Setting Communities Alight

Darby Bicheno | RMIT

Durable Visual Record

2014 Industrial Design Thesis Project

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RMIT University
Honours Year Proposal
Durable Visual Record

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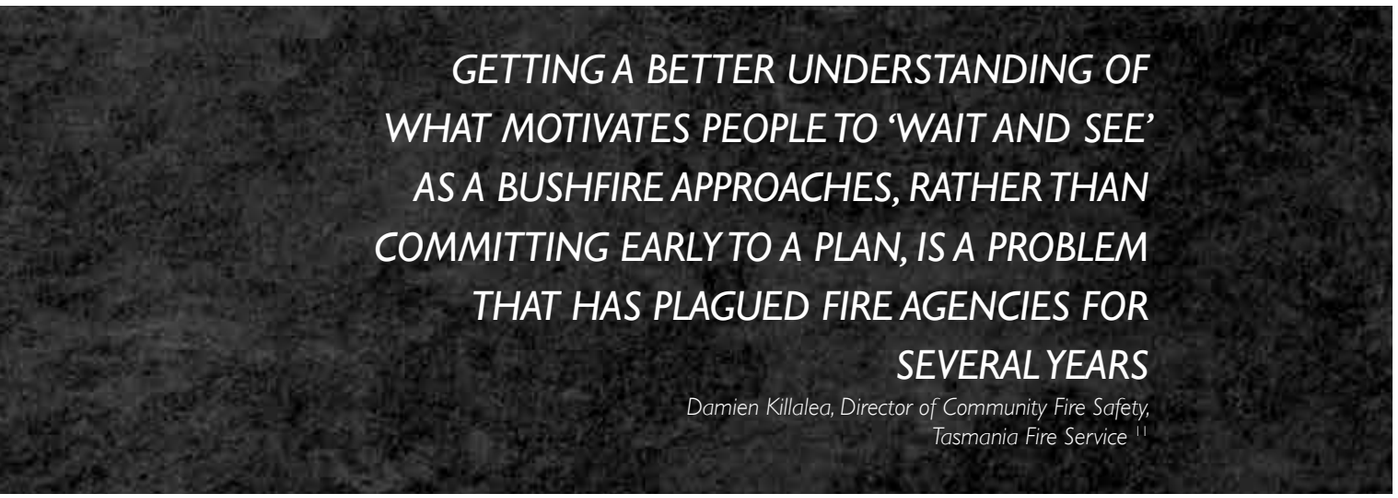

GETTING A BETTER UNDERSTANDING OF WHAT MOTIVATES PEOPLE TO 'WAIT AND SEE' AS A BUSHFIRE APPROACHES, RATHER THAN COMMITTING EARLY TO A PLAN, IS A PROBLEM THAT HAS PLAGUED FIRE AGENCIES FOR SEVERAL YEARS

Damien Killalea, Director of Community Fire Safety, Tasmania Fire Service [11]

The risks to people and property from bushfires are well known, but according to literature from the Bushfire CRC and the quarterly publication FireNote, the vast majority of residents in fire prone areas delay their decision to 'Prepare, Stay and Defend or Leave Early' until they are in immediate risk. This delay has been attributed variously to; current government policies, tool and systems, residents relying too heavily on often hard to interpret textual and live analogue radio based information streams, and an observed reliance amongst residents on emergency services to guide their decisions.

To tackle the question of whether residents' hesitation to plan can be overcome, the concept of 'community conversation' has been coupled with an accessible system for the delivery of warning information. Setting Communities Alight follows a product service system methodology, where an in-home device engages users through regular interaction, and provides a constant reminder to be prepared. The information displayed is distributed by a locally installed and maintained weather station. The provision of localised weather conditions and warning information aims to elicit a high degree of trust from community users. Supported by a smartphone application, the system facilitates conversation via a 'phone trees' logic, common in rural and peri-urban communities that live with the risk of bushfire.

User experience testing and conversation with relevant authorities has shown that by equipping communities with a system of checks and balances, alongside information that is relevant to their locality, individuals are enabled to be smarter, safer and more prepared for the risks of bushfire.

Setting Communities Alight

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For many people 'the home' acts as an anchor point in life and a safe haven from external troubles, and the concept of losing it and all it contains to natural disaster is so devastating that they avoid planning for these scenarios.

It's well established that people living in bushfire prone areas are well aware of the potential for risk, and are aware that it is their own responsibility to choose between preparing for and then staying to defend their properties, or choosing to evacuate themselves and their belongings in advance of immediate danger. Unfortunately these choices are perceived by many as being equally poor, and result in a significant number of people either delaying their choice or reconsidering options when directly confronted by fire.

Current methodologies designed to assist residents present a disconnection between the planning and execution of bushfire preparations, where the development of a bushfire plan is a complex and often abstract task of weighing up risks and often unknowable eventualities, triggers and contingencies, and in many ways may be too heavy a burden to require civilians to perform independently. These elements contribute to the indecision of at-risk people who are unable to choose between the rock and hard place that is the national 'stay or go' policy. In their execution, these plans often result in inexperienced people determining when plan triggers should occur relative to perceptions of local conditions, and in deciding on appropriate actions to take. A delay in such decisions can lead to tragic consequences but the most widespread result is that people in a period of significant stress either do not leave themselves enough time to properly evacuate their homes and leave behind important possessions, or choose to defend their homes without adequate preparation.

The aim of Setting Communities Alight is to tackle this indecision through the development of a tool to assist communities in developing social networks, where those with more experience or inclination for action are able to assist, encourage and motivate others in their area to adequately prepare themselves for bushfire. The form that this tool takes has been influenced through collaboration with relevant stakeholders, including those who have been affected by fires, those who are fortunate enough to have avoided it, and with relevant fire management agencies. This dialogue was in the form of structured interviews and user experience testing.

Through this process I have developed a product service system consisting of an in-home display that acts as a fire notification system, hidden behind an aesthetic intended to appeal to a wide audience. The information it displays is served by a locally installed weather station that is able to provide extremely localised weather information and acts as an information relay. To tie the system together a smartphone application facilitates communication between residents.

While it is important that the end users of this tool are willing to place their trust in it, their influence in its development has been limited to initial interpretations and feelings towards the idea of a community focused tool, and user testing towards completion. Co-creation was not used in the design process for the same reason that I do not want to be limited by the stipulations of the 'stay or 'go' policy, as I predicted that I would run into the same problems of indecision and insecurity plaguing the current systems that are in place.

I also propose that design thinking is an incredibly important tool in the development

of systems that assist and enable people in making and planning for decisions that have such potential to go wrong. This is where many current systems that are limited by potential for political liability fail their users by refusing to address the real world concerns and multiple realities of circumstance and situation seen in the year round effects that bushfires have on people's lives. In line with this idea, the development stage led me to develop a system that is focused on encouraging planning and preparedness. This is a large point of difference to other fire projects which are focused either specifically on providing tools for planning, or providing fire fighting and evacuation equipment.

Prior to the development of the physical components that make up the project a materials and technology study was performed. During this stage I developed a strong understanding of the techniques and processes I would be using, as well as a familiarity with the electrical components that would make everything tick. Throughout the making process I made every effort to demonstrate as many of my skills as I could, and to develop a working understanding of a

range of new ones. The development of the system involved graphic and interface work in the form of the smartphone app, digital work in the form of the coding and animations required for the in-home display, and physical model making that included 3d printing, CNC milling, timber work, vacuum forming, laser cutting and more.

My hypotheses have been validated through a combination of user experience testing in the form of surveys coupled with laddered interviews and demonstrations of prototypes. This process has indicated strong support and approval from residents, who seemed extremely eager to see new technologies that would make their lives easier and safer. The testing has also indicated that many residents have actively sought better sources of information and for better tools to enable neighbourly communication in fire events.

Conversations with the CFA have shown a recognition of the accuracy and conciseness of the project problem statement and goals. Although the project will require a significant amount of extra work before a feasible outcome can be reached, the testing has strongly indicated that it is a huge step in the right direction.

MY METHODS, PLANS AND TECHNIQUES

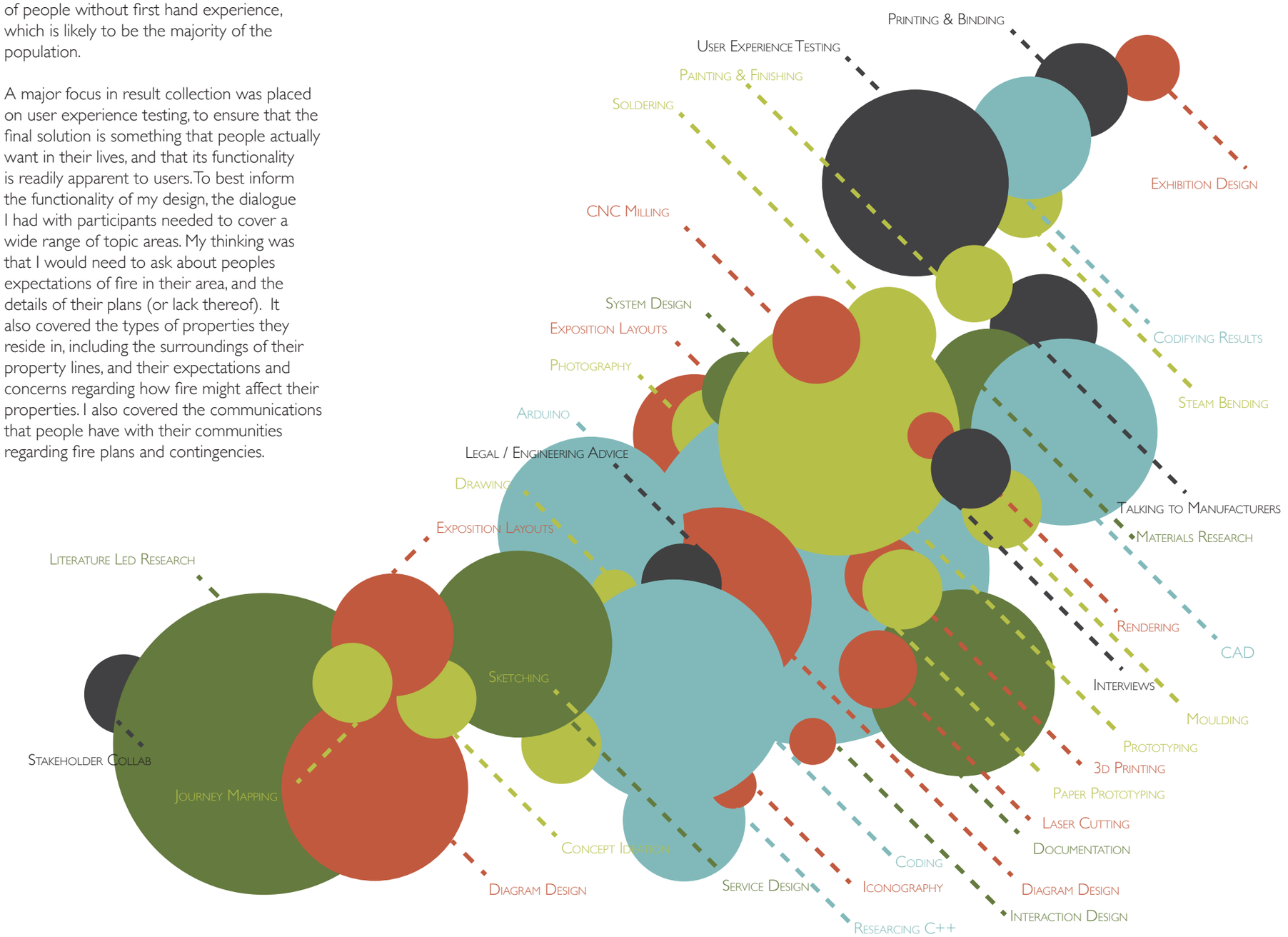
The methodology of a project is the coalescence of techniques and processes that define its undertaking. Careful consideration of its structure, and of the methods of research and design used to complete a project is probably one of the easiest ways to avoid running into roadblocks in its later stages, and to avoiding spending time on unnecessary tasks. This is especially true on projects like this, which are constrained to a rigidly fixed period of time.

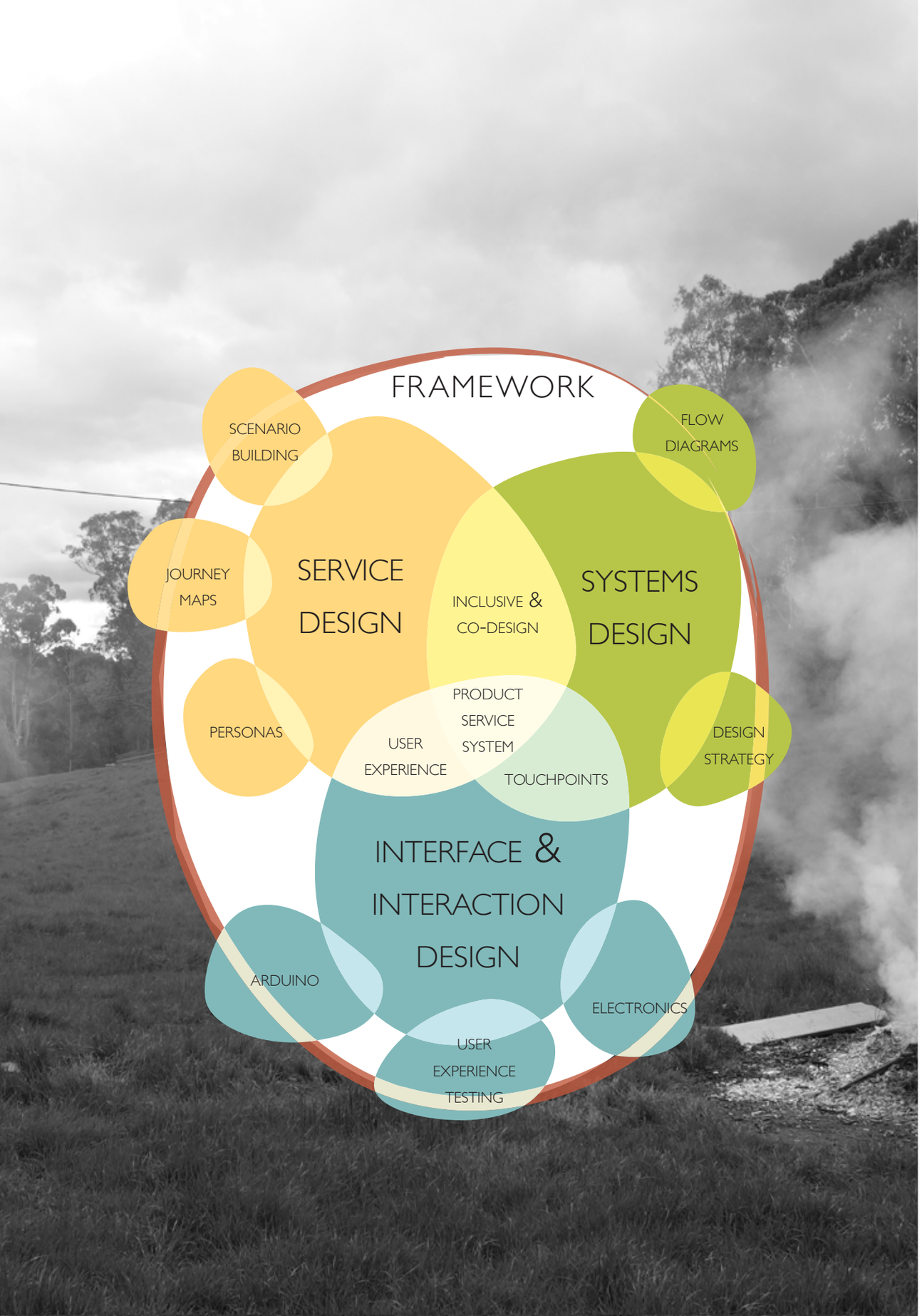
Due to the large scope and immense variety between regions at risk of fire, I opted to focus my research on data pertaining to Australian bushfire, with Victoria as my target region. This is primarily because of time constraints, but also because it is a region with a long history of fire, and which is the most likely to benefit from my research.

Setting Communities Alight required a very multifaceted approach to data collection, and required me to tread carefully through very emotional areas. Community engagement was an important aspect of the research, and required communication with people that have been through traumatic experiences. These engagements needed to be carefully structured, as I was seeking rich information from the participants regarding their actions both in defending their homes and fleeing from fires. Identification of the emotions they would have been going through was of great use to me in informing the primary functions of the design.

Structured interviews were conducted with residents of at risk areas to get an understanding of their needs and ideas. I worked with people that have not been involved in any form of fire event, and where possible, also those with some experience. This data helped inform me of opinions, thought processes, concerns, fears and plans of people without first hand experience, which is likely to be the majority of the population.

A major focus in result collection was placed on user experience testing, to ensure that the final solution is something that people actually want in their lives, and that its functionality is readily apparent to users. To best inform the functionality of my design, the dialogue I had with participants needed to cover a wide range of topic areas. My thinking was that I would need to ask about peoples expectations of fire in their area, and the details of their plans (or lack thereof). It also covered the types of properties they reside in, including the surroundings of their property lines, and their expectations and concerns regarding how fire might affect their properties. I also covered the communications that people have with their communities regarding fire plans and contingencies.





Collaboration with relevant fire agencies was also a necessity for this project, and I engaged a number of authorities on their opinions of the Stay or Go policy, and their major concerns with the actions and plans of the people in their communities. They were also happy to provide me with feedback and opinions relating to my proposal

Outside of direct communication with stakeholders, I also performed my own design investigations to map out potential problems and solutions without the emotional interference of stakeholders. By developing journey maps and service diagrams, I was able to fully map out the possibilities and likely outcomes of my design. In doing so I was able to determine the necessary functions and likely uses of the device, which prevented me from spending time implementing unnecessary details.

Both journey maps and service diagrams were useful later on in the project as a means of communicating the functions and potentials to outside observers.

Between the research and testing stages, I focused on developing and demonstrating my model making capabilities. This involved initial paper prototypes to explore forms and functions, which moved on to laser cut models where needed. Once the final form was drawn out, I took my work into CAD to create engineering drawings to build my final model against, and also to create a series of digital renders of the final product in use.

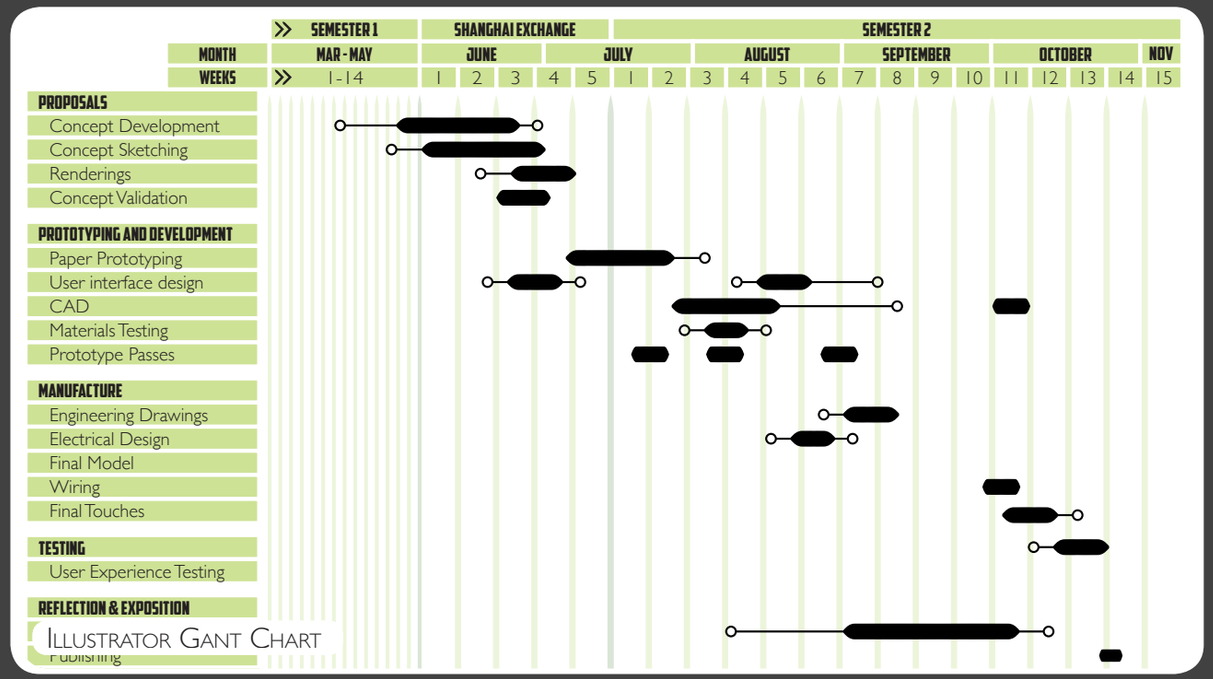
A key element of my design process is to always have the confidence to dive headfirst into problems and new techniques, and to educate myself in their use on the fly, and this mindset has proven effective once again.

PLANNING THE PROJECT

As important as the planning of the methodology, actually managing my time has been key to ensuring the project actually got done. Throughout the project I've developed a number of separate gant charts, and relied on a number of technologies to keep my notes organised.

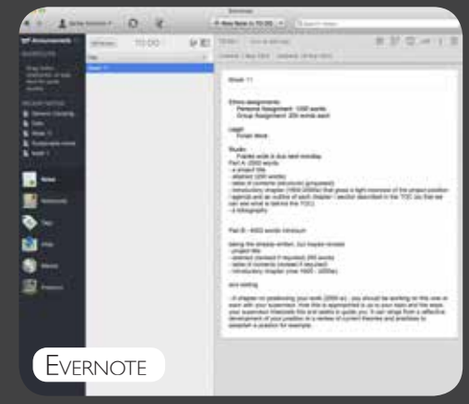
At the start, I opted to use Evernote as my primary organiser of text, as it was software I was already familiar with. On the advice of a lecturer however I opted to transfer my work over to another piece of software called VooDoo pad, which acts as a personal desktop wiki, allowing pages to link to each other and with support for all kinds of media. This worked really well for me for at least a semester, after which I moved on to another note taking application called Scrivener. This is a tool made specifically for writers, that makes it very easy to divide text into chapters, keep revisions and leave notes and keywords through all of your work.

Gant charts are my preferred time management technique. At first I was creating these charts by hand, and prettying them up in illustrator, but as the year went on and these charts started to become unweildy, I opted to move over to the software OmniPlan, which is a powerful tool for project managers to keep track of everything and everyone in a project.



ILLUSTRATOR GANT CHART

OMNIPLAN GANT CHART


EVERNOTE


VOODOOPAD


SCRIVENER

Laddered Interviews

Laddered interviews need to be both carefully planned in advance, and also allow for unexpected responses. The idea is to use the interview questions and responses to inform further questions, and to lead the participant to provide otherwise difficult to obtain information. The objective here is not to influence the responses, but rather to guide the participant in directions that the researcher needs to better understand. This does mean that the information gleaned from each interview may be quite varied, which will make coding results difficult but will also provide a wider range of ideas.
This method will be particularly useful for this project as interview participants are likely to be harboring strong emotions related to prior experience with fires, and the interview structure will need to be able to both work with, and around these emotions

Surveys

In contrast to the laddered interviews, surveys will produce very specific data, and can be easily distributed to a large number of participants.
This data can be easily used to determine the consensus of public opinions, and with carefully crafted questions can inform the researcher of issues and opinions that may not have occurred to them.
Every question in a survey is incredibly important, and must be carefully thought through. The researcher must consider both how the reader will interpret and respond to the questions, but also how this information will later be mapped and analysed

System / Service Diagrams

System and service diagrams will be used in two ways in this project. The first will be early on, to allow myself to explore possible uses, with the intention of finding extraneous details and isolating important and oft used functions.

