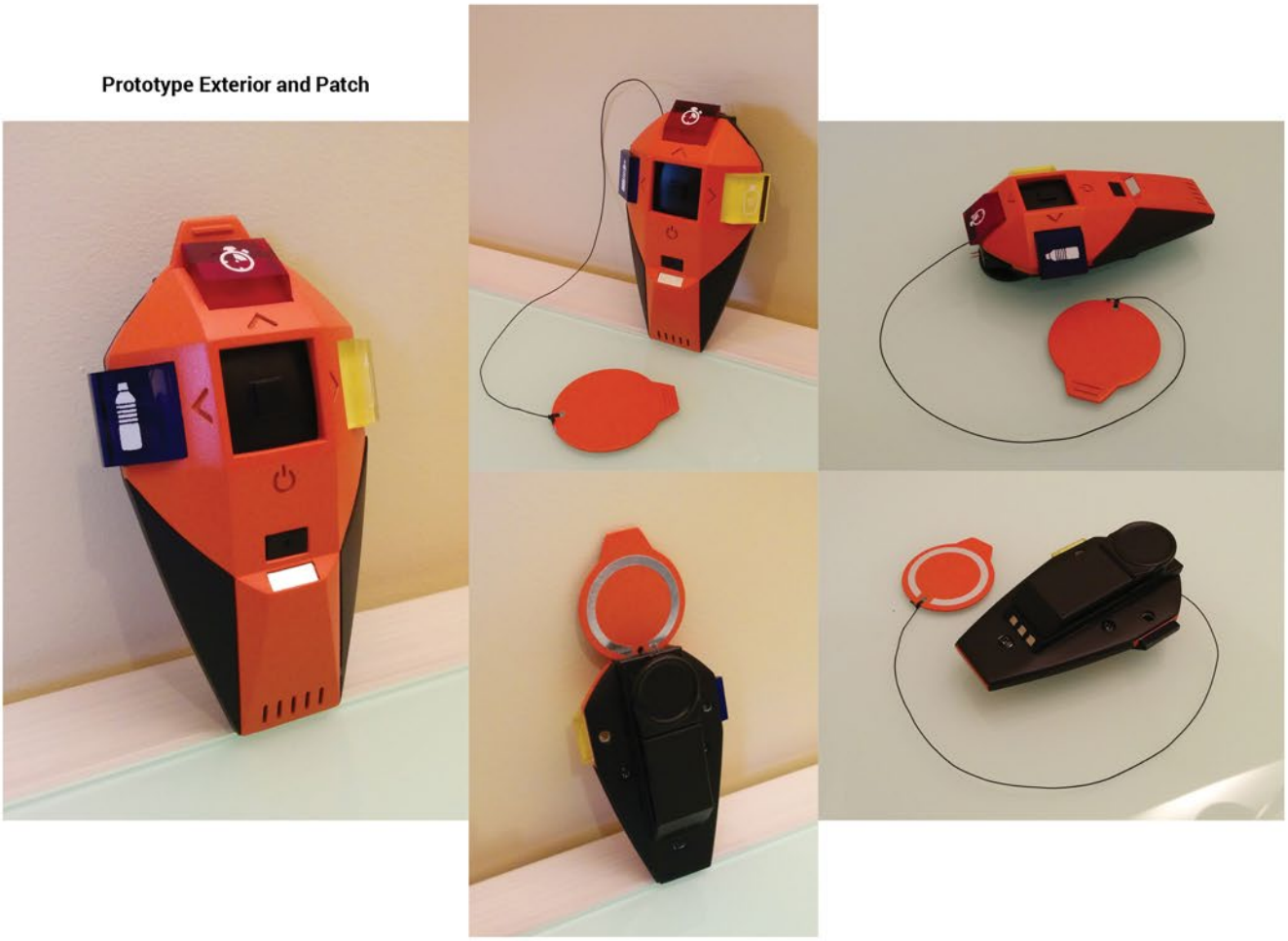


Making the Final Device Prototype



Appendix: More Device Photos

Prototype Exterior and Patch



Prototype Interior and Lighting