The second use will be for later in the year, where refined journey maps will be used in presentations to assist in informing viewers of the intended functions of the tool

Paper Prototyping

Paper prototyping is a quick means of generating working models for testing, and will best allow me to visualise my concepts in a physical form.

These prototypes could be either 3d models of devices, or just scenario cards to simulate circumstances under which the device might be used

Arduino

Arduino boards are small circuit boards that serve as a central device for all sorts of extras, such as led lights, sensors, input devices, displays and power sources. Its operator is also able to upload code to the Arduino, which controls everything that goes on. These devices serve as a great tool for prototyping electronics.

I go into greater detail on the potential uses of Arduino's later on page 68

User Experience Testing

Due to the nature of this project, which aims to develop a product the user will develop a high level of trust in, testing its interface with actual users will be incredibly important. Through the use of paper prototypes and system diagrams, I will work with stakeholders in testing the experience and flow of the interface designs.

The idea here is to conduct multiple tests, which each iteration informing future prototypes, until a final structure, form and system flow is decided on. These tests will also act as a major source of results for testing the final result against the hypothesis

Journey Maps

Journey maps will be used after conducting interviews, to map out the ways that people either prepare their homes for evac, and then where they go, or preparing their homes for defense, and how this defence is conducted. This information will allow me to see the scope of possibilities, which can be programmed into the design, and used in communication with end users

A COUNTRY ON FIRE, IN NEED OF HELP

Bushfires have been a fact of life in Australia for it's entire history, and as a result we live in a country populated by flora and fauna that not only survive in these conditions, but often thrive on, or even rely on these extreme events to survive. [18]

It is widely believed that the Aboriginal people of Australia have conducted their own burn offs of vast swathes of land since their settlement here some 50,000 years ago as a means of encouraging agricultural growth, clearing difficult to traverse land, and to prevent larger naturally occurring fires. [26]

"Bushfires are a natural part of ecosystem processes in Australia. However, as human settlements expand into or adjacent to bushland areas, the risk to lives and property increases." [17]

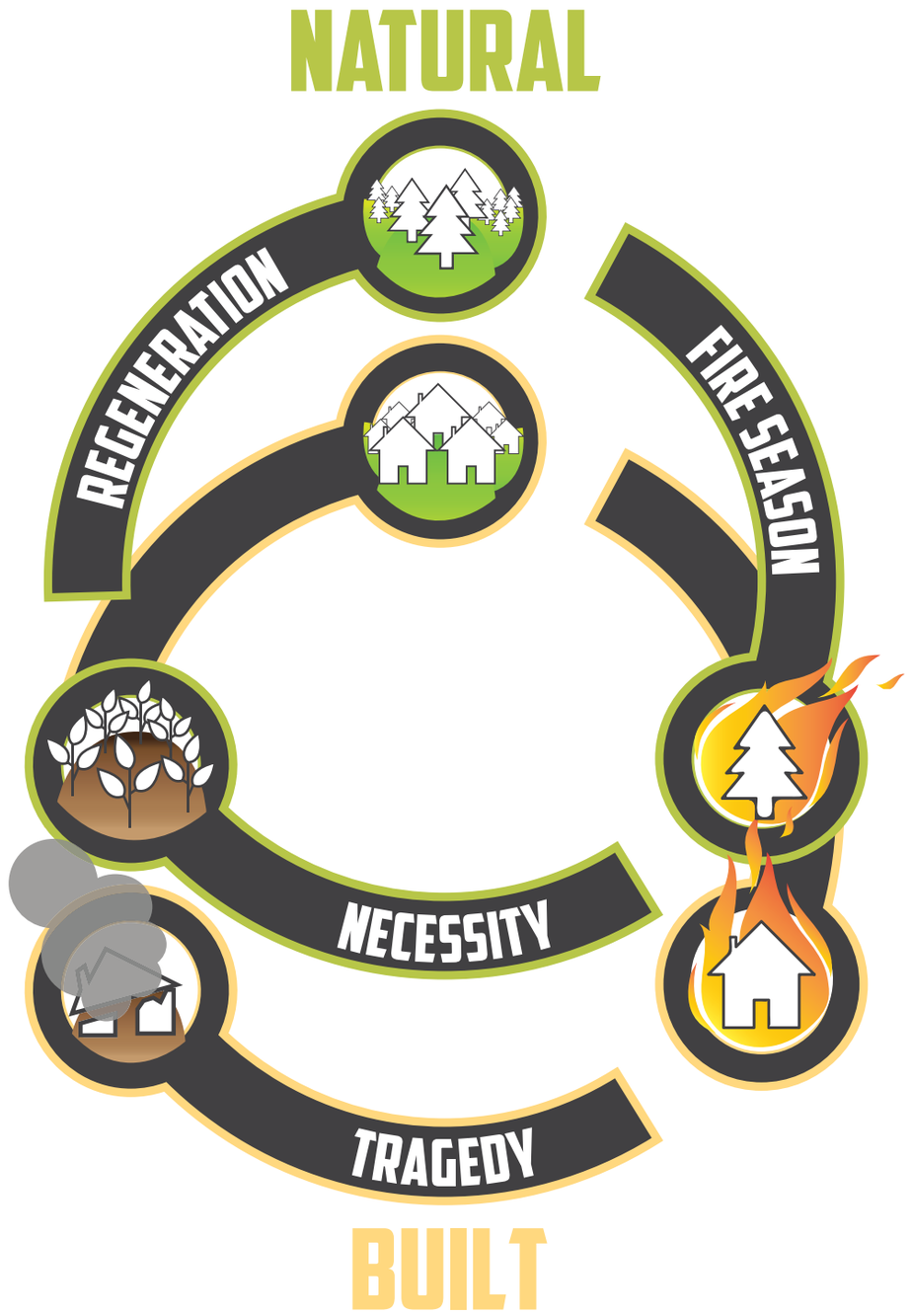
While this theory has come under some doubt through the study of charcoal samples in the Australasian region, [27] there is no doubt that the massive reduction in the number of fires in Australia, a result of Aboriginal peoples moving away from nomadic lifestyles, has meant that the less frequent fires have been much more intense because of the now common excess of natural fuels. [28 | 34]

There are strong arguments [32 | 34] that many examples of bushfire tragedy could have been mitigated or prevented if there was a greater degree of focus on prescribed burn-offs of fuel. As an example of this, the 2003 Canberra bushfires incurred personal insurance costs of $257,000,000, but could have been prevented with burn-offs that would have cost an estimated $100,000[31.] In the period from 1851-2009 bushfires have caused 815 recorded human fatalities, 9,946 injuries, affected 1,311,050 people, and made 31,942 homeless, with a total estimated cost of $1,673,697,366 (although these figures do not include the results of, or any fires since the 2009 black saturday fires, known to be a great Australian tragedy, and are only representative of personal costs, and do not include the hidden costs of firefighting, infrastructure damage, mental health issues and loss of life).[17] In 2009, the Black Saturday fires raged throughout Victoria, and served as a horrific reminder of the potential for damage that bushfire presents.

The previous record for the Forest Fire Danger Index was broken by such an extent that it was revised and the category "Catastrophic" or "Code Red" was added.[20]

With the current trend in Australia of building our cities out rather than up, more and more people are purchasing properties in what are called peri-urban areas [14]. These areas are defined as having a 'wildland urban interface', which is to say that the homes of many residents are in direct contact with entirely natural bushland. In 2013 there were almost 95000 people that moved to areas of regional Melbourne [30], and many of these people will have come from urban areas with little to no experience of bushfire [14].

Because of this, there is going to be a statistical increase in the number of people affected by bushfires every year, and even with a national effort to mitigate bushfire risk, unexpected fires will continue to occur. These communities and the people that live in them will need to be prepared for the worst.



Climate change is now a well and truly established fact, and one that will have major impacts on the frequency and severity of bushfires in Australia. It is not a major focus area of this project, but it is important to highlight it to stress the importance of bushfire preparedness as a result of the effects it will have on the future of bushfires in Australia

Upon being set-up, the Australian Climate Council decided that its first publication would be a report specifically focused on the impacts of climate change towards bushfire risk. It painted a very bleak picture, showing that current trends and predictions are leading to an increase in the number of high risk fire days; a result of hotter days, longer heatwaves and subsequently dryer conditions.

Over the past year, (2013) record breaking temperatures have been experienced across the country. More than 120 weather records were broken last summer, including the hottest summer, the hottest January, and the hottest day. [20]

To compound these issues, climate change is predicted to have a great effect on future fires, and it is well understood that its negative effects on the frequency and ferocity of fires will be ongoing. [20] According to the Bushfire CRC:

"Climate change is increasing the frequency and severity of very hot days and driving up the likelihood of very high fire danger weather" [20]

These increases are going to have far wider reaching impacts than the small numerical increases in global temperature would indicate. For example; it's predicted that the Sydney region will need to increase it's efforts of bushfire mitigation by 3-5 times to keep up with the increased fire activity. Longer fire periods will mean less time for bushfire mitigation efforts. The number of days with a fire danger rating of catastrophic will increase (whereas they were almost non existent only 30 years ago). [20 | 34]

Increases in global temperature, and a subsequent increase in hot dry days, is also going to have an impact on fire fuel loads nationwide, as quantities of leaf litter and dehydrated flora will continue to rise. This, compounded by windier days will mean that fires are more likely to begin, and when they do they will burn hotter and spread faster than ever observed before. [19]

All of these effects, and more that cannot be predicted, will mean that the risk of, and damage caused by bushfires is going to get worse and worse in coming years. Global efforts to reduce emissions will help, but only to slow these increases. [20] In this situation of knowing that things are going to get worse, it's only sensible to be taking increased measures in educating the population, and helping them deal with these increasingly risky circumstances.

Australian policy regarding bushfire management is internationally unique in the fact that it not only allows people to defend their own homes, but also requires that they make this decision on their own terms. The essence of this policy is well expressed by its title; 'Prepare, Stay and Defend or Leave Early', and is described by the state as "advice" about a fundamental choice that people should make about where to be when a fire occurs [33]. This policy, colloquially know as the 'Stay or Go' policy, has come under intense scrutiny following the large number of deaths of people in their homes during the 2009 Black Saturday fires, but is unlikely to change in coming years [24|33]

The Fine Print

A central tenet of this policy is that all properties can be effectively defended in the event of bushfire with adequate preparation, and that residents need to decide in advance whether they will prepare their property with the intention of defending, or leave well in advance of risk. The policy specifically does not make mention of the possibility that either direction may fail, and does not go into any detail regarding contingency plans [33]. A major criticism of the policy is that CFA personnel are specifically forbidden from advising residents that their home is anything other than defensible, and are not permitted to inform residents of whether they should choose to stay or go [33]. The idea that all homes are defensible is one that many have been critical of, with some pointing to the fact that prior to the policies introduction CFA regulations often led management staff to inform people that their homes were very unlikely to be defensible, if not impossible to defend under some circumstances [33]. Previous CFA policy also recognised that bushfires are often unpredictable, and that unusual changes in wind, temperature, and many other elements can quickly take the defense of a property from being under control to uncontrollable [33]. Reviews of the Black Saturday fires have shown that many of those who died defending their homes had not prepared to the extent that would be recommended by the CFA [33]

One Plan For Many People

Bushfire planning advisement is well advertised in at risk areas, and it is safe to assume that all of these residents are well aware of the potential risks of living in these areas. The major problems faced by fire fighting agencies here though are that people delay their decisions, and do not adequately prepare or plan for these disaster events [33|11].

The devastation caused by bushfires is well documented. It is known that the success of an individual or household bushfire survival plan relates to the preparatory actions undertaken prior to a fire season. [9]

Ethnography seems to play a large role in the decision making process, with studies showing that gender, age, risk perception, experience, community and family relationships, attitude towards the stay or go policy, and expectations of obstacles all affect the actions taken by at risk residents. [2|9|11] Most current training and education programs are intended for all target audiences, but habitually tend to focus on the activities usually undertaken by men [2]. It has been widely observed that women in households perform different, and complimentary preparatory actions to men, but these duties are rarely covered by training programs, and many women feel that they do not have adequate knowledge in the face

of bushfire threats. It has also been observed that women tend to act much more passively, and often rely on specific instruction before making the decision to leave [2].

Similarly, those with special needs are often left without tailored advice. In one study focused specifically on the actions taken by those with disabilities or other impairments or special needs, it was observed that those who had experienced fires before lived on properties that were well prepared, and had well formulated (but often unwritten) plans. Many of those without this perception of risk though had no form of plan in place, very little in the way of property preparation, and were in-fact often unaware of the policy requiring residents to make their own decision to stay or go[1]. A major problem seen throughout at risk communities is that many people have some form of a plan, and often stick to that plan, but rarely do so in a timely manner [11]. These plans are often considered by fire management officials as inadequate though, and rarely involve even basic contingencies [33]. A substantial number of people in at risk areas delay their decision to defend or evacuate until the day of the fire, which is problematic for many reasons, but primarily because they tend to be less prepared for either decision than those with a pre-meditated plan [11].

Residents reported a high level of awareness of bushfire risk, but less than half had prepared for a possible fire. Most had thought about what they would do in case of a bushfire, and acted accordingly. [3]

Tough Choices

Those who choose to leave in this situation are putting themselves at great and unnecessary risk, with the chance of tragedy occurring increasing the longer they delay their choice [11]. They are also less able to evacuate in a sensible manner, without allowing themselves time to collect their important belongings and prepare for insurance claims. Those who choose to defend their homes without proper preparation are putting themselves and their dependents at great risk.

People might delay their decision as a means of avoiding responsibility for any negative outcomes resulting from their decision, such as their house burning down as a result of having chosen to evacuate. This is because outcomes resulting from a decision lead to greater perceived responsibility compared with outcomes resulting from decision avoidance. [11]

This happens for a number of reasons; Many maintain the mindset that emergency services will either knock on their doors and tell them its time to leave, or even that they will rescue them if their house ignites [3]. Others find the choice between staying or going impossible, and cannot decide on which is the lesser of two evils [11]. Residents that consider themselves responsible for their own safety are more likely to conduct prior preparations, and those that were more inclined to expect that they could rely on an official warning were generally less likely to carry out preparatory actions [9]

Making Plans

Many people have trouble defining action triggers in their plans, which is a result of a lack of confidence in developing well defined plans with detailed contingencies, which are themselves hard to develop because there are so many "what if's" involved. They then have trouble identifying, or again lack the confidence to identify the triggers that define when it is time to act. [11]

only about 40 per cent of residents in fire prone areas across the nation have a well-constructed fire plan. [34]

From both legal and ethical standpoints, bushfires are incredibly problematic as fear of legal liability may hinder decision makers and individuals [16]. Fear of litigation is likely to be impeding decision making at all stages of the "prevent, prepare, respond and recover" cycles of bushfire management [16]. Thankfully, this fear is mostly contained in advisement prior to fires, rather than in actual exercises of duty in emergency situations.

To make things more difficult however, it is presumed that providing the public with an excess of warnings, updates and advisement throughout the year will result in a higher than appropriate level of expectation from the public in emergency situations. Conversely, not providing enough information will go unnoticed by the public until the actual event of fire, where emergency organisations are likely to be held more accountable [15].

Following a large fire in WA in 2011, the bushfire CRC conducted a survey of residents, which produced some of the following results; [3]

- Most residents interviewed had received FESA bushfire safety and preparedness material in the post from the Waroona shire; however many confessed they had not studied it.
- There was a high level of awareness of bushfire risk in the community – but few personalised the risk; less than half indicated that they had made any preparations for a possible bushfire.
- For many residents, their initial response to evidence of the emerging bushfire threat was to 'wait and see' what developed; some drove towards the smoke plume to see for themselves whether or not the fire seemed likely to pose a real threat.
- Visual cues of the approaching fire such as smoke, embers or flames were particularly important in the decision making process of residents
- Few residents reported that official warnings (radio, sms alerts, tv) were an important factor in their decisions about what to do.
- Practical assistance from family and friends, and information on the location of the fire were seen as key factors impacting on survival.
- Many residents' understandings of what constituted leaving safely in the event of bushfire – for example, "when we saw the flames" – was very different from the definition of leaving safely of the FESA community engagement staff.

Use of the word community is being increasingly seen in international emergency management programs, which are shifting their focus towards the empowerment of individuals [5]. The definition of the word community is extremely broad in these contexts though, and is often used to represent a wide range of meanings in any given document. Some examples of its definition are that a community is a locality, or that community is a shared sense of belonging, or is a form of social network [5]. These meanings are all correct, and all relevant in particular use, but considering the importance placed on the idea of community in these management plans, it is important to ensure that the reader is properly aware of the intended definition.

The community as a social network is an area with a lot of potential in bushfire management, as communication between residents can ensure that people are not left in the dark about these stressful situations [7]. Dr Yoko Akama's 'Social Network Study' was focused on mapping out and analysing community reliance networks of individuals in a township in Tasmania. Through this study, she determined that certain individuals naturally took on a central role in helping those that wanted help. There were also those that were specifically not interested in help, and made a point of avoiding any conversation regarding their plans with others in the community, which proved to be a concern for others. [7]

Social networks are dynamic connections between people. These relationships are significant in helping communities and individuals cope with unexpected events, such as natural disasters. [7]

In particular, it seemed that those in the community with special needs, or lower degrees of independence were more likely to have developed a strong support network [7]. These social networks operate in complex ways, and there is mounting evidence that critical information is regularly passed between individuals such as family, friends and neighbours [7]. These interactions are important in creating opportunities for residents to explore risks and concerns, and can lead them to take collective actions to address common issues [7].

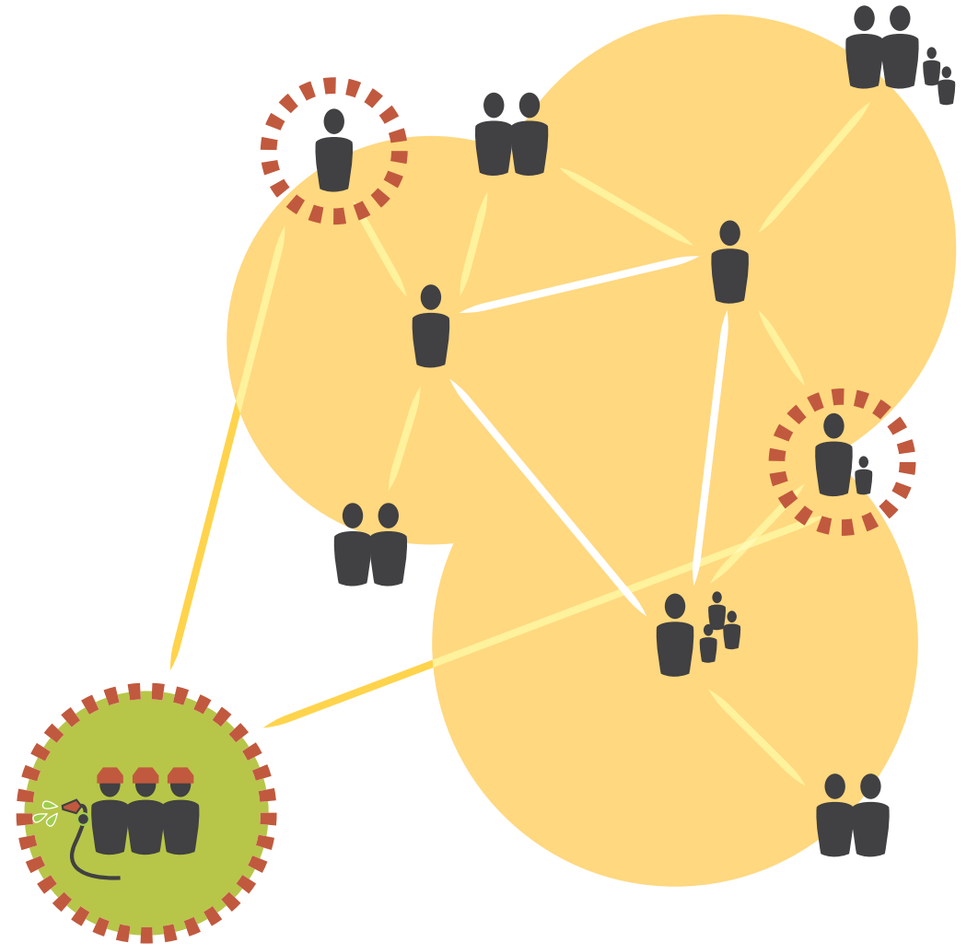
There has been an increasing number of community education programs aimed at increasing awareness, preparedness and self reliance in high bushfire risk areas [4], but whether the program 'works' is entirely dependent on the context of the training, and the public perceptions of risk and environment [4].

Fire and land management agencies have long recognised that there must be a 'shared' responsibility in preparing for and responding to bushfires. While the agencies have their most obvious roles to play in the management of fire, well-informed and well-prepared individuals and communities offer a vital way to minimise harm to people and property. [4]

Traditionally these programs have been based on the assumption that providing people with information on how to prepare and defend themselves will result in them adopting these measures [8]. People living in high bushfire risk areas have demonstrated a reluctance in integrating the content of these education programs into their own fire plans when these measures are communicated through passive, information based media [8].

Strategies for unlocking and realising the full value of social networks are under-explored and poorly understood.[7]

Problematically, measurements of the success of these programs is often based entirely on direct metrics, such as attendance, and the number of meetings held, rather than being based on the actual outcomes of the training [4]. With the growing focus on community self reliance in bushfire management, it is important that the evaluations of their performance focus more on the ways that participants implement this training into their lives, and how they then share this information with others in their communities.



WHO ARE THE STAKEHOLDERS?

CFA
The Country Fire Authority is the fire service that provides service to all country areas and regional communities in Victoria. Its members are primarily made up of volunteers, and they are the first point of contact in reporting local fires. The CFA has a direct interest in improving the action plans of their wards, as knowledge of who is and is not prepared in the event of a fire will surely make their duties easier to perform.

Insurance Agencies
House and contents insurance is extremely important in at risk areas, and as such, any reduction in the number of claims made by residents will benefit both the insurance agencies, and help to lower premiums for their clients. Because of this, many agencies are involved in the marketing and implementation of bushfire prevention measures.

Local Councils
The local councils of regional Victoria are elected by their residents, and have a huge impact on the attitudes of their localities. Development of a project that empowers community action outside of the 'Stay or Go' policy will need to have the support of these councils, and should be constructed around ensuring that it meets their advise and needs.

Residents
The residents of at risk areas are the primary stakeholders of this project. Although it is simple to bring them all together under one label, the reality is that there are a plethora of different groups, needs and circumstances to satisfy. This project is aimed specifically in changing the mindset's and actions of residents, and any reduction in loss of life and property is a win for them all.

The opinions of users on the form and functions of my project will make or break its usefulness to them. Alongside this, it's crucial that they view it as something they can place their trust in, and are able to make sense of.

Ambulance Services
By developing a stronger system to ensure that all residents make choices appropriate to their individual circumstances, and that they are not putting themselves in a position of risk is of clear benefit to Victoria's already overworked ambulance, medical and search and rescue services.

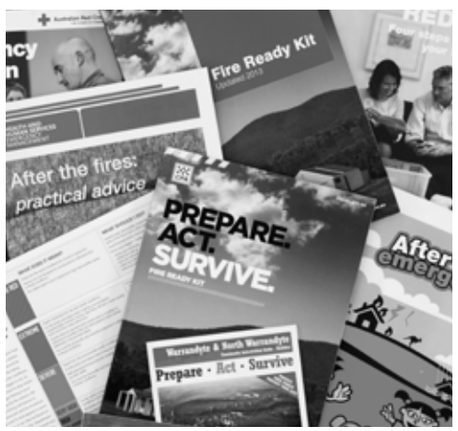
BUSHFIRE AND THE LAW

Sitting alongside bushfire policy are the laws that are used to determine actions and conversely the penalties for inaction. Bushfires are a tricky area here, as the law is usually only ever brought into question in events of great or tragic loss. Because of this, those in positions of responsibility have to be well aware that their advise and actions have huge potential for scrutiny. Likewise, residents in at risk areas need to be aware of what is reasonable to expect, and what duties fire agencies are actually required to fulfill [15]. They must also understand the limits of the law as it applies to planning and emergencies [15].

Conflicting legal requirements, and fear of litigation, may impede decision making at all stages of the "prevent, prepare, respond and recover" cycle of hazard management. [16]

In light of the abnormally strong and frequent fires over the last few years, media attention has increased, and so has its scope. This has resulted in a larger percentage of the population following and scrutinising every trend in fire news, even those that live in areas with zero risk of fire [15]. Because of this, residents of at risk communities are more reliant on the media for their warnings and updates (a role they are not required to perform). This poses the problem of some people becoming so reliant on these messages that in the event of a small, unreported fire, they may be complacent in checking more conventional fire notices.

Alongside the increased frequency of claims, the number and type of defendants has also grown. Cases were originally brought against landowners for negligence in starting or failing to contain fires. In 1977 actions were commenced against electrical authorities. In 1995 fire and land management agencies first appeared as defendants [16]



Smoke Alarms

Legislation requires all homes in Australia to be fitted with smoke alarms, which detect smoke through a variety of means depending on how modern they are. They serve to warn home owners only of fires within their own homes, and are better known by many people as a nuisance that triggers whenever they cook toast. Based on one study[25] less than 1 in 20 people properly maintain their smoke alarms, and many people choose to intentionally disable or remove them to avoid the aforementioned toast issue.

Planning Kits

There are a huge number of publications available for free to people that cover wide range of topics, from how to make a plan, what to do after a fire, advise for the elderly and disabled, easy to understand guides for children and guides on how to seek help or insurance. While easily available, I suspect that many people shy away from or only breeze through these guides as they are often extremely text heavy and can sometimes be quite technical

FireReady - Smartphone App

The FireReady smartphone application was developed by the Victorian government to serve as a central access point to warnings sent out by the MFB, the CFA and the DEPI. It also allows users to set up watch zones that they want alerts for, and gives access to a google maps overlay that all current warnings and messages statewide

Posters & Public Advertising

The Victorian government releases a range of new poster based advertisements on a regular basis, which often have effective slogans and clever photography to serve as a reminder to their audience. While effective, posters that people don't want to see are easily ignored, and often get left in the sun or rain for overly extended periods of time.

FM/AM Radio

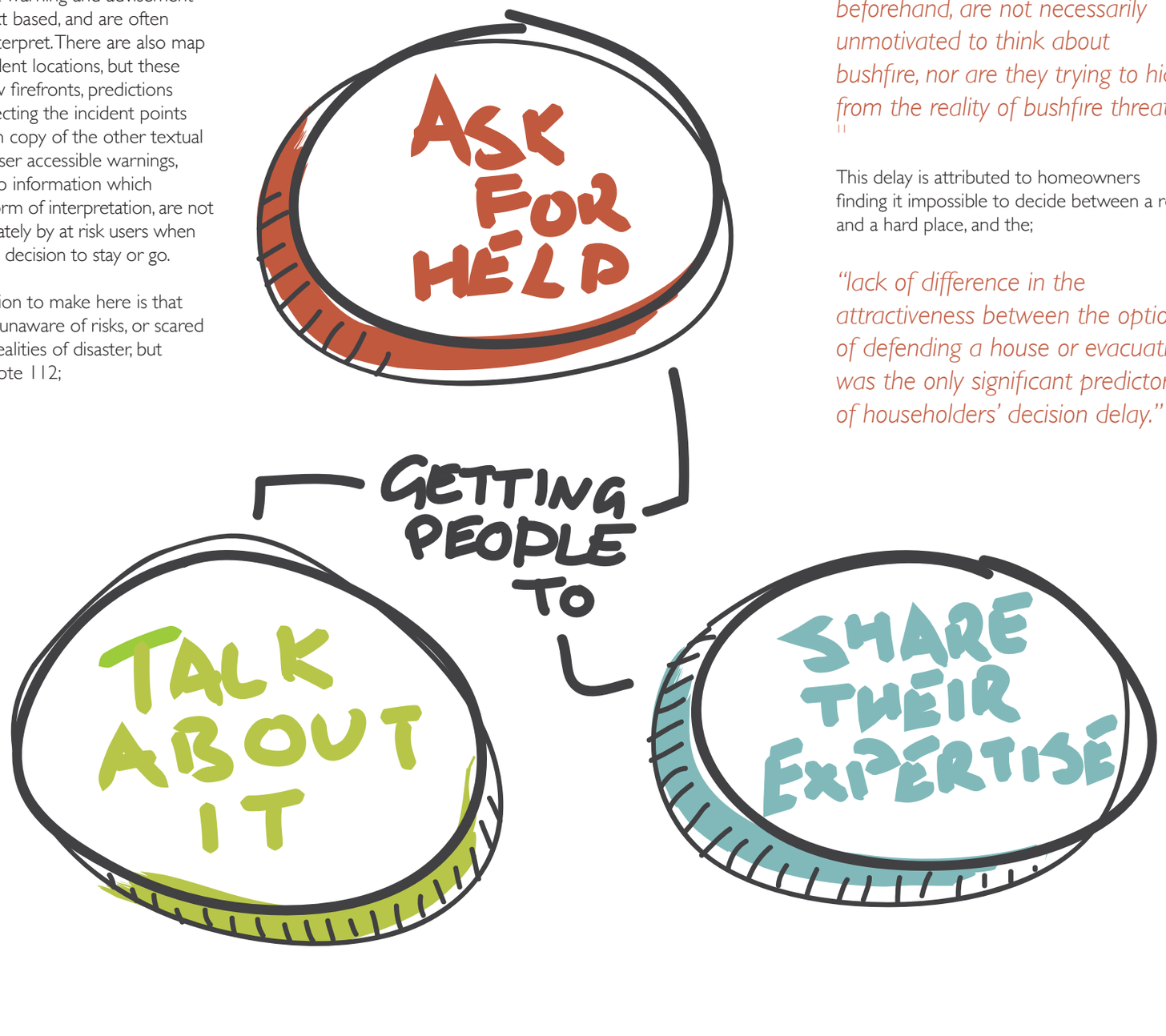
Many regional communities reserve an AM channel specifically for use in emergency incidents, and advertise as such allong their main roads. FM/AM radio is usefull for many people as it is easily accessible while driving, and is not affected by smoke from fires to the same extent as many more modern technologies.

Community Meetings

Meetings for the public are often organised by community groups, and are focussed on whatever is deemed necessary by their organisers. In many cases they are postponed throughout the winter, and are most active in the spring time build up to the fire season. These meetings are a fantastic source of knowledge and advice, but only work for those who choose to attend them.

Bushfire advisement policy is rife with ethical and legal problems, as it requires policy makers to advise people in potentially deadly situations. Current warning and advisement systems are all text based, and are often very difficult to interpret. There are also map overlays with incident locations, but these maps do not show firefronts, predictions or advice, and selecting the incident points brings up a carbon copy of the other textual messages. These user accessible warnings, alongside the radio information which requires its own form of interpretation, are not accessed appropriately by at risk users when trying to make the decision to stay or go.

The easy assumption to make here is that people are either unaware of risks, or scared to face the grim realities of disaster, but according to firenote 112;



"householders who delay their decision about either defending their home, or evacuating beforehand, are not necessarily unmotivated to think about bushfire, nor are they trying to hide from the reality of bushfire threat." [11]

This delay is attributed to homeowners finding it impossible to decide between a rock and a hard place, and the;

"lack of difference in the attractiveness between the options of defending a house or evacuating was the only significant predictor of householders' decision delay." [11]

These stresses are unduly brought on by the well intentioned 'Stay or Go' policy, which mandates that civilians are required to make their own decision ahead of time to either risk their life in defence of their homes, or to flee and potentially lose many of their worldly possessions. The reality of course is that bushfires are by their very nature destructive, and it is being left entirely up to each individual to take their own actions to mitigate their losses, and to determine the risks they are willing to take.

Many people in at risk communities are not self reliant in bushfire situations, and rely on the assistance of friends, family and neighbours both in preparing in advance, and in helping them identify plan triggers. There are many people that have a hard time identifying when it is time to leave, with many waiting in their homes for a phone call or a knock on the door from someone there to specifically tell them its time to go. Although evacuation notices are issued, there is no guarantee that they will be, or that people will receive them.

A major caveat of the 'Stay or Go' policy is that emergency personnel and specialists are required to withhold their opinions and advice from residents, and are not allowed to inform residents if they believe that a home will be particularly difficult if not impossible to defend.

Because of this, it's up to the community to regulate and manage itself. This is already being seen in the form of impromptu neighbourly social networks. Many people let each other know if they feel that they will need help in the event of a fire, and share the responsibility of property preparation. Others set up systems whereby they communicate with each other in 'phone trees' to let others know what is going on, and to let others

know if they're leaving. While these networks are a great start, there are still many that are either socially reclusive, or shy away from bushfire conversation. The reasons for this are still unknown, but are reasons that need to be addressed. On top of this there are surely large communities of people that do not have networks as strong as those studied.

There is currently nothing to assist people in making these connections available other than general advise to do so given in training programs. With the current position of Australian policy, there really needs to be an easily accessible and simple to use medium to facilitate community coordination and assistance.

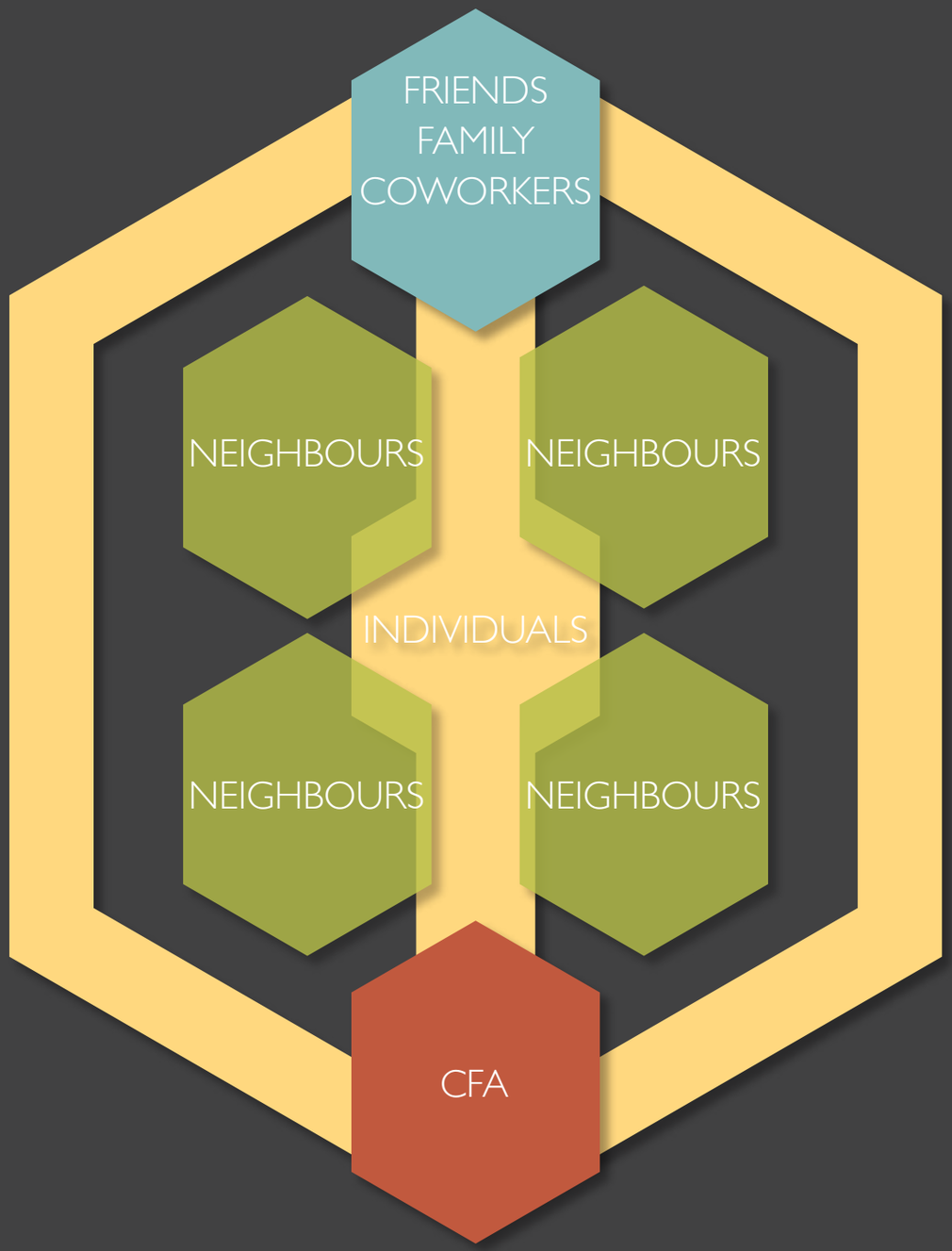
This area is a perfect fit for design intervention, as the media currently available shows what happens when policy makers are put in charge of developing tools that require a strong emotional connection to users. Through stakeholder interactions, and an in-depth study of user needs and wants, there is room to develop a tool for communities to use and develop a trust and reliance on. The ultimate goal of this project is to help people to both decide between staying or going in the event of a bushfire well in advance of such an event, and to then assist them in preparing for, and then enacting this plan.

This set of criteria is likely to result in a tool of some sort to be used by residents of at risk and bushfire prone areas as a central source of information. One of the most apparent needs in this area is for an increase in community communication in these events, and so I will be focusing on allowing residents to communicate either through data collection and display, or through direct neighborly conversation. The data collection aspect will be particularly useful to fire fighting agencies in extreme weather events as a means of determining the movements, actions and choices being made by those in their communities.

Working in line with the 'Stay or Go' policy, this tool will not directly make the choice for the users, but rather remind them and assist them in making their decision, and to act as a trigger for their plans. In order to function properly, it will need to develop a relationship of trust with the user, which will be accomplished through an aesthetic of authority, and through user/device interactions in times outside of emergencies.

Although this project will not aid in the prevention of bushfires, it may be able to help people make better and more adequate preparations for bushfires, and assist in getting those who choose to leave to do so in a timely and safe manner. The impacts this can have are diverse, and will include a lower loss of life, reduced mental health issues following disasters and a marked reduction in the loss of property and possessions. All of these benefits are morally beneficial, but perhaps more importantly they will reduce the economic strain of these disasters on the Australian people, their companies and their government. The costs associated with natural disasters are huge, and the public huge amounts of money. By lowering the risks of bushfires, and providing a central data collection point for household plans and actions people can expect to see a reduction in the costs of caused by fire.

For all these reasons and more, better prepared citizens is a goal that I'm striving for.



THE PREDICAMENT OF CHOICE

The choice between 'Staying' or 'Going' is easy to perceive as a genuine Catch 22. Beyond all the preparatory actions required by either choice, each presents potential for enormous loss.

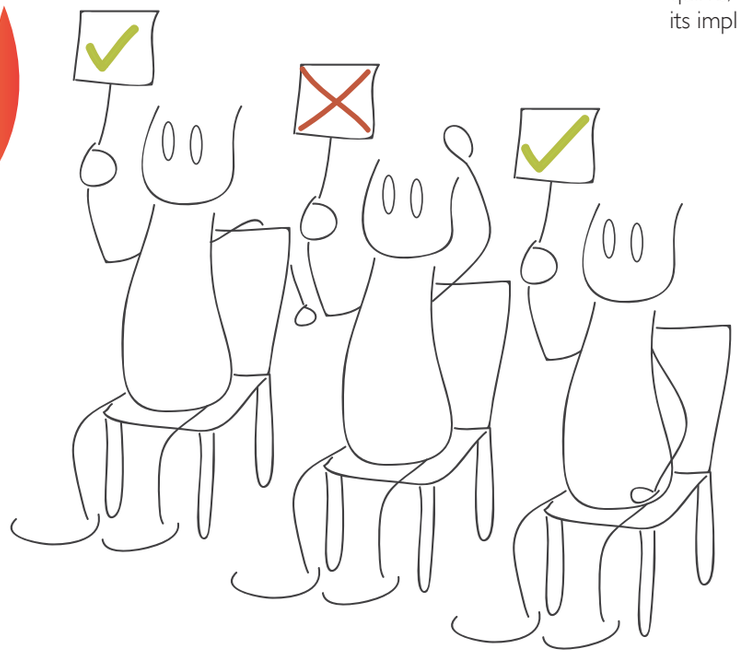
Choosing to stay presents the risk of failure, and death of the most gruesome sort. It can also become a very complicated choice when there is family involved, who you may have to organise an evacuation plan for anyway.
The choice to leave on the other hand, means making the choice of when to leave. Do you leave whenever the fire danger rating is sitting on catastrophic, which is likely to mean leaving multiple times every year? Do you leave only when fire is perceived to be somewhere nearby? Or do you wait until you are 100% sure that fire will reach your home. On top of this, evacuation means leaving things behind, which means making the tough choice of what to keep, and what to leave to the ravages of fire.

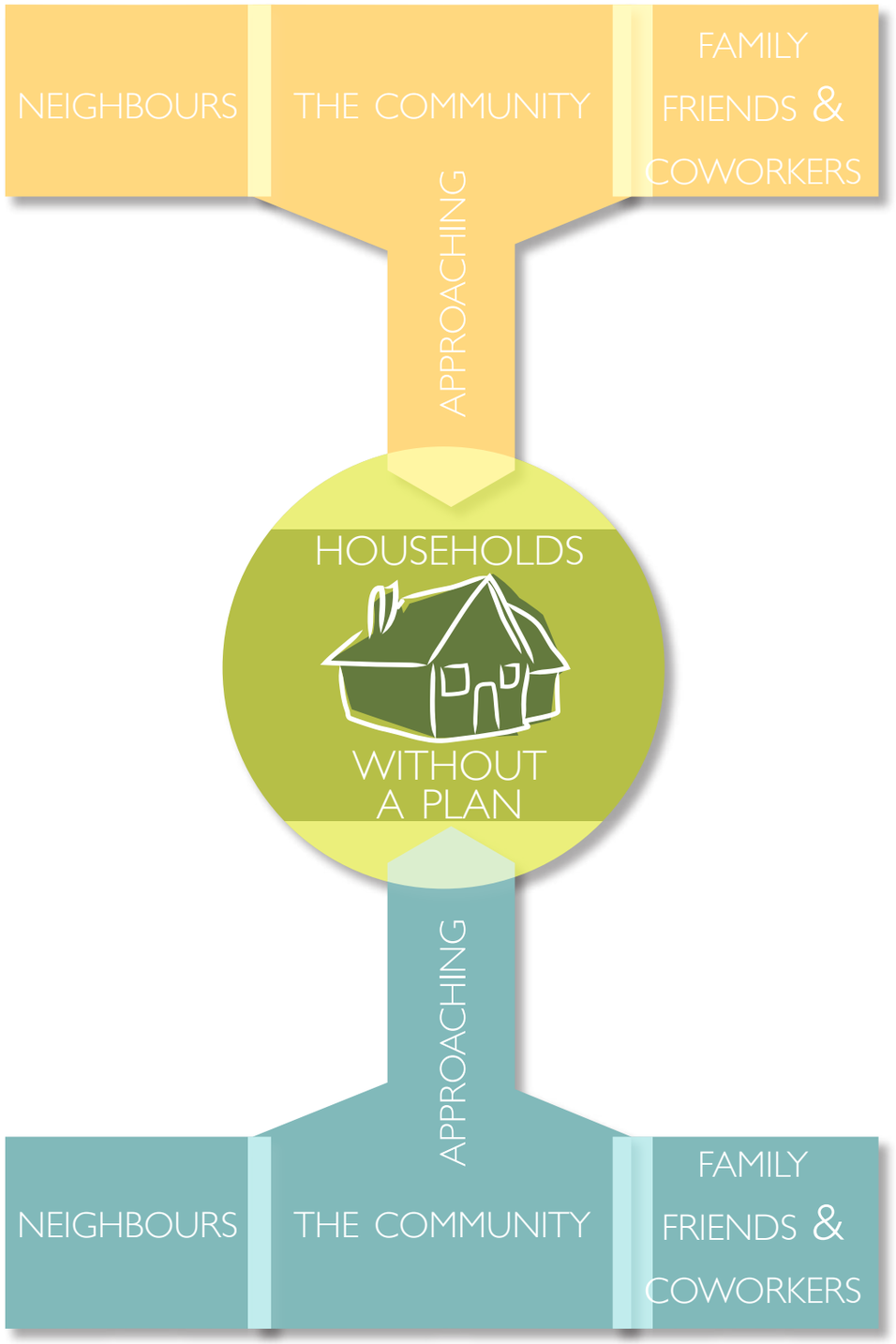
This choice is both incredibly difficult, and very personal. It is also one that can easily be allowed to continue to roll around ones mind all the way up its execution. If you are choosing to defend, do you have a limit on fire intensity before changing your mind? if you are choosing to stay, is there a fire small enough to make you consider fighting it instead?

AND HOW TO REINFORCE IT

It's crucial that there is some mechanism for solidarity in decisions as big as this. The usual means for achieving this is through the development of a well thought out fire plan. The development of such a plan is something I suspect acts as a major contributor to the delays and indecision seen in the population. Its a process that could certainly be made easier through collaboration with other people who provide their own expertise and guidance in key areas of the plan making process. These decisions and plans should also be something to be shared within the community. Doing so would add a level of finality and recognition that is impossible to achieve through internalisation of ideas.

Enabling local groups to take hold of the reigns in these situations will allow for the implementation of community developed rules. In order to engender trust in the idea of community centered plan making, regional quirks, habits and mindsets should influence its implementation and modes of conduct.





Solutions to these problems can be reasonably split between designing a tool for individuals to use on their own terms, or designing a tool that engages a community as a whole. Both of these directions come with strong arguments for and against.

A personal tool can be just that, a tool that it's user can develop a specific bond with. Trust should also be easier to achieve, both through bonding, and through regular use. Unfortunately though, it relies on individuals actually choosing to purchase, and then use its features. A great example of this issue is the misuse of smoke alarms, with less than 1 in 20 [25] properly maintaining them. This is a key tool in preventing tragedy in house fires, but one routinely ignored and often intentionally disabled by users. In order to encourage people to actually use my device, it will have to either offer them other services (radio, clock, etc, etc) as an incentive, or it will need to rely on its user taking it as seriously as it deserves to be.

Community focused tools on the other hand can be implemented at a cost lower than providing equivalent tools to each resident of an area, and is more inclusive by allowing any and all to take advantage of it. I envision that such a solution would be a large installation in a public area, designed to promote conversation and co-planning. Having a large pool of people work with it will also have the benefit of providing relevant metrics about the community and their choices. It too can be ignored by those most in need of its services though, and could easily be viewed by residents as a tacky, 'discovery centre' style object that has been installed by someone that doesn't "understand them". Getting past this issue could be done in the same way as the personal device, by incentivising its use by offering other services.

It appears as though the best solution to my identified problems will be a multifaceted approach, with solutions that target each area and work together as a whole. This will mean developing a device for individuals to rely on, as well as developing a community bond through some other service. This will allow me to tackle the problems of each area individually, and to make sure that no detail gets left out.

Having spent allot of time thinking about the community vs individual issue, I've come to a few important realisations. Firstly I need to always be aware of the fact that individuals that are delaying their choices are my primary target audience, and that the people around them are just potential avenues in getting to them.

Left is a diagram I've drawn that demonstrates these possible avenues. It can either be viewed as family and friends, communities, and direct neighbours that are approaching those in need, or as those in need approaching help themselves.

As seen in my research, those households without a plan are likely to be one of two things; either they are reclusive, or otherwise reluctant to tackle the issue of fire in their area, or they are households that are trying to address the issue, but cannot make sense of the two options.

Each of these 6 areas could potentially be a project in and of itself, but individually they will be excluding potential avenues and individuals.

Prior to starting my design process, I developed the following five persona's to act as simulated users prior to performing treal world user experience testing. I've always been a fan of a technique taught to me at RMIT called 'Extreme Users', which argues that designing against regular Joe's will result in a solution that only serves those with average needs. A better option is to frame the persona's around extreme examples of users such as crazy cat ladies and star trek obsessed recluses. I've shied away from going for such aggressive examples, but kept this technique in mind while developing my persona's.

Having these persona's thought out prior to the ideation stage allowed me to have distinct users in mind, rather than just working against the idea of 'residents of bushfire prone areas'. I've tried to include users that fill out a wide scope of target audiences, and they are all characters that are likely to appear in most, if not all regional communities.

The New Guy

James has just moved into town, and having come from Melbourne city, he's pretty confused about the whole fire thing. Asking around, he is directed to speak to the local CFA, which is happy to provide him with a number of guides to creating fire plans, and lets him know when the next local fire meeting is.

Taking the guides home, James gets quite anxious about the amount of work that goes into creating a fully fleshed out plan, and opts to hold off on thinking about the stay or go choice until he has had more time to work through things. As time passes, James talks to some of the locals he meets, and comes to develop a rudimentary understanding of what people expect and predict in future fires. He realises pretty quickly that while the chance of a home surviving a fire is pretty high if properly defended by the owner, there is a huge amount of time and money involved in readying your property, as well as very little in the way of professional training. On the other hand evacuating every time the fire danger rating reaches catastrophic is a logistical nightmare, and if his house burnt down he'd have to start again from scratch!, What to do!

The Expert

Martin has lived here for a really long time, but has managed to avoid fire thus far. He's always been a stout believer in defending ones home from bushfires, and has spent allot of effort on fire pumps, clearing trees, etc etc. In the last few years though, its been pretty wet, and he has allowed his level of preperation to drop, with grass getting longer, trees getting bigger, and expensive maintenance being spread further apart. Because he is seen in the community as being someone with a strong plan, no one thinks to query him, and those who benchmark their homes against his are starting to slack off a little too!

The Recluse

Mary and Simon are quite content with their own company, and don't have many close friends in their neighbourhood. As winter is coming to its end, its increasingly looking like there is a nasty summer coming on, and a few residents are worried that the reclusive couple on the hill have done very little to prepare their property, and no one is sure about whether they have an evac plan, or if anyone would even know if they had left. On request, some CFA members have been up to talk to them, but have received very stony responses that their business is their own. Its no one else's job to look after them, but their property could be a danger to others in a fire.

The Dependants

Fran has always helped George with fire proofing the house, but they aren't getting any younger, and now that George is starting to show signs of Parkinsons disease, they are really struggling to keep up each year. In the 40 years they have lived in this house, they have defended it against 3 fires, and wouldn't know what they would do if they had to start all over again. At the same time, they also realise that the longer it takes the next fire to come along, the less capable they will be at defending against it, and will eventually have to give up on the idea of choosing to stay rather than go. If there is a fire this year though, they're really unsure whether they will be confident in defending, or if they will make a last minute decision to leave.

The Frail

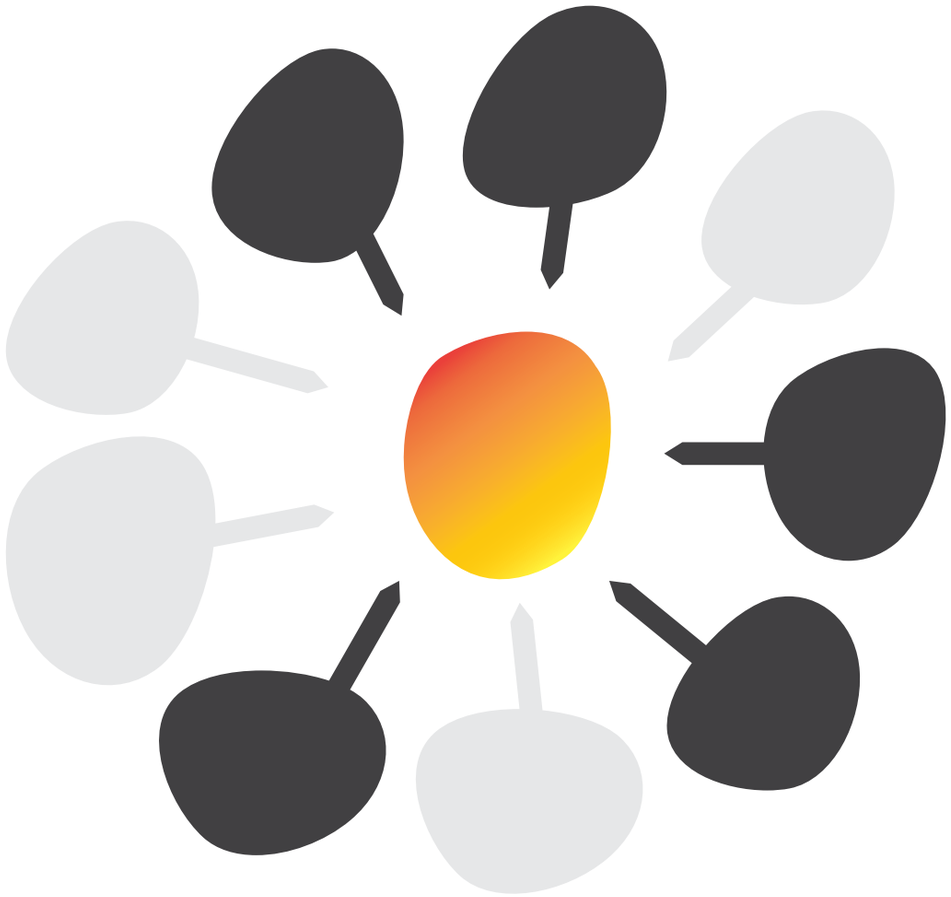
Julie was forced to leave her home and all her belongings to the ravages of fire a decade ago. Luckily her insurance covered the cost of replacing her belongings, but there were so many photos, heirlooms and memories tied up in that house, that she has never fully recovered from that devastation. She has just moved back to an at risk area, but cannot make up her mind on her course of action. She isn't confident that she would be able to defend her property on her own, but trying to figure out the logistics of emptying everything she wants to keep in the short notice given by fires is proving to be so stressful that nothing seems to be getting done.

Tackling the choice of staying or going

These options are polar opposites as far as choices go, but it's crucial that my project addresses the issue of helping people decide.

Knowing what others choose to do

Knowing what other households are planning to do in the event of a fire will help people both deciding for themselves, and help emergency services workers in doing their jobs

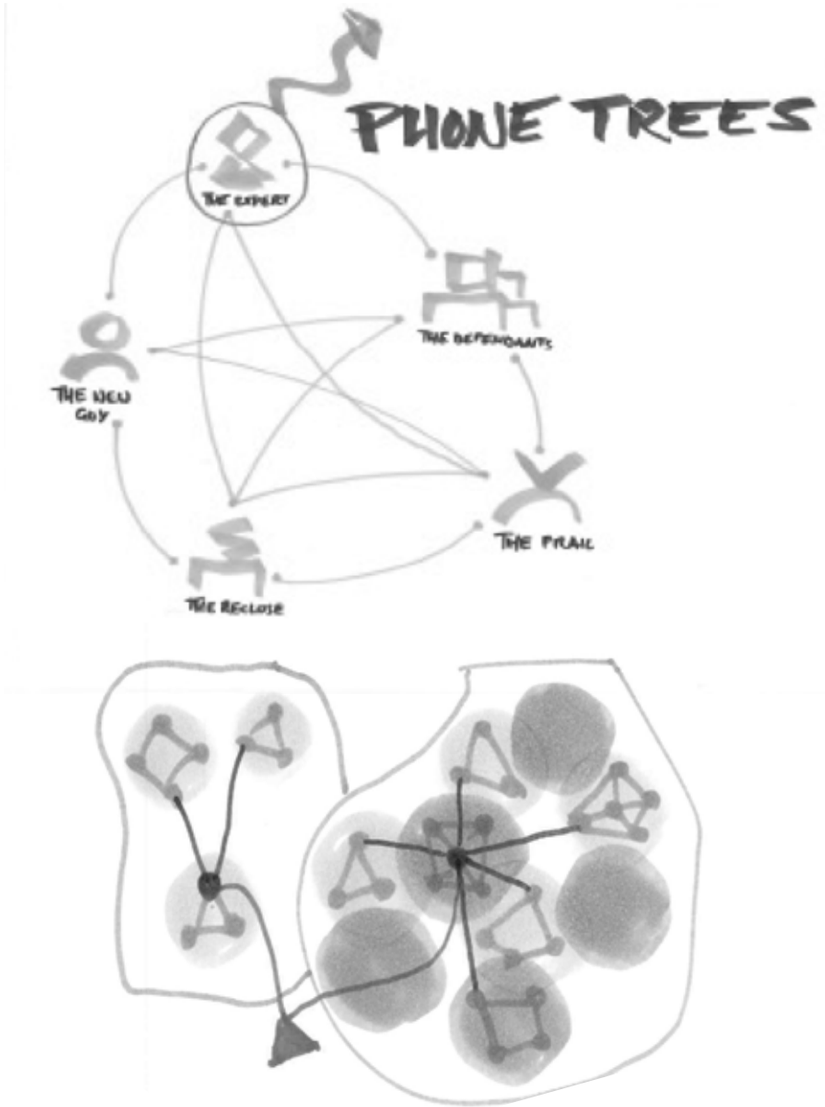


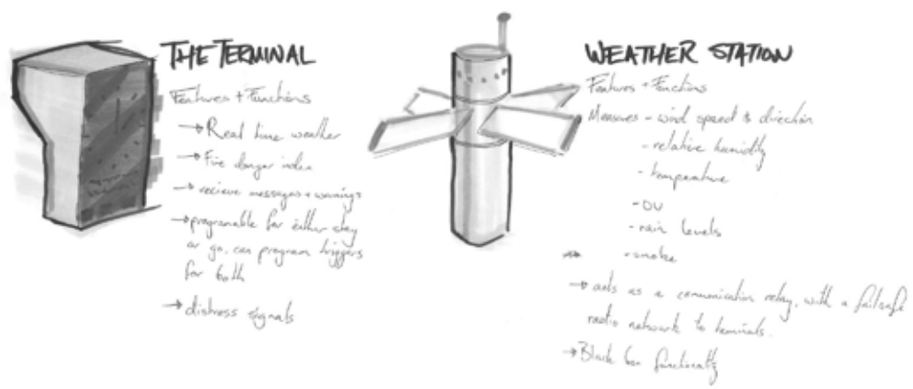
Allowing Communities to discuss ideas

Having a central system to facilitate community wide communication will encourage people to seek out help and advice from their peers.

Providing a central source of information

Providing a tool for individuals that they can use as a central source of fire updates, including notifying them when preset triggers occur will help them develop confidence in their plans





KEEPING IT SIMPLE WITH A COMPLEX NETWORK

Considering the importance placed on social networks identified in the problem statement, I'm proposing a product service system that ties a physical interface into a formalised version of the phone trees concept so often seen in at risk communities. By grouping neighbours together into small networks of 4-6 households (depending on population density) rather than allowing individuals to pick and choose based on prior relations I hope to develop a suburb by suburb collection of networks that leaves no one out.

Each of these households will be given an in-home terminal that acts as a personalisable warnings display device. In the interest of avoiding the issue of people discarding or not using it as many do with their smoke alarms, their main interactions with it will be to use more utilitarian functions like a clock radio and to check the weather. Behind these functions is the capability to subtly inform users of the daily Fire Danger Index, receive updates about local fire related issues and allow the input of choices such as stay or go. These functions are intended to provide a regular reminder to residents that they live in an at risk community, and that they need to have plans in place.

In the event of a fire, it will be able to send low and high level warnings to the display, which will be a combination of light and audio based signals. The user will then be asked to reaffirm their choice between staying or going, which will be sent to relevant authorities to allow them to better plan their activities.

The signal it receives will be in the form of AX.25 packet radio, which operates on an FM radio signal that will be unperturbed by heavy smoke or loss of satellite vision. This signal will be generated by a locally installed weather station that provides the terminals with extremely localised weather information to better allow people to make decisions than more sparse conventional weather sources.

As well as the in-home display, a smartphone application will be freely available to all residents. This app, tentatively titled 'Firefly' expands on the features of the in-home display by creating an interface that allows users to send and receive messages from the CFA and their neighbours. On first use, it prompts the user to enter the details of their property, including their family name, number of people that live in the house, fire shelters and telephone number. The telephone number is ordinarily hidden to prevent abuse, but is available to the rest of the phone tree and the CFA in instances of fire. Firefly also allows users to enter the serial number of their in-home display to sync it with their plans and information.

As well as these functions, Firefly also acts as a central location for fire resources, including online information and guides, and access to local fire agencies. To provide continuity between the app and the display, detailed weather information is also available. After doing so, residents are then prompted to decide between staying or going, which is an option that can be freely changed as often as they like.

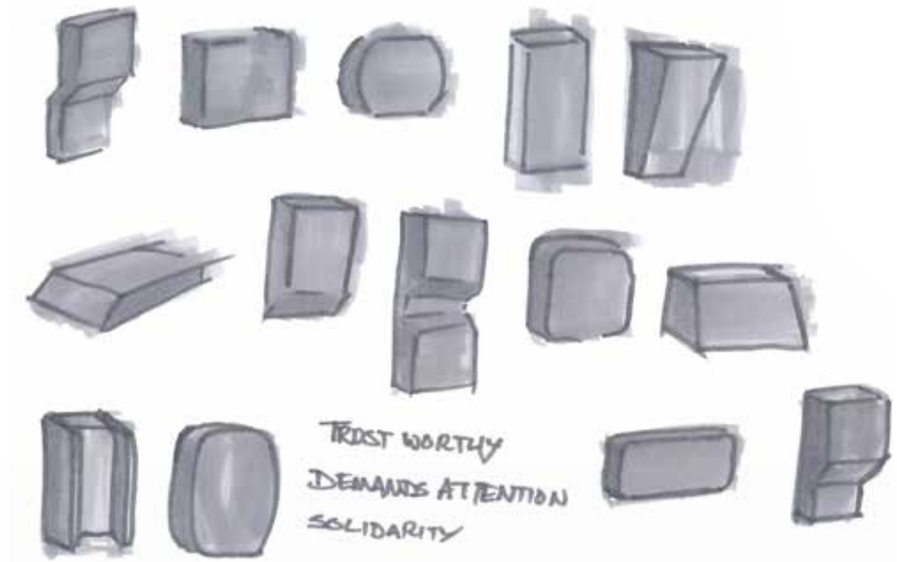
In instances of local fires, the app changes from a friendly colour palate to a red/black colour scheme, and its functions are limited to checking warnings and updates, setting a definite course of action, and contacting other people in your phone tree.

I have opted to take modernist design styles as influence to the aesthetic of the in-home display, particularly the works of Braun and Deiter Rams. Aiming for a form that is pleasant to look at is acting in accordance with the aim of having users actually want to use the service, and framing the display in a timber veneer will help it fit into homes in rural areas. For the same reason, I have opted to use an extremely low resolution dot matrix display rather than a more modern LCD display, which would look very out of place in the homes of many people. This should also help keep the cost per unit down.

This display will create a limitation to the depth of information displayed on the screen, which adds an interesting level of difficulty in designing the icons and textual messages that the display is able to present.

This combination of services is intended to be comprehensive in including all people into a community friendly network of neighbours, and so must be simple enough for people of all types. Although it would be best if everyone used both Firefly and the in-home display, the service does allow for people to use one or the other.

On the following page is a service diagram showing the communication of an emergency from a household, to the cfa, and on to the rest of the community.



1 RESIDENT SPOTS FIRE, SENDS WARNING TO CFA

2 CFA SENDS OUT WARNINGS TO HOME GROUPS

3 RESIDENTS FOLLOW THEIR FIRE PLANS

THE GUTS OF IT ALL

WHAT THE HECK IS AN ARDUINO?

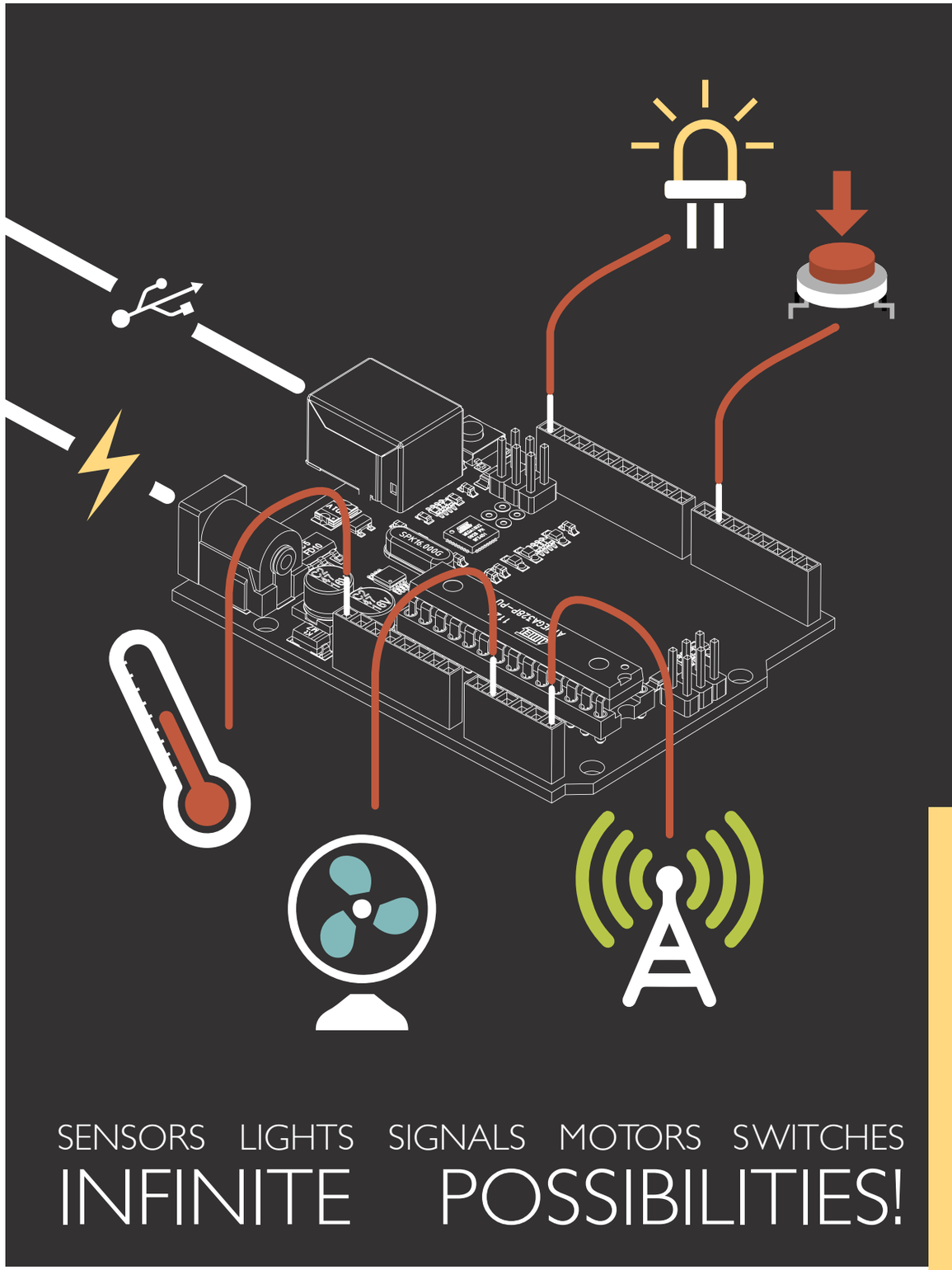
An Arduino is a simple to use micro controller, intended to make the implementation of interactive and digital elements to objects an easy process. First released in 2005 as an open source platform, the concept behind the Arduino has become massively successful, with there now being a range of other platforms with different capabilities available on the market today.

The official Arduino boards now come in a range of sizes and forms, with the standard Uno board costing around $40 aud, and being small enough to fit in the palm of your hand. Others are made to be smaller with digital IO (in/out signal) pins that require soldering rather than a simple plug and play interface. Others still are built on flexible pads ringed with holes that allow for easy sewing into garments.

Running on a modified version of the C++ programming language, they are very easy to learn to use for those that have little or no experience with computer languages. This is made even easier through the open source philosophy of the platform, whereby manufacturers of components made for use with Arduino's such as; led lights, all sorts of sensors (temperature, light, sound etc), motors, digital displays and communication devices often develop well annotated and thorough documentation and sample code to help get them up and running as fast as possible. Simpler components such as single led's or buttons can generally be wired straight into an available IO port, but some other components require multiple data pins and are built onto what are known as 'shields' that conform to a standard size that slot straight on top of the Arduino. This standard size also allows many of these components to be stacked into an array of parts.

While extremely versatile and easy to get up and running, Arduino's are only ever intended to be used in proof of concept prototypes and one off devices. What they allow a designer to do though is to create a (more or less) fully functional model of their design that can be tested and tweaked to the point that it's ready to be sent off to an engineering and software development team to be remade into something that is more viable and permanent for mass manufacture.

In this project, I will be using an Arduino Mega board to power the in-home device. The display will need the larger, more powerful Arduino Mega board to drive both a digital display, as well as receive signals from an added time-keeper and the required switches that allow users to interact with the device.

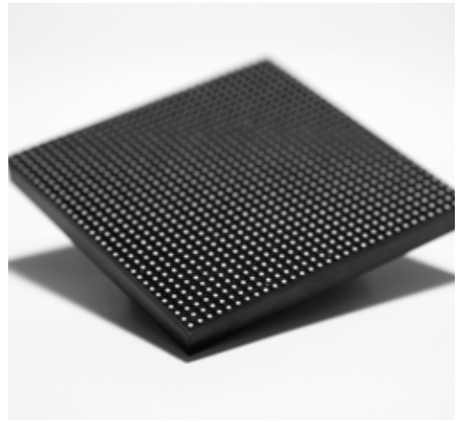


Thermo and Hydrometer

Often sold as one unit, this component is able to measure both the ambient temperature with an accuracy of +/- 0.1 Celsius, and relative humidity with an accuracy of +/- 1%. Both of these are very useful pieces of data, especially in determining fire danger.

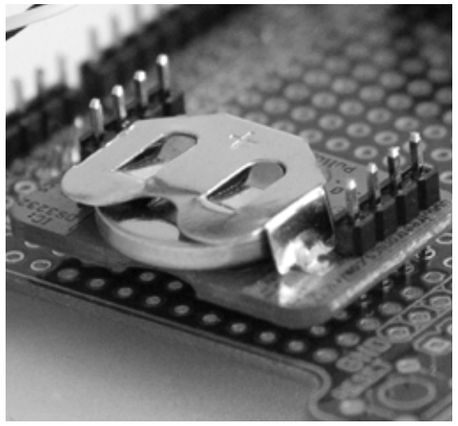
RGB LED Matrix

The display I've opted to use is a full colour 32 x 32 pixel display, measuring roughly 128 x 128mm. Each of these pixels is individually addressable, and allows for adjustments to its brightness. It was quite complicated to wire into the Arduino, and I had to develop my own code to get it to work outside of the example code provided by the supplier.



Quartz Clock Module

To keep accurate time, I've installed a small clock module that allows me to program in a time and date that can be called on in the code whener I need to. This component has its own small power supply that allows it to maintain accurate time even when the entire device is disconnected from mains power.



Anemometer

An anemometer measures wind speed by coupling and carefully fine tuning a digital encoder with free spinning cups that spin on a bearing in the wind. These devices are extremely accurate and hardy. They do however only measure wind speed and not direction.

Photodetector

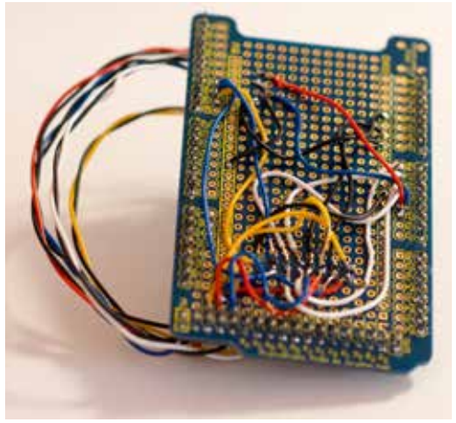
A photodetector sends a digital signal that is adjusted by the amount of light that falls onto its resistor. For this project I'm using a UV sensitive photodetector, meaning that it is able to both measure LUX (quantity of light) and strength of UV light. This will allow the weather station to be able to determine the risk of sunburn to people in the area.

RX.25 Packet Radio

In bushfires, many forms of communication systems fail for a number of reasons. Considering this project will be used in these extremes, its important that its communication lines are robust and fail safe. Due to this, I have opted to research and implement the AX.25 amateur packet radio link layer protocol. Packet radio is a system that allows for the transfer of data over fm radio space, and using it in a point to point system will mean that the signals remain at ground level.

Soldering

Soldering is the process of using a wand heated up to ~350 degrees to heat 2 metal surfaces to a high enough temperature that when a length of solder is touched on where they join it melts and rapidly dries, permanently welding them together with a conductive material. There are lots of different solders and irons available on the market, but they all essentially do the same thing with varying degrees of user control.

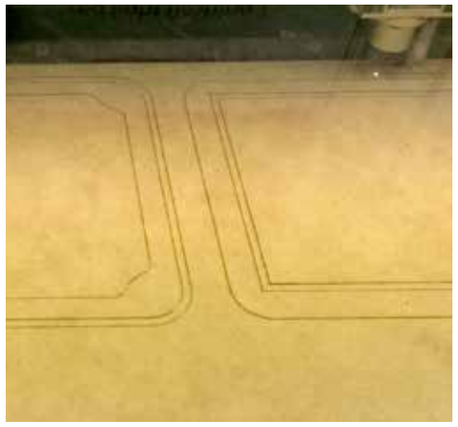


Circuit Design / Wiring

Outside of coding, all of the components of a circuit must be wired together, which is a process that is simple to do in a haphazard messy way, or it can be done meticulously to create a neat, organised circuit, with wires as short as possible to limit interference and signal degradation. Most projects start with a breadboard that allows easy plug and play designs that are often very messy, but allow the design to be organised, followed by a hand soldered prototype board (left) that minimises space. this can then be replaced by a printed circuit board that removes the wires

Laser Cutting

Laser cutting is a manufacturing method that takes an extremely high power UV laser that burns through a given material, while following a user defined path. This process allows for extremely intricate and detailed designs to be cut incredibly simply, and can be used on timbers, plastics, metals, textiles and all range of other materials.



Laminating / Steam Bending

Laminating timber veneers into plywood is a simple way to produce strong timber shapes that can be applied to other surfaces. This process allows for internal ply layers to be of less than beautiful materials with a more expensive top and bottom layer. Steam bending is the process of soaking timber in steam to make it pliable, before bending into a form to dry in, allowing for complex bends in timber that would otherwise be impossible to create. In this project I have steam bent veneers around a jig, then laminated and glued them to the outside of the model

3D Printing

The future of complex manufacture, there are numerous different methods of 3d printing materials. They all share the process of slicing a 3d model into ultra thin horizontal slices, which the printer then creates layer by layer to result in a final form. The easiest way to imagine this process is to think of drawing a shape on paper with a hot glue gun, allowing it to dry, and continually adding layers until a 3d shape is created.

CNC Milling

Quite the opposite of 3d printing, CNC milling is a reductive manufacturing process that starts with a block that is milled out by a robotic device that drives a drill bit through the material. This process is often much cheaper than 3d printing, as it allows for the use of much cheaper materials, and is often a much faster process. For this project I have milled the two half's of my weather stations form, to be used as moulds to create plastic shells.

The use of pictograms has become a central element of service design in the modern day. Arguably the design of the London tube map in 1936 was the event that brought their use to prominence, however ideograms have been widely in use for much longer. Pictograms are images that represent something physical, and are usually intended to have obvious meaning across cultural boundaries. Ideograms however are symbols that have meanings that are less obvious, but have become widely recognisable. Two great examples of this are the divided circle used in no smoking signs that now represents a restriction on use, and the radiation and biohazard signs that have no correlation to their subject matter, but are intended to be provoking and to appear dangerous.

In dangerous events, people do not act as rationally as they normally do, and emergency services coordinators need to distribute information as quickly as possible in a form that is easily understood by everyone. This is why alarms and sirens are so abrasive, and why bold colours and stark patterns are so effective in conveying emergency messages.

A convenient result of the low resolution of the screen I am using is that pictograms will be my only viable means of conveying messages visually. The two main things I will be informing users of are fire events and warnings, and the current local weather. Pictograms are almost universally used by weather reporting agencies nowadays, and so I've had easy access to their symbols as reference to my own study. Realising that I only have 32 x 32 pixels to display my images on, my form studies have been intentionally kept very simple with a range of symbols inspired by online sources to represent all the common weather events. Each of these is then taken into Photoshop to be drawn in a one to one scale drawing to see how well each does when drawn as a bitmap.

Fire symbols went through the same kind of rigor, however there was a much smaller pool of resources to study that reference fire specifically, and those that do often rely on textual support. Most of the fire related icons I've played with have been simple representations of a fire, which would be easily animatable to give them a flickering effect. Others made use of exclamation marks and basic house forms as ideograms to try and stress the issue of importance. Although I want my device to be pleasant to use outside of fire events, in such situations its extremely important that the representation of fire is immediately recognisable, and that it stresses that serious action is required.

Outside of the symbols I've designed, I've also created a custom font to be used for the clock, and for short, single word messages that are displayed on the screen, such as; 'local fire', warning', stay or go? and radio station names and addresses.'

Located about 45 minutes north west of Melbourne, I've chosen the hilly regional Victorian suburb of Warrandyte to provide a real world location to test my project within. In its past, it has been subjected to terrific fires, and was the centre of the Black Friday fires in 1939, in which 71 people lost their lives. It is one of 52 high risk areas in Victoria, and

Local surveys have found a mystifying level of complacency among its residents - as if the lessons of Black Saturday, February 7, 2009, have faded. [34]

Due to its topography and dense bushland, it is a community that must be extremely cautious of fire risks. While it is now one that pays strong attention to fire preparation I had no doubt that there were still those in the community that do not prepare adequately enough, and it presents a vibrant mix of dense suburban areas, peri-urban properties and homes that live on blocks surrounded by bushland. It's history of fire also helped assure me that there would be numerous residents that were willing to converse with me on the topic of fires and my project, and allow me to perform user experience testing.

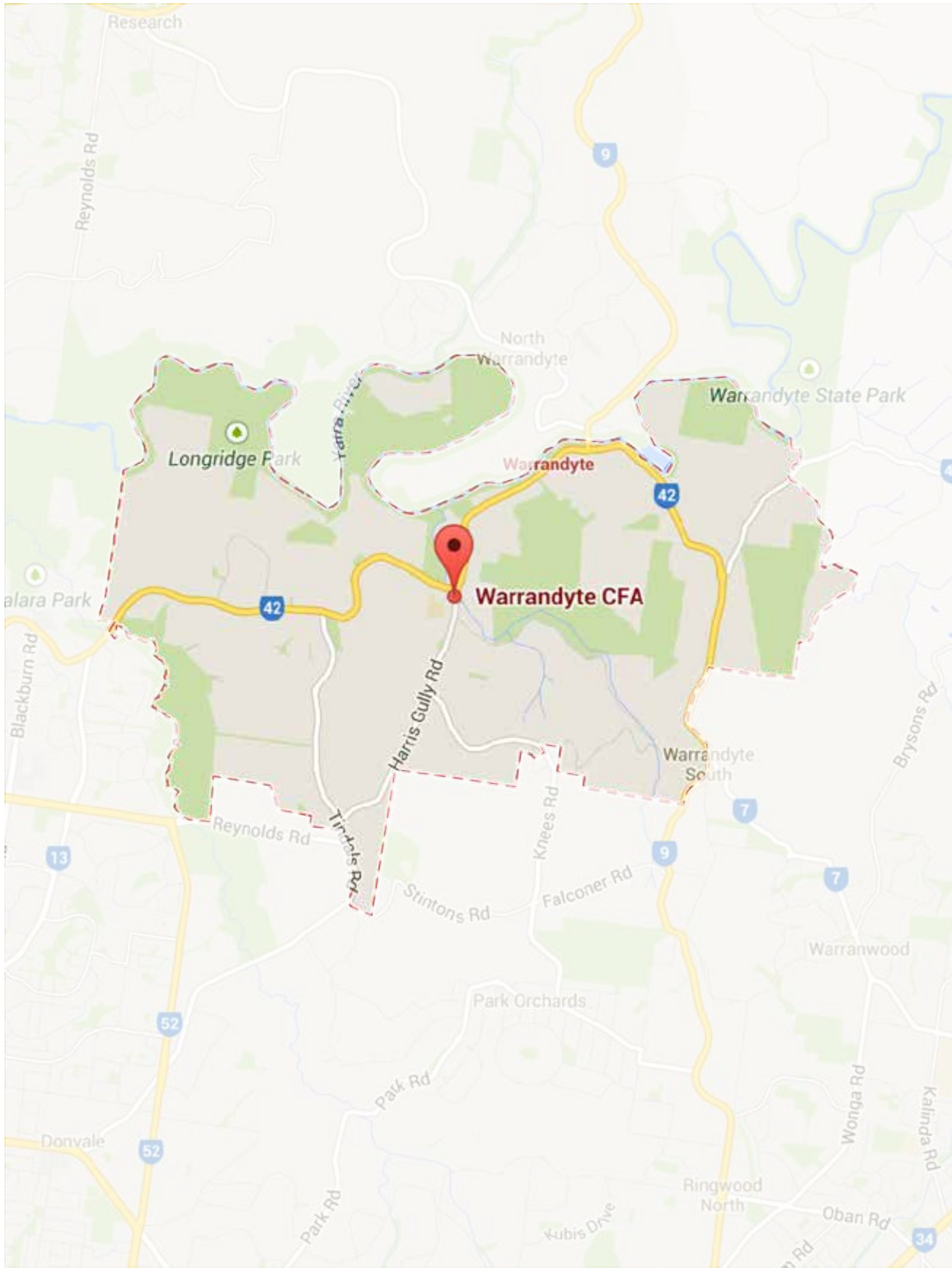
Local community leaders and CFA volunteers describe the town as a fire trap and tragedy waiting to happen. [34]

Warrandyte has a very active CFA, who were very willing to talk with me about my project, its scope, and their perceived issues and advise. Talking to the CFA's eastern headquarters manager of community education was a really nice reinforcement of the goals and strategy of my project, as she described my research and problem statement as being 'extremely accurate' and that 'I had thoroughly identified the major issues that the CFA is constantly trying to tackle'. The local CFA was also very helpful in pointing me in the direction of people that would be willing to talk to me about my project, and to perform testing of my final prototype.

Thousands of people flock to Warrandyte on hot weekends to swim in the Yarra and soak up its scenery and historic attractions, unaware that if a fire approaches they could suddenly find themselves in one of Australia's most dangerous places. [34]

The community itself has an interesting mix of warning sources. The local community library has a room dedicated to local information (mostly flyer's) which includes a wide array of the publications made available to the public regarding fire, however outside of this room there is very little in the community that makes mention of it. I could only find two roadside FDI indicators, and the CFA station itself is not overly obvious or inviting, unlike the stereotypical big red fire stations seen in other places.

I assume that this is partly a result of there not having been a major fire in the area for quite some time. To reiterate, I do believe that many of the residents are well aware of the risks, however there surely would be many people that now live in the area that have never been exposed to fire and would not have the real world experience to be able to truly rationalise the risks. As well as this there is the surety that there will be people that



do have experience who have allowed the lack of recent fires to make them somewhat complacent.

Dick Davies, president of the Warrandyte Community Association, says only 23 per cent of residents bothered to respond to a survey on local fire planning. He blames ignorance and denial in a community that has not directly experienced a bushfire in decades.

"Of those who did respond, more than 80 per cent believed bushfire would threaten them in the next few years, yet only 8 per cent had a very detailed survival plan," he says. About 60 per cent claimed to have some sort of plan, but many people have no idea what to do if something unexpected happens."

"Given the massive wildfire risk here, I'm bewildered as to why residents aren't taking the process of fire planning a lot more seriously," [34]

On the next page is a journey map showing the pathways that I expect my persona's would follow in their adoption of the service.

1
DEPENDANTS

2
NEW GUY

3
EXPERT

4
FRAIL

5
RECLUSE

CFA

ASKS FOR HELP CLEARING PROPERTY

SUBMITS PLAN TO GO, PREPARES BELONINGS

SAFELY READY TO GO

HELPS DEPENDANTS LEARN TO USE THE APP

OFFER HELP

STARTS MAKING PLANS AND PRERPERATIONS

SAFELY READY TO STAY

DEVELOP THOUGHOUGH KNOWLEDGE OF APP

NOTICES EVERYONE PREPARING, UPDATES OWN PLANS

SAFELY READY TO STAY

ASKS EXPERT FOR HELP MAKING A PLAN

OFFERS NEIGHBOURHOOD BBQ FOR HELP PREPARING

SAFELY READY TO GO

OFFER TO HELP CLEAR GARDEN AND PROPERTY

NOTICES PEOPLE COMMUNICATING VIA APP

MAKES PLAN IN PRIVATE, BUT UPLOADS CHOICE TO APP

SAFELY READY TO GO

PROVIDE DISPLAY, SHOW OFF ITS EXTRA FUNCTIONS

NOTICE THAT RECLUSE IS NOT CLEANING PROPERTY

REMINDS PEOPLE TO PREPARE

ORGANISES COMMUNITY EVENT

SENDS OUT FIRE WARNING

January February March April May June July August September October November December

Summer Autumn Winter Spring Summer

THE 3 ELEMENTS, A PRODUCT SERVICE SYSTEM

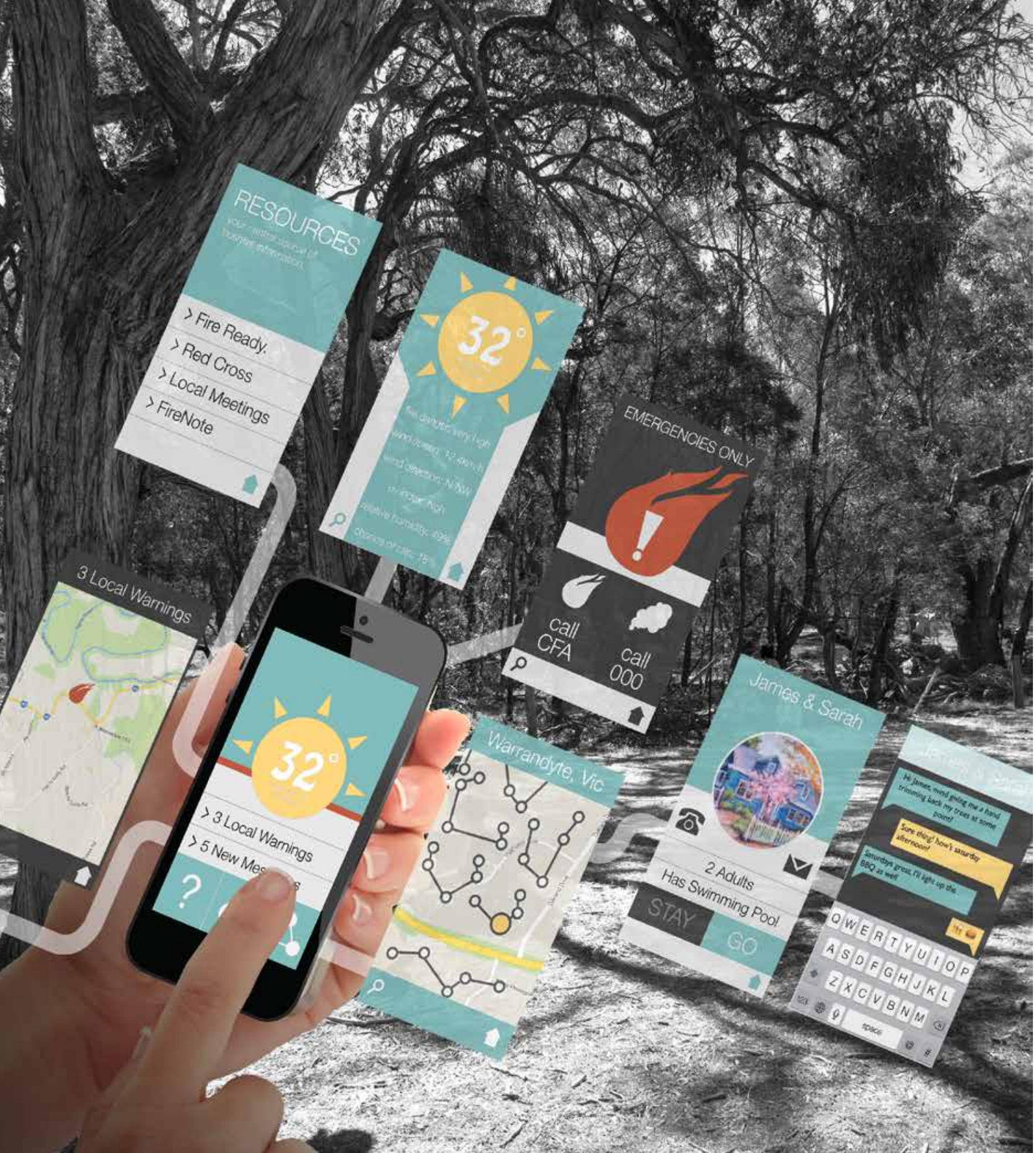
NO PROJECT IS COMPLETE WITHOUT AN APP

A late addition to my project, I decided to follow the advice of my lecturers and develop a smartphone application to support and bring together the other elements of my project. At first I had some trepidation in taking on another degree of complexity, but it quickly became apparent that its implementation was going to solve many of the problems I was trying to tackle in joining the dots of my project. I had originally avoided the idea of doing an app as I expected that it would be easily forgotten by its users, and would not have the same ability to influence and remind them as the physical display

However, having the app in place allows my project to have a freely distributable service, which is much more easily modified by the user. On first use it allows the user to register their home, and enter the details of their plans. It also them to easily report fires to the authorities, and provides a simple means of accessing and contacting the other people on their phone trees.

To the left is a selection of the screens I designed as a first prototype, to be printed and used for paper based testing. To create this I started by mapping out the functions I wanted it to provide in a wireframe, and then attempted to design a visual language that could coexist with the in-home display.

Initial tests and responses indicated that the colours were too garish, and that it looked tacky. Outside of these opinions though, its functionality was well received.



Taking this feedback into consideration, I spent some more time researching the visual styles of other app's on the market, from their choices of colours to the design of buttons and the ways they layer and spread out information. I used this to redesign all the screens with a softer feel, and re-designed the wire frame to make every element easy to reach. To encourage use, I saw the flow of the app as being extremely important, and I didn't want it to be possible for people to not know how to get to anything, or for them to not know how they reached any particular screen. For this reason, the wireframe is set up so that everything is reached in a linear matter.

The app is designed to have two modes of use. The first, and most commonly used is similar to the in-home display in that it allows users to check the weather, access online fire information resources and make plans. This is also the mode in which users can update and submit their plans, and communicate with other members of the community within an integrated messenger app. In the interest of privacy, these messages will not appear to anyone unless they open up the app itself, and users cannot access their entered phone numbers unless the app switches over to emergency mode. In this mode, all extraneous functions are stripped away, and the colour scheme changes to a palate of red, black and grey. In the event of a fire, users can access a Google maps overlay with incident locations and warnings, contact the CFA or 000, report their plan to the CFA and their phone tree, and quickly contact others in their phone tree to check in on them.

MAKING THE APP

For the purposes of testing and presentation, I needed to figure out a way to display the app on an actual phone, but without the enormous headache of actually creating a fully functional app. To do this, I opted to use an online service called InVision, which proved to be incredibly capable considering it low cost. Getting it working was simply a matter of creating an online project, specifying the model of iPhone being used (because of differences in screen sizes) and uploading all of your frames as images.

Once uploaded, the tool allows you to link the screens together by selecting sections of the screen that will act as buttons. These transitions have a few different options for animations, and are really easily managed. Once complete, the app is sent via sms to a phone, where it sits on the homescreen just like a real app, and can then be interacted with.

Having this app as an additional service really helped sell the idea of the project to observers, as it was immediately obvious that they could get it for free, whereas many looked at the in-home display as something of an investment.

As a component of my system, the weather station will have the most public and environmental exposure. Rather than designing it to have an aesthetic appropriate for the home, it instead needed to be something that would fit into a public space cleanly, while also being distinct enough that it is a recognisable element of the system.

As an element of the project I wanted the weather station to be heavily focused on model making, and opted to go with a mouldable plastic shell to house the components that would be mountable on a local street pole.

Above is an image of my first CAD mockup, intended to wrap around and bolt onto a street pole visible from the desk I work at. After toying around with this idea for a while, I concluded that trying to design a universal mount system was going to require more effort than it would be worth, and opted to adjust the design to stand atop either a pole or star picket, both readily available in country areas. This will also allow the device to be purchasable by either the residents themselves, or installed at a local CFA station, where a larger number of installations means there would be a stronger signal and more accurate weather data.

As with the in-home display, redundancy is a major concern here, but unlike its power hungry counterpart this device will only require a trickle of power, and could be coded to only activate at intervals or in times of need. To generate this power, I've opted to cut and flex a weatherproof solar panel over the top of the device, which will be hooked up to an internal battery. To generate a signal, an AX.25 packet radio module will be installed inside attached to a cable antenna kept dry inside the shell.

After reflecting on my first concepts and the feedback I'd received about it from my peers, I opted to shrink the form into a much tighter package. I've designed it to have a friendlier aesthetic, with an almost cartoon like, animated form. I've also kept manufacturing in mind and made every effort to ensure it would be possible to manufacture with regular manufacturing processes.

As this is a weather station, taking readings on the local conditions is its core functionality. To do this though, a few of the electrical components need to be exposed to the elements in such a way that they do not degrade over time. The anemometer and wind vein are the most obvious features, and the anemometer is protected from water by living on the underside of the device. The wind vein however is sitting atop a small nipple on the top of the shell, which should help direct water away from the opening that it sits in. Besides this, the arm that it spins on still needs to be sealed against any moisture that will degrade the internals. The temperature and hydrometer live on the underside of the shell, behind the anemometer in a small enclosure with holes that allow the climate onto the surface of the sensor.

All of the components have been fitted to the right hand side of the shell, which will allow for everything to be easily installed before the left hand side closes it up with through hole bolts.

Final cad and assembly,
ready to be sent to
the cnc robot for
manufacture.

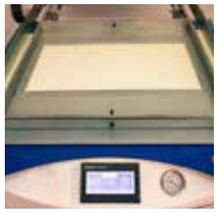
With deadlines looming close, I opted to instead create this form by 3d printing it, but after receiving a quote of $800 I decided that I should instead go back to spending some time in the workshop and make it myself.
To create it, I opted to take my CAD model, shell it to a 3mm thickness, and use a KUKA robot to cut out the resulting block. This process took roughly 4 hours to cut a block of jelutong into forms that are true to within 0.1mm of my CAD file. The two halves then need to be hand finished and sanded to as fine a finish as possible, and then needs to be bogged up with building glue to fill in and sand back any anomalies.

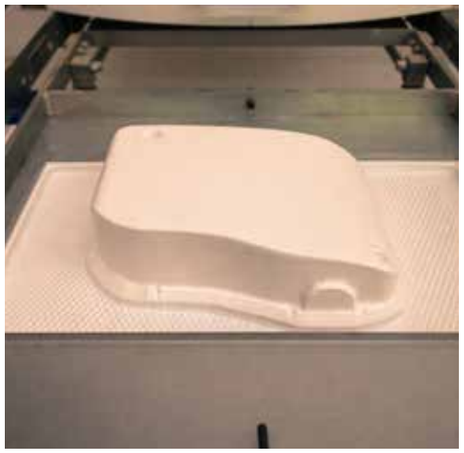
The process of thermoforming involves taking a sheet of thermoplastic material and heating it to the point that it sags enough that it can be stretched over a form. While still hot, a powerful vacuum pulls at the plastic from below, sucking it directly against the mould. Once this cools and hardens again, the plastic is a perfect shell of the desired form. To work though, the mould must be designed to not have any undercuts that would prevent the shell from being removed from the mould. In the case of my model, two of the main edges have very little draft angle, which proved to make it extremely difficult to de-mould. To get around this, I cut and attached a larger base to each mould, with holes drilled through to allow me to push off the plastic from underneath, rather than having to bolt a handle to the form to try and pull it out.

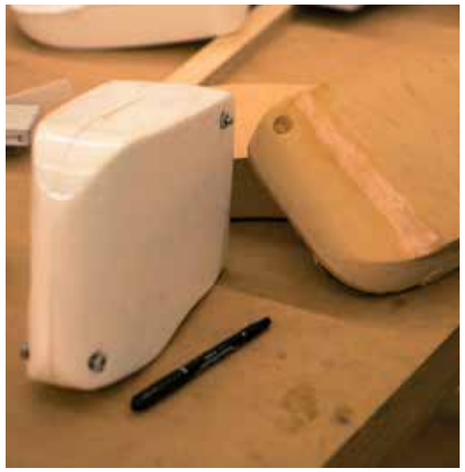
This process took allot of trial and error to get an acceptable product, especially features like the circular extrusions for some of the sensors and bolt holes.

Once I had the form looking nice on the outside, I had to 3d print some internal features that would otherwise be easy to include in an injection moulded part. These were the protrusions and ribs that all of the circuitry and sensors are attached to, as well as the hole on the underside that allows the device to stand neatly on a star picket.

An unexpected side effect of the extremely steep draft angles on the sides was that the top and bottom faces of the part were inclined to sag in under the pressure of the surrounding plastic. To alleviate this, I created a 3d printed part that acts as a middle piece which keeps the form in its correct shape, and doubles as a weather seal that creates a nice part line around the form.







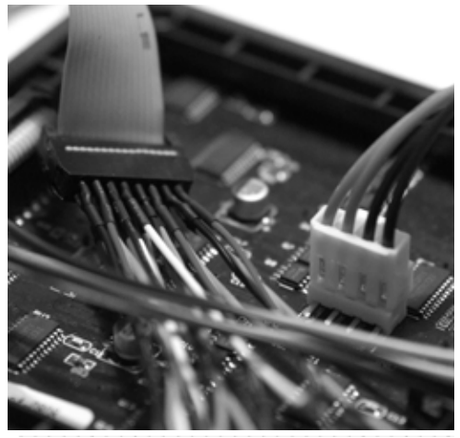
The final weather station prototype, photographed prior to completion to be included in this exposition

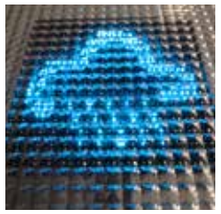
I decided to start the process of creating the in-home display by purchasing a screen that would fit the graphic style I opted with, as its dimensions would be the primary factor that determined the enclosures form. To allow myself the most options in creating icons and images to be displayed, I opted to order a 32 x 32 RGB led matrix from Adafruit in the USA. Being an Arduino focused company, I had hoped that this display would be reasonably simple to code for, which proved to be only true if I was working on projects that were covered by their sample code. Aside from how easy it is to get wires mixed up when the screen requires 16 data lines, getting the display up and running was simple enough. After confirming that it worked by running some of Adafruit's sample code I opted to try and create my own graphic by coding each of the 1024 pixels manually to get an idea of how deep a hole I was going to be digging myself into. Two hours and one rain cloud later, it occurred to me that I was going to have to figure out a better way of transferring my designs into usable code.

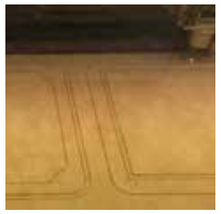
Firstly, I feel that this is a good place to re-acknowledge the RMIT lecturers Scott Mitchell and Chuan Khoo for all their support and patience in helping me debug and re-frame my code all throughout this project. To accomplish this in time I needed to speed up the creation of graphics, and spent quite some time online researching C++ techniques (a oft recurring theme) on coding bitmaps and converting them to workable data arrays. After some trial and error (another oft repeated occurrence) I decide to stick with a piece of free software called The Dot Factory into which I could upload a black and white 32 x 32 pixel bitmap file which would be converted into an array of 1's and 0's. This array could then be copied into a fancy piece of software called Microsoft Word, which has a useful find and replace feature that I was able to use to convert The Dot Factory's data array into one that would play nicely with the Arduino. Although labour intensive I felt that my method would be overall less time consuming than the manual creation of additional customised software. One limitation that my method placed on my process was that The Dot Factory would only accept black and white images, meaning that if I wanted a third colour, I would have to manually change the relevant digits in the array, (ex; 0's are recognised as off pixels, and 1's are recognised as whatever colour I wanted. If I wanted an extra colour though, I would need to change individual 1's to 2's) and as such I have limited multicolour graphics as much as possible.

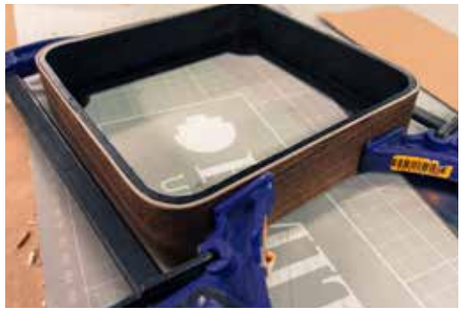
Once I had this method playing nicely, I started to get right into creating images in Photoshop to be used on the display. This quickly came to a standstill when the Arduino flatly refused to display any more than three graphics at a time. After quite a bit of tinkering, this turned out to be an issue with the Arduino's RAM capacity, and required me to again re-structure my graphics to be stored on the Arduino's ProgMem instead. While this was in the end a reasonably simple solution, it was one of many that took me many hours to realise.

After solving the memory issues, and having a display that was actually doing what I told it too (its just a language issue, if my grammar (code) was not %100 correct the Arduino would just throw a fit (any one of a seemingly endless number of possible 'error' messages)) I decided to clean up my hardware by soldering together a permanent prototyping board that would prevent wires from getting mixed up and create a cleaner circuit, and a clearer passage for the data to travel along.









DESIGNING AND MAKING THE ENCLOSURE

I've always liked working in CAD, and prefer working on the minutiae elements of a design than the general feeling or style of a design that is imagined on paper. Jumping straight into Solidworks, I began by modeling an exact replica of the screen, and downloading a pre-made model of the Arduino Mega I was using. Starting with an outer shell and then a mount for the display I then built all the other elements of the internal mechanisms to create a form that was as slim as possible. This included the buttons that would live under the screen, and the screws that would hold all the components together.

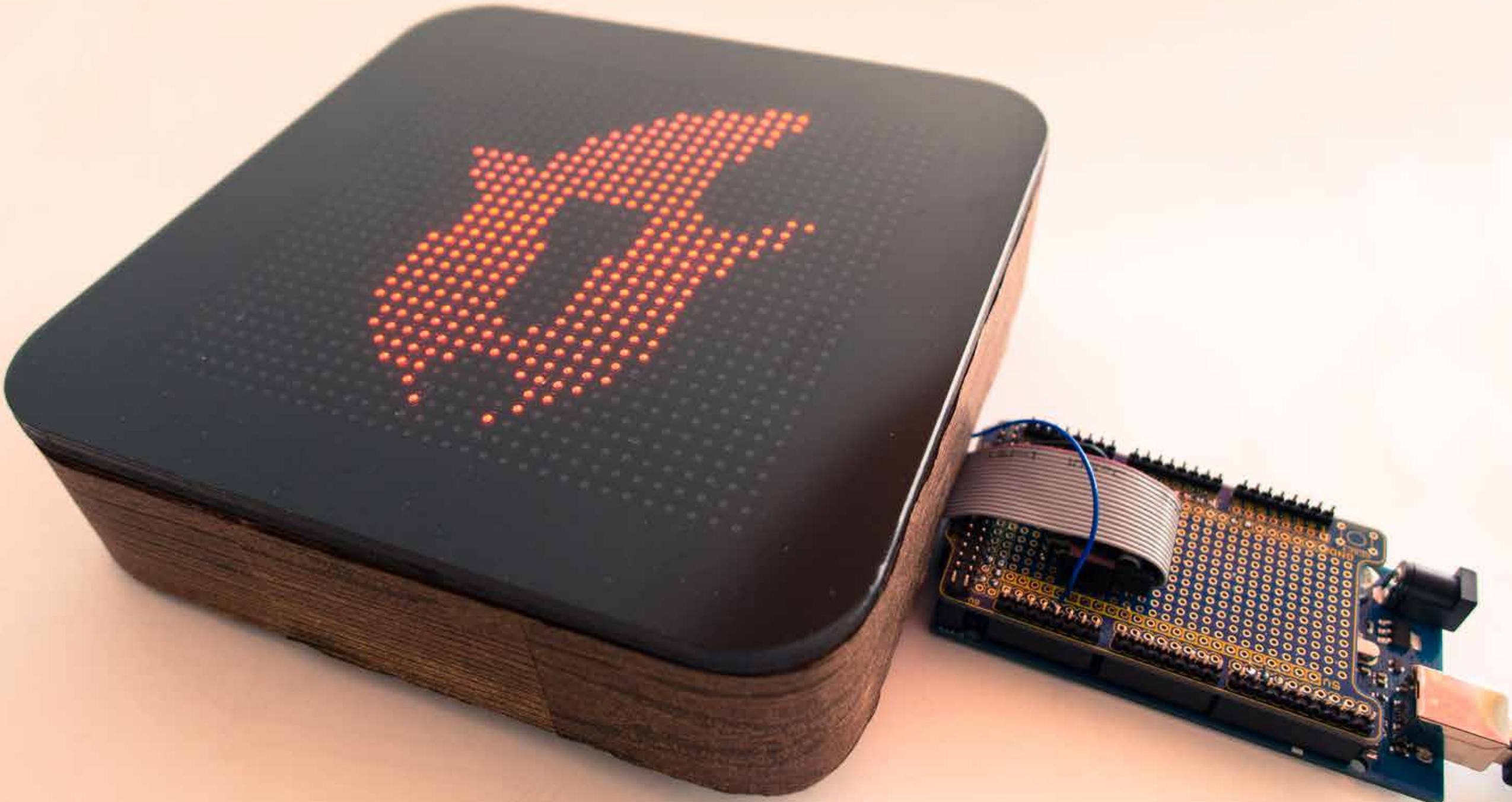
After completing v.1 of the CAD, I created a number of renders in Keyshot to simulate the design and test colours and materials. Following this I sliced each component into 3mm sections along the z axis to be laser cut from mdf, and glued back together to create a one to one model of the housing. This was then taken down to Rmit's prototyping workshop to be sanded and cleaned up, then spray painted a matte 95% black. Around this I glued on a paper thin veneer of dark timber to add a degree of realism.

For the front of the display, I opted to test a range of coloured and textured acrylics before settling on an even grey finish, which was again laser cut according to the CAD design and glued onto the front of the display to finish off the model.

Inside of this I glued down the 4 screen switches in their approximate locations to add the interactivity my concept called for. It was only after assembling the entire model that I realised that I had failed to account for the protrusions created by the Arduino's usb and power cables and unfortunately had to wire the Arduino externally in this first prototype.

In the interest of the designs end of life procedure, I ensured that the whole device could be easily disassembled with the removal of the 4 rear facing screws. The only exception to this was the screen itself, which was permanently glued between its housing and the acrylic on the front. This issue was one I opted to ignore for this initial prototype, and deal with in a later version.

Coupled with the code I'd already written, I then had a fully functional prototype to work with, and display to users and stakeholders.

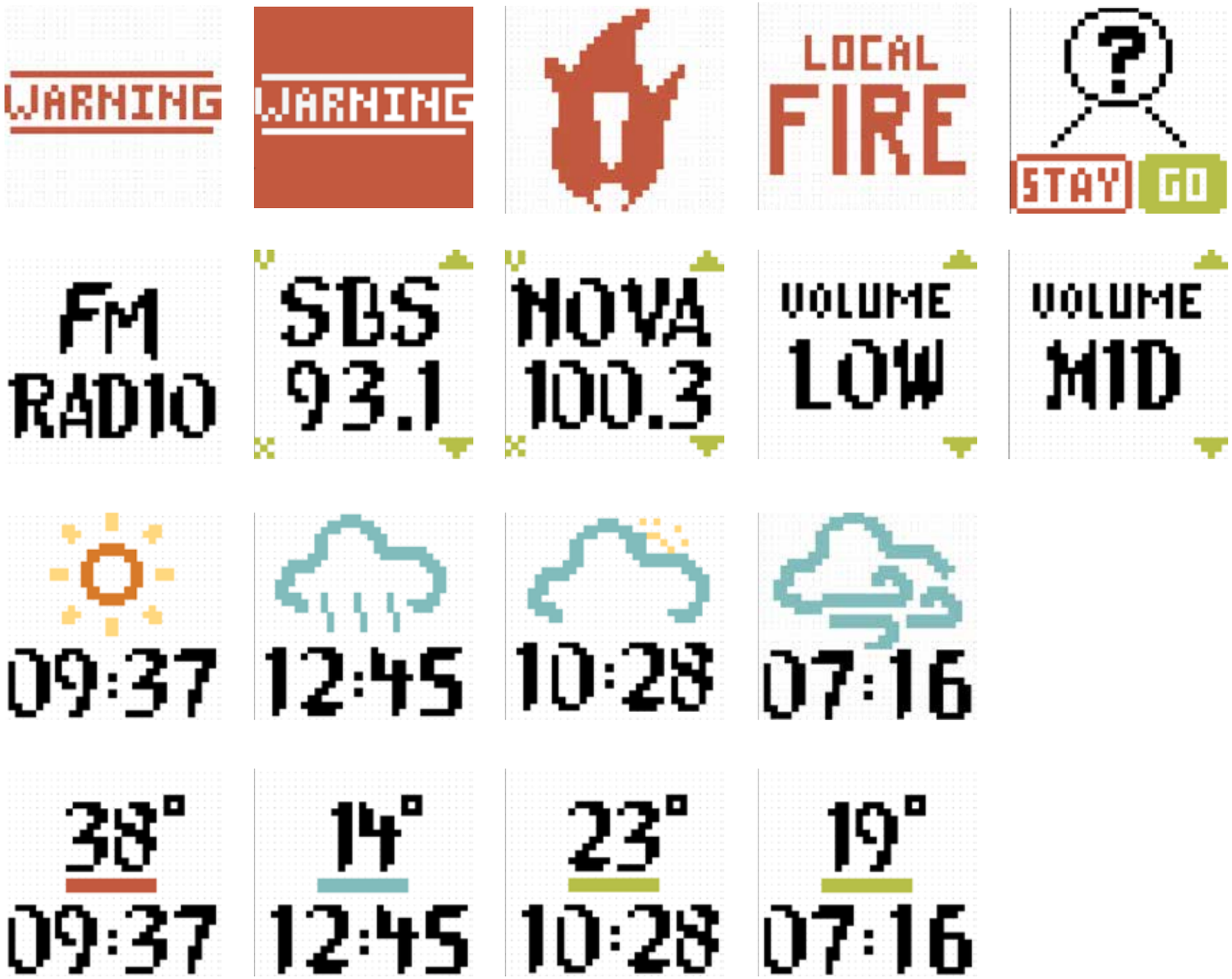


Elastic bands hold the front piece to the main body, and provide spring back when the buttons are pressed

The screen mount nestles into the control panel on a dome, allowing it to angle in any direction, to allow for smooth button presses

To allow a flush edge on the front facing acrylic, the bottom of the screen mount slides away to allow for disassembly

Everything fits together quite tightly, and most of the internal space is being used for something



Ready to be coded in, this is a selection of the screens that are animated on the in-home display's screen. In ordinary use, the clock is always showing, with the space above rotating between weather icons and the temperature. Just under the temperature is a colour bar that indicates the current FDI. On pressing the top left corner of the screen, the user is presented with more detailed weather information, in the same way as the smartphone application works. Touching the top right of the screen will change the display to a low light, white analogue clock face that is less obtrusive at night.

Pressing the bottom left corner of the screen brings up the FM radio, which can then be cycled and adjusted using the indicated corner softkeys.

In the event of a fire, the display changes to a distinct red colour, and flashes a sequence of images and text while the rear facing led's illuminate the wall red. At the same time, an alarm is sounded, not unlike that of a smoke alarm. Once a user touches any of the corners to disable the siren, they are presented with the choice between staying or going, which is then sent off to the CFA, and to prompt the resident to take some form of action.

The final in-home display prototype, photographed prior to completion to be included in this exposition

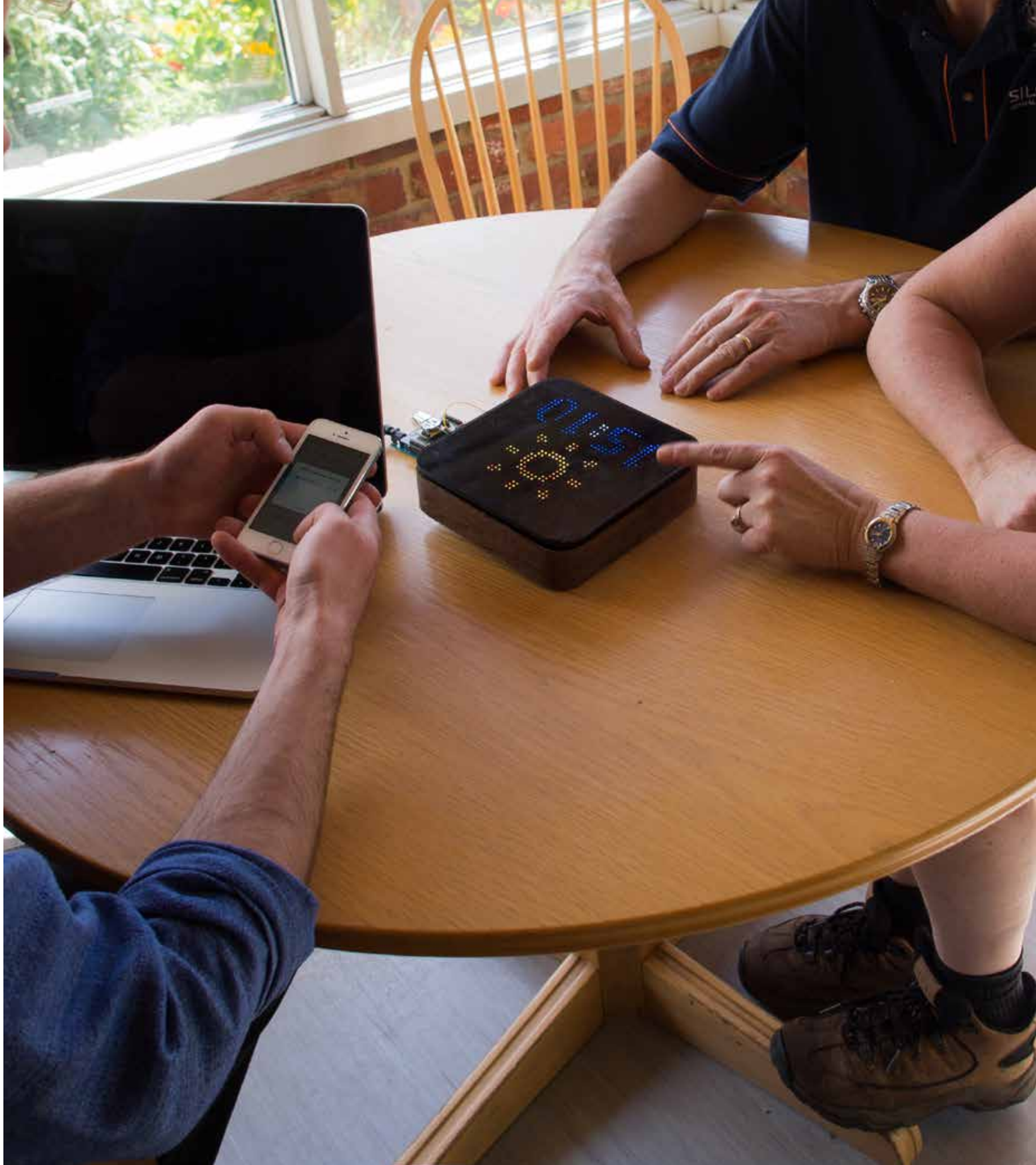
DRAWING CONCLUSIONS FROM THE COMMUNITY VOICE

USER EXPERIENCE TESTING

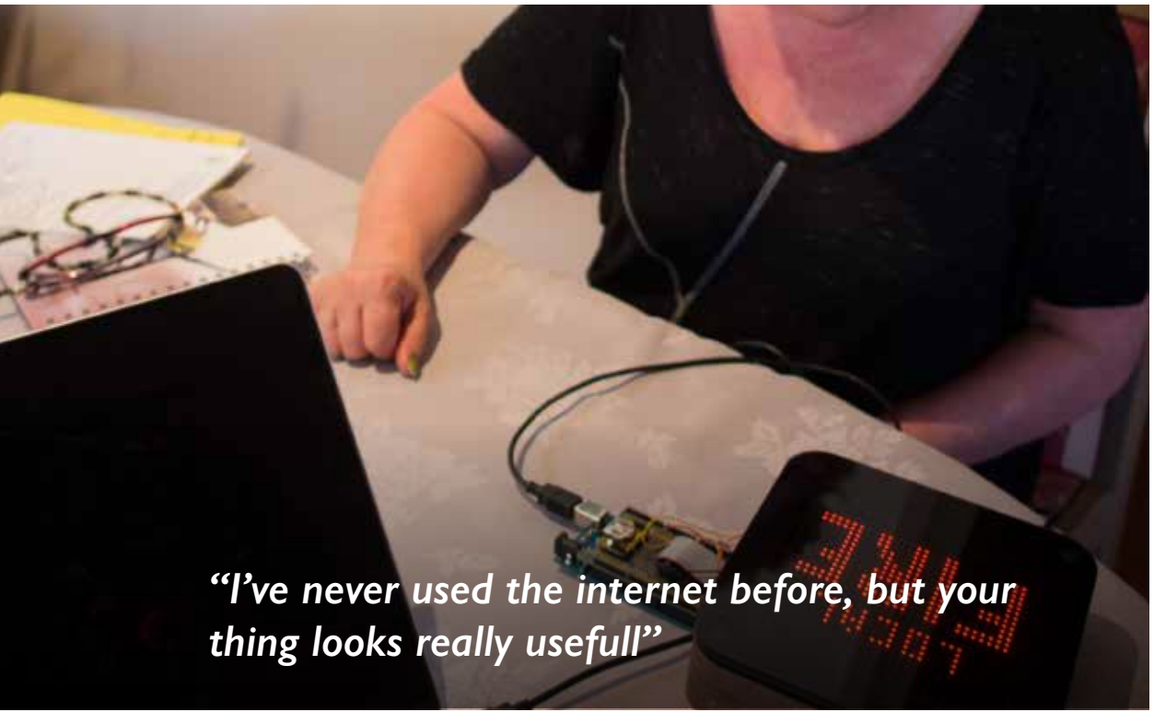
To test the impacts and effectiveness of my concept, I opted to focus on user experience testing (UXP) as my main method. Due to the nature of the issue I am tackling, getting a definitive answer to the question 'does my proposal markedly improve the number of residents that make a definite choice between staying or going well in advance of fire seasons' is simply impossible to achieve within the time frame of this project. Instead I have focused on having one on one meetings with residents in their homes, to discuss the project, the functions of the devices and their potential capacity to make a difference.

Doing this has allowed me to get some very personal opinions and to eke out information about people's plans that might otherwise be hard to find (I wouldn't have guessed that 30% of the subjects would not have smoke alarms installed). These meetings were organised as an amalgamation of user experience testing, laddered interviews and survey techniques. I had a list of questions and problems to discuss, with the goal being to get as many thoughts and opinions on the problem statement, interface, aesthetic, and capacity to change the users mindset as possible.

Through this process, I was able to interview a number of my target audiences, including a resident in her 70's, a few couples in their 50's, a family with parents in their 40's, and a number of 20 somethings that grew up in the area.



ELDERLY COUPLE 1
RESIDENTS OF WARRANDYTE FOR 40 YEARS



Have you lived in a community during a fire event?
“Not really, we were here in 91, but we weren’t at risk. We had 100 people here on black Saturday and we were all pretty oblivious to any info. This January I chose to leave in a fire, as I had my 12month old granddaughter here. My son who is a firey told me to leave”

Key in-home display comments
“Its quite attractive” would it have a place in your home? “Yes, absolutely, its really nice”

“up to about 200$ would be good”

Key smartphone app comments
“I don’t think I’m qualified enough to help others. That’s what the cfa is for.”

“Looks pretty simple. I can read it. I can understand whats going on”

RETIRED COUPLE
RESIDENTS OF WARRANDYTE FOR 45 YEARS

Have you lived in a community during a fire event?
“Not a serious one, we have a pump and allot of gear. Our first choice was to stay and defend, but now with my age we will be going at first warning. We’ve done that 3 times already. Our last ditch effort is the swimming pool, and we have fire blankets”

Key in-home display comments
(the fire messages are) ” fairly obvious, but our intention is to definitely leave”

“$100 would be fair”

Key smartphone app comments
“I already have one (a weather app), yours is easier to read though”

(would you use the phone tree?) “Yep. We don’t have one, we currently haphazardly call people.”

(would you check people plans?) “Possibly not, I don’t think so. I know allot of their plans already, and I know my plan. good idea though”

ELDERLY COUPLE 2
RESIDENTS OF WARRANDYTE FOR 51 YEARS

Have you lived in a community during a fire event?
“Yes, we decided to hang around, last year though we evacuated as I’m no longer young enough to defend”

Key in-home display comments
“They should definitely have the siren (cfa call) again. It depends. Especially around here, where its really hard to evac, really early warning is really important.”

“I don’t really like it, it’s a bit too modern. I wouldn’t buy it for its beauty, but it looks really useful”

Key smartphone app comments
“That’s particularly important (emergency notices) , because you could be in a state of panic and it gets really quickly to the point, especially if people aren’t thinking clearly”

“Oh yes, absolutely. (check the choices of others) I don’t normally do that, I just leave because I don’t have time to be banging on doors, but your system is extremely easy to use.”

MIDDLE AGE FAMILY
RESIDENTS OF WARRANDYTE FOR 17 YEARS

Have you lived in a community during a fire event?
“On a holiday. At a conference in Warberton. We had planned to evacuate. About 25 years ago”

Key in-home display comments
“Display is too bright. Wind speed info would be nice”

“People in black Saturday didn’t know there was a fire until they actually heard it”

Key smartphone app comments
“The size of the font is nice, as its big. Nobody will need to get their glasses”

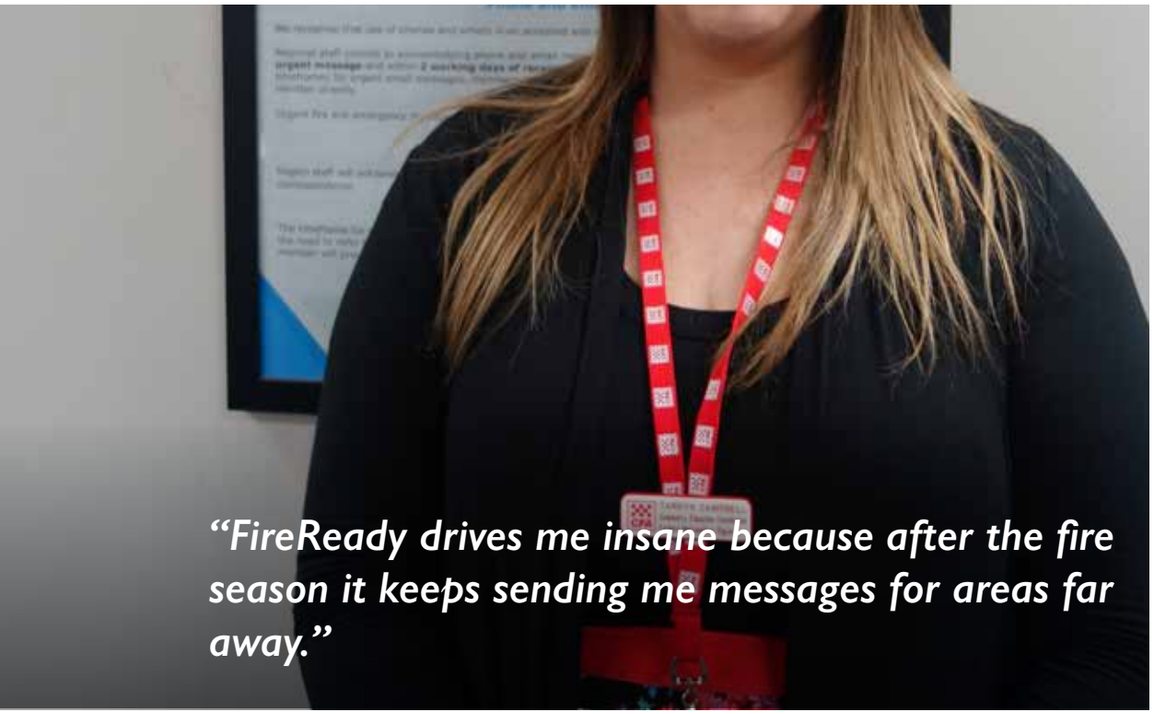
“Maybe include the bushfire information line, and the SES”

“We’ve had plenty of people come and look at the design of our fire shelter”

“Knowing when the non burn off period would be good, maybe implementing a fire calendar with this kind of info”

“Many of the new people that move in are really willing to do this sort of thing, and we have had lots of help from our own neighbours”

CFA STAFF
RESIDENTS OF WARRANDYTE FOR 41 YEARS



“FireReady drives me insane because after the fire season it keeps sending me messages for areas far away.”

Have you lived in a community during a fire event?
“Ive had to evacuate, on ash Wednesday, and the fire last year”

Key in-home display comments
“I like it, it’s a good idea to have something in the actual house for warnings. Battery is important”

“$50 seems right. Info for fires up to 15km’s away would be good”

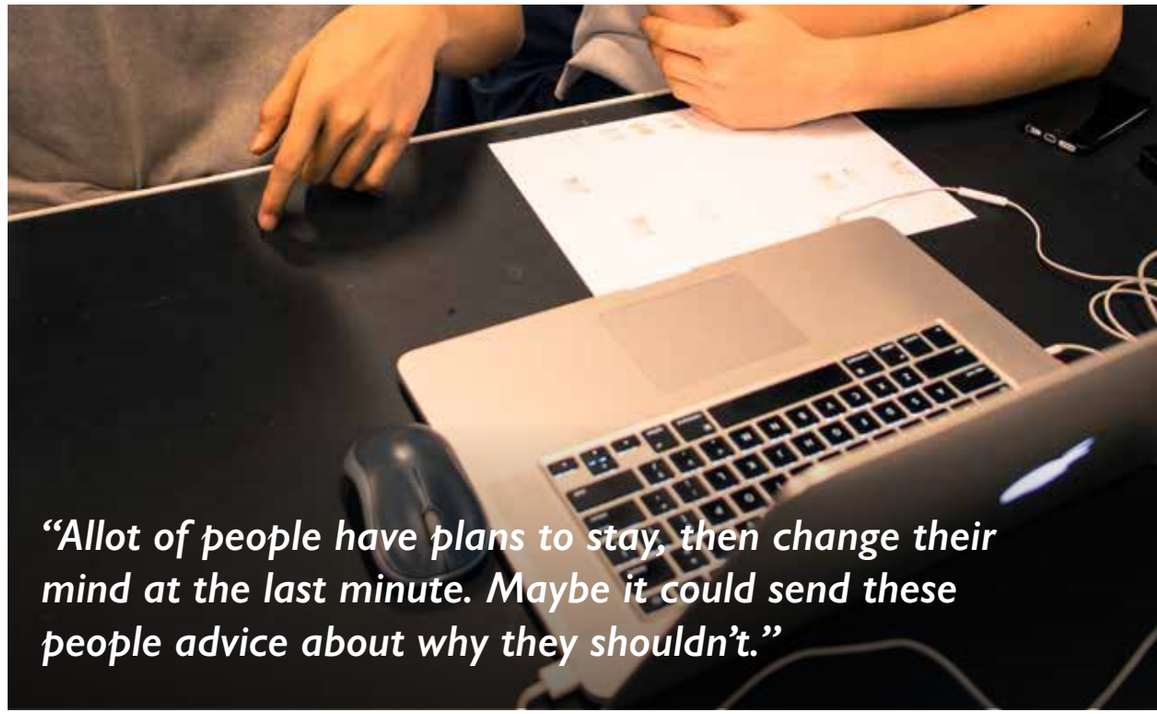
Key smartphone app comments
“It seems pretty easy, but thats why I have kids”

“I already have an app for that” (weather info)

“Most people do their own thing, and don’t want/need help”

“If it was simple enough, then sure, but I have no motivation to do so” (phone trees)

YOUNG RESIDENTS
RESIDENT OF WARRANDYTE FOR 17 YEARS



“Allot of people have plans to stay, then change their mind at the last minute. Maybe it could send these people advice about why they shouldn’t.”

Have you lived in a community during a fire event?
“No. technically I wasn’t there when it happened”

Key in-home display comments
“It glows red, which is pretty cool. Im pretty close so its kind of hard to read, but if I was further away it’d be easier”

“Maybe use a lcd screen rather than this pin point scree. It’d actually fit in pretty well in my place. Making it available in different colours would be cool, definitely thinner.”

Key smartphone app comments
“Make the fdi bar a little bigger. More obvious”

“Might be a good idea to be able to add extra people to the phone tree, like our cousins who live a few streets away”

“Would be great as a black box of sorts, then after a fire the cfa could know which houses to search first”

YOUNG RESIDENT 1
RESIDENT OF WARRANDYTE FOR 12T YEARS

"Coming into summer you always forget to revise things, I don't think weve gone over our plan for years. But if there was something in your face its a great reminder"

Have you lived in a community during a fire event?
"Yes. It didn't have a name, but theres been a few. Plan is to pack, clear away the house, put out the splinker system, let the horses out to escape as they choose. Then usually we take small animals and docs and go. One time we had a fire 100 metres away, like a wall of fire and we didnt even realise. That was pretty scary"

Key in-home display comments
"I think its quite modern and nice. Its not too big. Maybe some of the screen colours might annoy people, but its good that it's visual"

"integrating it with stuff like the weather radio etc, makes it usefull outside fire situations all year"

"The fire warnings are really effective. Its good that its really red, there is a clear difference to normal use"

Key smartphone app comments
"I think its really good. I like all of it to be honest. Even for older people, its user friendly for them, easy to learn and highly functional."

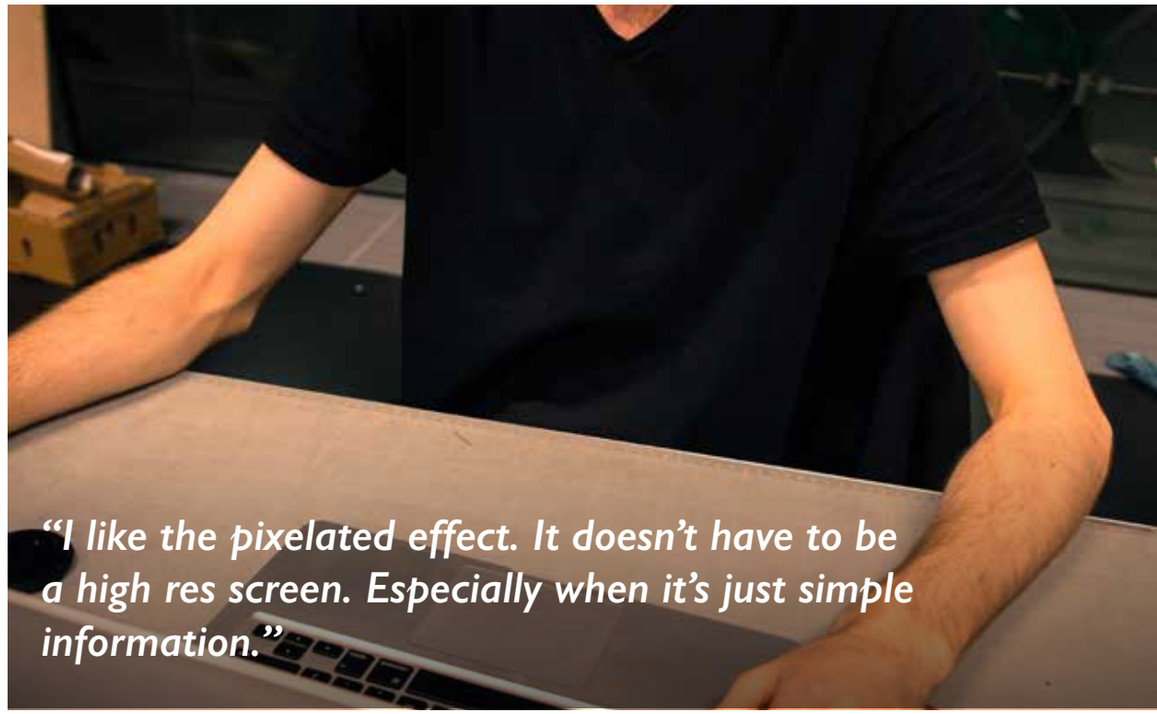
"its great having a way to encourage the community to get together"

"Its good that the weather is really obvious Maybe put in an hourly forecasting feature."

"like that the phone tree is visual and that anyone could use it. Connecting to people is really important and doesn't often happen"

"As a neighbor I'd use it to make sure properties around me are doing theire stuff, and if everyone is leaving I might do the same"

YOUNG RESIDENT 2
RESIDENT OF WARRANDYTE FOR 18 YEARS



"I like the pixelated effect. It doesn't have to be a high res screen. Especially when it's just simple information."

Have you lived in a community during a fire event?
"Ah, yeah… black Saturday. That rode right across the back of my suburb, I was there at the time. I wasn't concerned about the fire, as I understand the weather."

Key in-home display comments
"Its really nice. Yeah I think if it came in a white plastic, maybe different colour of veneer... I'd install it on my wall"

"With all those features, it's definitely worth more than $200."

"The fire icon, looks pretty weird. Maybe something more relatable, maybe throw in some orange"

Key smartphone app comments
"I reckon, maybe, over summer a helluva lot of people are away. If you could determine whether people where away from home. So you could save someones dog if you saw they were on holiday. "

"Can you add other people to your phone tree?. Having a distance based map might not work for people with large properties"

"Im pretty switched on, but my mother might not understand it"

"It's a good idea, but are people selfish? What if people don't use the app in a fire and just leave"

"I probably wouldn't look at their choices, because most people are idiots, but for an area like Warrandyte. Id prefer the app to just tell me what to do"

KEY FEEDBACK & ACTIONS

The UXP testing sessions went far better than I had expected them to. Without exception, all of the people that I engaged were wholly willing to talk about bushfire risks, their experiences, and their ideas about what needs to change in the way things are done. A number of residents who do not use smoke alarms told me so after stating that 'there isn't any point in lying about these things I guess', which was a strong indicator that they were extremely interested in new ways of dealing with their daily risks.

Feedback was very positive across the board, with some people being very happy with all elements of the proposal, and others that loved the ideas and features, but would prefer them to come in a different aesthetic.

One group that I was unfortunately unable to test accurately were residents that were specifically distant from fire issues. While wandering around Warrandyte knocking on doors to try and get people to participate, there was a small number of homes that immediately declined to review my work, but it was always under the pretense of being too busy with something around the house. Because of this I cannot be entirely sure that they fit my reclusive archetype, but I was able to talk about residents with distant qualities with a few of the participants. The overall opinion here was that those that do not adequately plan would be well served by a system like this, and many of the participants claimed they would be more than happy to use the phone tree map to observe the actions of others and to offer assistance.

REVISIONS - IN-HOME DISPLAY

Almost universally the in-home display was considered to be an extremely useful device in the user experience tests, however a number of people had suggested that it was;

A: too bright and colourful

B: too large and bulky

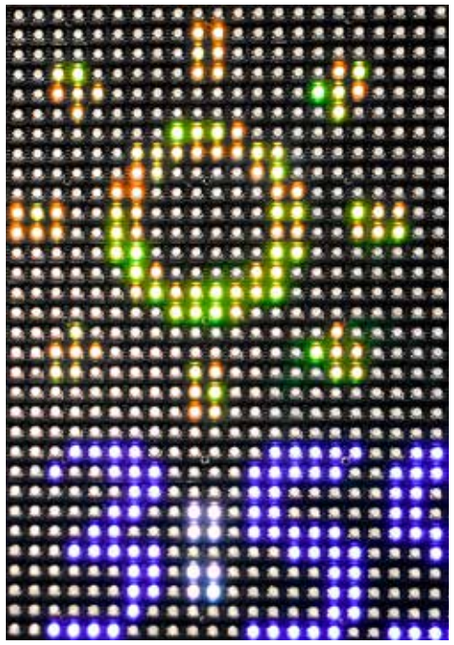
C: that they would prefer that it was available in different colours,

D: that it would be great if it could replace the recently deactivated CFA 'call to arms' siren, which was shut down after an influx of noise complaints

To the left I have rendered the device in a number of different colour and material schemes, which would all be relatively easy to create in mass production. Particularly popular was the choice to have it in all white plastic, however as a form study I also decided to play with different colours, timbers, and clear options.

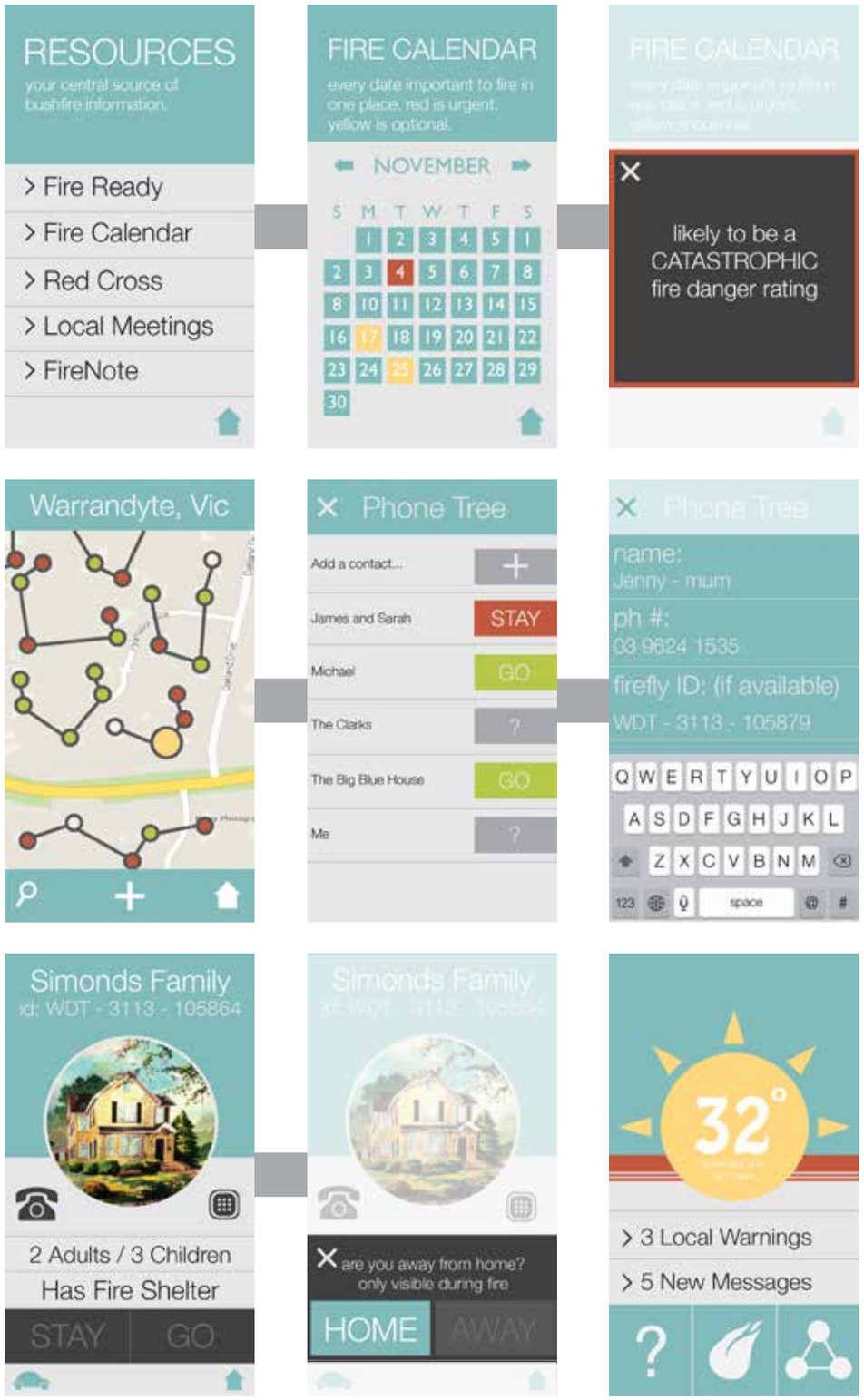
On top of colour choices, I've added a rendering of the device with a 80% reflective coating, that would transform the display into a mirror when not in use. When switched on though, or when transmitting a message from the CFA, the pixels would shine through the surface.

Due to the closeness of my project deadlines, I have not added a speaker to the display to be used by either a radio or the CFA alarm, however I have drilled mock holes into the display to represent the location of speakers, and have created an additional animation sequence to represent these warnings on the display.



In response to the devices dimensions, I've mocked up a version of the display with a thinner shell to show the difference it would make in the devices aesthetic. With the current hardware being used, making it smaller is almost impossible without a complete overhaul of the internal mechanics, but in mass production with the use of a custom made PCB it could be slimmed down by almost half.

Although difficult to demonstrate in this book, I have experimented with dimming the display, and will set it to a level appropriate for the brightness of the room it will be exhibited in. In real world use, it would ideally have a light detector built into it, to allow it to automatically adjust its brightness in the same was that a smartphone display does. It seems as though the display I am using in my prototype is able to adjust the brightness of red's quite easily, but struggles to do so with blues and whites. This is likely a voltage issue, which would be remedied by a more finely tuned power adapter running to the display, but could also be a symptom of the displays capabilities.



In response to the feedback from the user experience testing, a number of key features have been added to the phone app. Not all suggestions were added, but four features were suggested by a number of the participants, and fit in quite well with the objective of the app.

The first was to include an inbuilt calender that can be updated by the CFA or the local council, which allows easy access to information about legal burn off periods, hard rubbish collection days, predicted danger ratings and community education events. This calender was added to the resources page.

The second was to allow residents to add extra people to their phone trees outside of the ones the alloted. Doing so will allow people to easily contact friends and relatives that live well away from them, and to add close friends and relatives from within their suburb. This feature was added to the map page, which now also allows residents another means of viewing those within their phone tree. To make this work as simply as possible, I've also assigned each property with a unique ID, that will allow for better integration of neighbours..

The third is the ability to indicate on your property page that your household is unoccupied, either because you are on holiday, or have elected to evacuate early on a high risk day. This will be visible to other people only during fire events, and only if they are in your phone tree.

Lastly, a few people had suggested that I make the FDI indicator on the homepage more visible, which has been done by making the coloured bar more obvious. I have avoided using symbols of words here, to try and keep it looking as friendly as possible, so as not to scare off some users.

User testing presented issues and comments that I had not entirely expected. Many of my concerns proved to be void, and a number of my assumptions regarding form were not corroborated by the participants. Where I had assumed that the display was quite friendly (likely through my regular interactions in coding it) many of the participants found it to be too garish and colourful. The form itself was mostly appreciated though.

The phone application received almost universal approval, with many users finding it extremely simple to use and understand, and with many of them seeing its immediate usefulness. There were a number of suggested additions to the applications functions, which were all things that had not occurred to me, and in hindsight make perfect sense. Both these and the suggestions regarding colour options for the in-home display were all incorporated into my designs for presentation in exhibition.

The concept of formalising the phone trees system was especially popular, and many of the participants recognised that their normal system was rather haphazard and untrustworthy.

Many of the users understood the independent functions of the in-home display and the smartphone app. They saw that the wall mounted display could act as an immediately recognisable warning, whereas a phone based warning could easily be ignored or left unnoticed. The phone itself however was seen to be especially useful outside fire periods to organise fire plans.

To the field of bushfire management I have strived to develop a system that can allow the CFA to better inform their residents while still conforming to the current legislation surrounding the issue. By giving residents a tool to encourage conversation and planning, nobody should be left uninformed. Extrapolating on the success of my findings, I believe that I have developed a potential solution to the issues surrounding bushfire complacency in residents. The system's capacity to allow communication between residents appears to also successfully motivate some residents to ask for, or offer assistance with fire management plans. By implementing this system into the CFA's set of tools, it will also make the process of finding and helping people in fires a more manageable task.

Looking forwards, the next stages of the projects research would be to;

1: Develop new aesthetics through a co-design methodology, to ensure that there are forms that are available on a budget, and forms that will fit comfortably into a wider range of homes.

2: Conduct a more extensive study into the development of pictograms and ideograms and colours to be used across the service, to ensure that all messages are being relayed extremely clearly to people of all ethnographies, ages and genders.

3: Conduct testing and engineering of the AX.25 packet radio delivery system to ensure that messages are relayed accurately, and that it functions well in low power and smokey environments.

4: Manufacture a small run of working prototypes to be distributed amongst a sample group for a 12 month period, and compare their initial and final plans, and their opinions of fires to be measured against a sample group without these devices.

The outcome of this project is the evidence that hesitant resident's of at risk communities

are extremely open to new methods and tools that will help them keep their peace of mind, and that tackling issues that cause people great stress through the lens of design thinking is potentially a necessity in ensuring adoption and success.

I have never been able to articulate a clear definition of the term 'industrial designer', but this project has taught me that it's one that needs to be able to take on many roles to fit any given situation. Having studied design methods and research practices was both necessary and useful in planning this project, but actually creating my own methods and putting them into use has been an experience to say the least. All of the hypothesis in this project were distinctly tied to my initial research, which showed me a clear problem to tackle. I can only hope that anyone outside of the field that reads through my work will take away from it the importance of putting the people it affects first, and to drill down and break apart the problems they are tackling into clear elements to work on.

In all, I'm very happy with the results of my work, and am glad that I chose bushfire as a focus for the project. It has been an area with huge capacity for change, and one that is close to many people in Australia. I can only hope that my work is taken forward in the future, and that it has a positive impact in the world of bushfire management and the people that live within its grasp.

ENDNOTES

CFA
Country Fire Authority - The fire service that provides service to all country areas and regional communities in Victoria. Its members are primarily made up of volunteers.

CSIRO
The Commonwealth Scientific and Industrial Research Organisation is the Australian governments official centre for scientific research. It studies a wide variety of fields, including climate change and all manner of bushfire related topics

MFB
Metropolitan Fire Brigade - The Victorian fire service that handles metropolitan areas. All members of the MFB are paid, full time firefighters.

CRC
Cooperative Research Centre - A program set up by the federal government in 1990 to develop industry led research centre's focused on developing Australia's primary economic fields.

'At risk area's / communities'
Areas of Australia that go through yearly fire seasons, and do not have natural barriers against fire risk. Almost all areas of regional Victoria are at risk areas.

UXT
User Experience Testing - A design research method which examines and quantifies the experiences that users have with designs. This is particularly important for interface design, and any designs that serve in critical roles

Arduino
A hobby prototyping kit for electronics. See page 68 for a more detailed description

CAD
Computer Aided Design - Can be meant to mean allot of different things, but for this proposal, CAD refers to using 3d modeling software, specifically Solidworks.

Firenote
A periodical published by the Bushfire CRC. Each issue covers a singular research topic, and usually serves as an executive summary to the researchers full work.

Climate Commission
A federal government owned organisation that served as its primary source of information for all things related to climate change. It was intended to serve as an independent source of information, but was controversially scrapped by the Australian government in 2013

Climate Council
After the Climate Commission was scrapped, its employees opened a crowdfunding campaign to re-open as the Climate Council. This campaign proved to be the largest crowd funded project in Australian History

Bushfire CRC
The CRC that focuses on bushfire research, from its current day effects, to future effects. Its focus is primarily on how bushfire affects the Australian economy, as all CRC's are wont to do.

RGB
Red, green, blue. The three colours that human eyes are receptive to, and by mixing them any colour can be achieved. All televisions, computers and electronic devices with colour screens display their images in RGB.

LED
'Light Emitting Diode' LED's are the modern day replacement of incandescent globes, and function by sending an electric current through a diode which (funnily enough) emits light when electrified. These diodes are made from a number of different materials, depending on what colour light is desired.

Adafruit
An American online store that specialises in hobby electronics, they both produce and supply an incredible range of very high quality Arduino components. They also design and manufacture the 'NeoPixels' range of RGB LED's which were used in this project. On top of all this, they often manage to get deliveries from the USA to Australia in under a week

Bitmap
A bitmap is a digital image format, where each individual pixel is assigned a value of either 1 or 0 to define black or white. They are an uncompressed file format, which means there is no blurring between pixels. Bitmaps were used in this project to convert images for the in-home display into data arrays.

Data Array
A data array is data that is often arranged in a grid like manner with rows and columns, but can also be a string of information. Data arrays were used here to display images on the in-home display by defining each pixel of the screen as either a 1 or a 0, to define 'on' or 'off'

C++
Is a coding language derived from the base C language, and is what the Arduino coding language is heavily based on. If you can code in C++, you can code an Arduino.

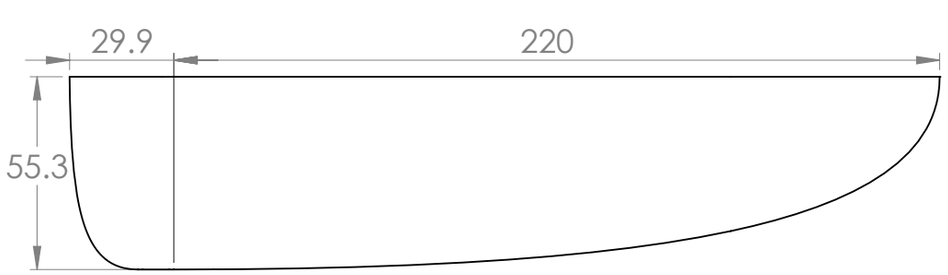
Anemometer
Wind speed sensor (see page 66)

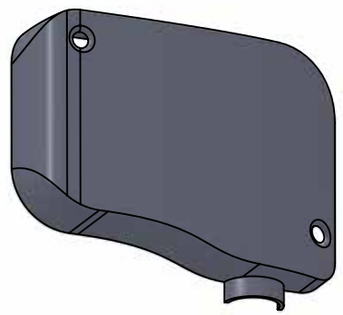
Hydrometer
Relative humidity sensor (see page 66)

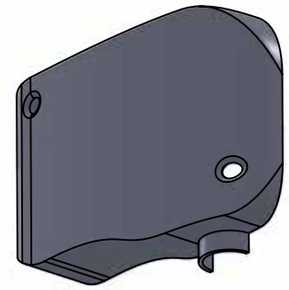
Thermometer
Temperature sensor (see page 66)

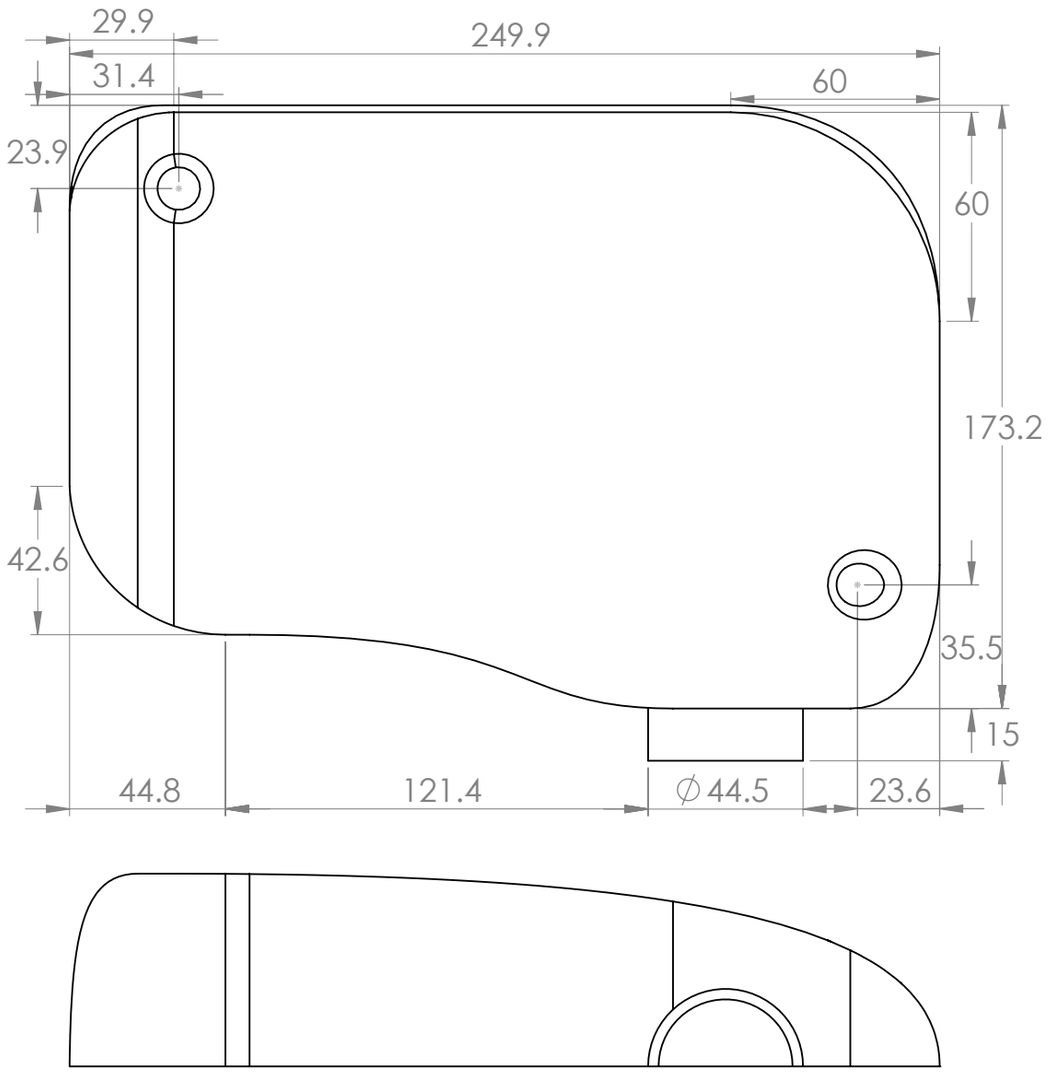
Photodetector
Visible and UV light sensor (see page 66)

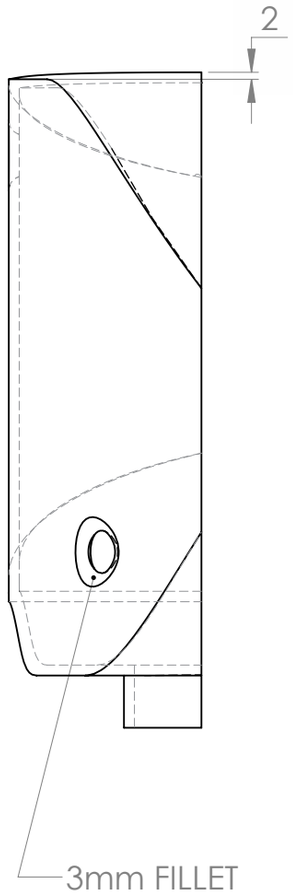
Wind Vane
Wind direction sensor

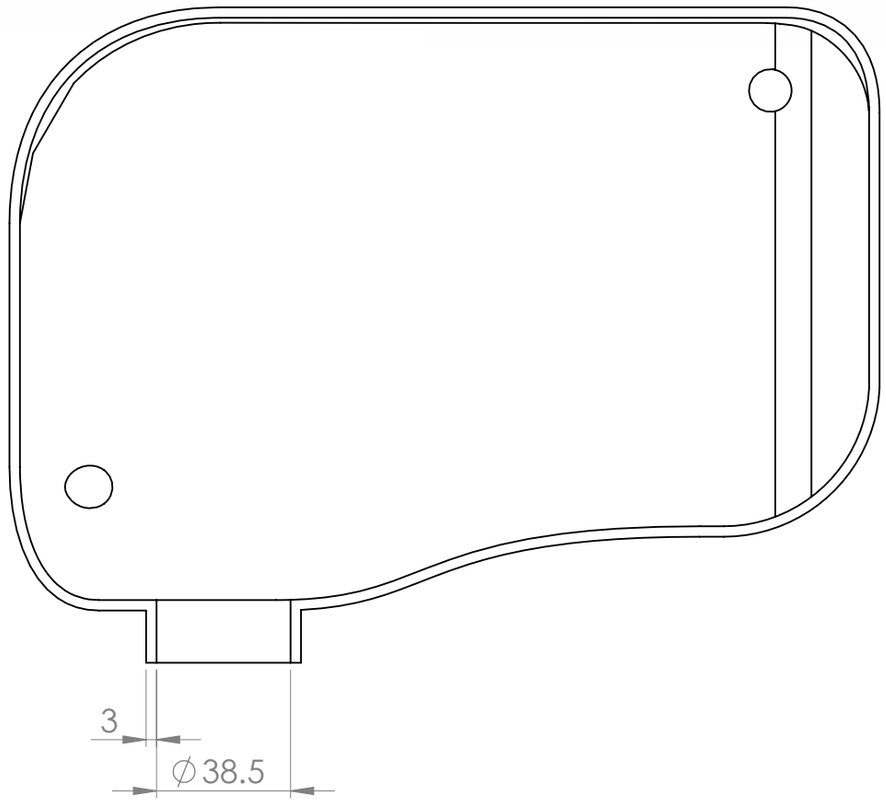




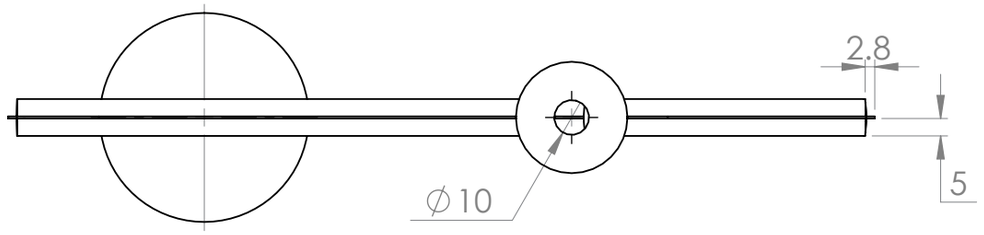


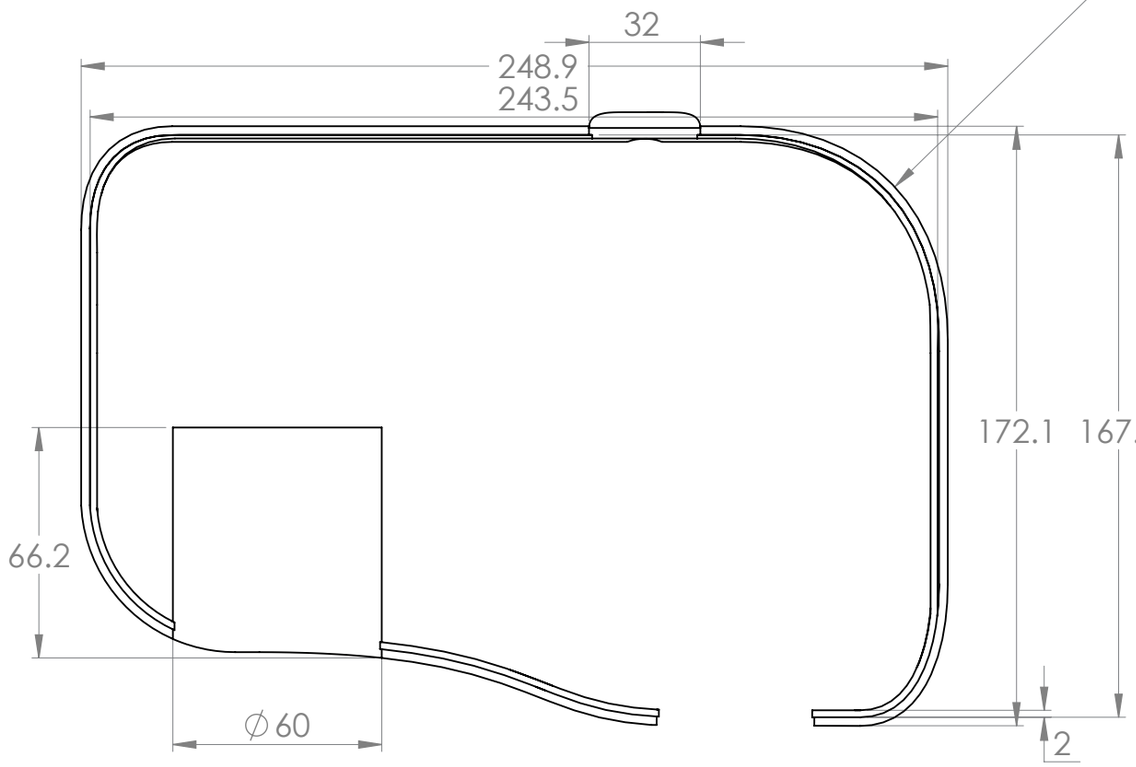






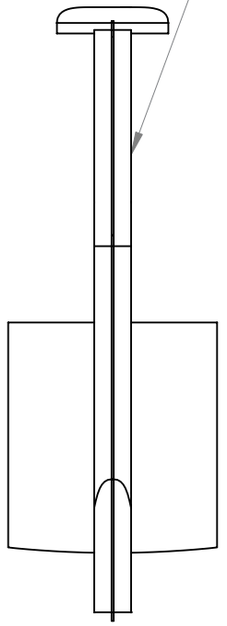
Project: Setting Communities Alight - Weather Station	Left Shell.	Sheet 1 / 2		Scale: 1-2	Drawn By: Darby Bicheno

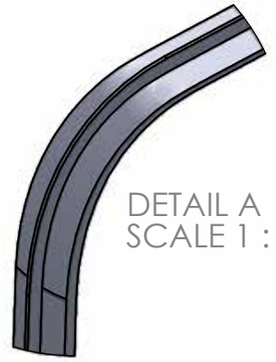




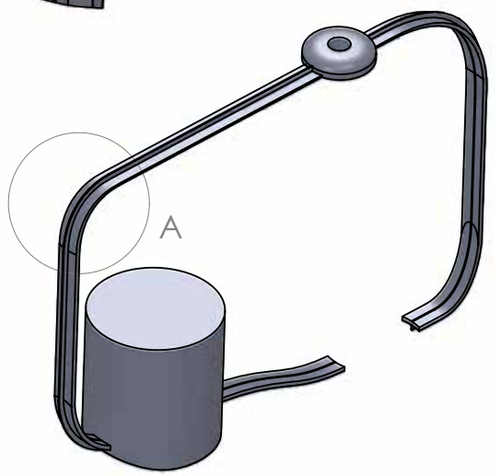
Acts as a shadow line,
seperating the 2 halves by 0.8mm

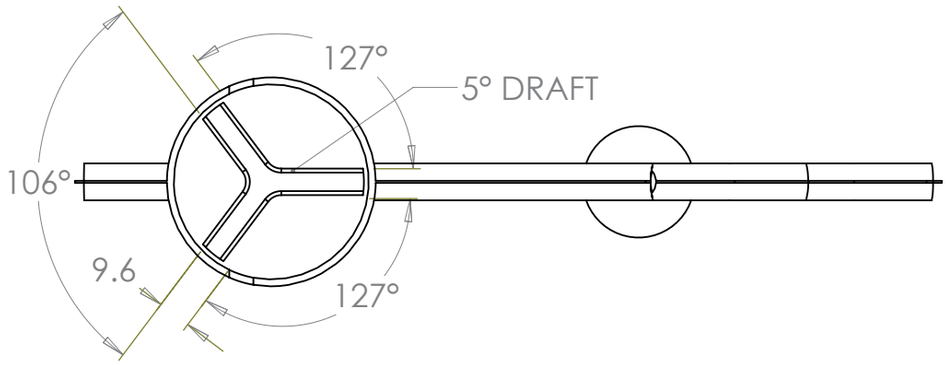
Holds the shell forms rigid



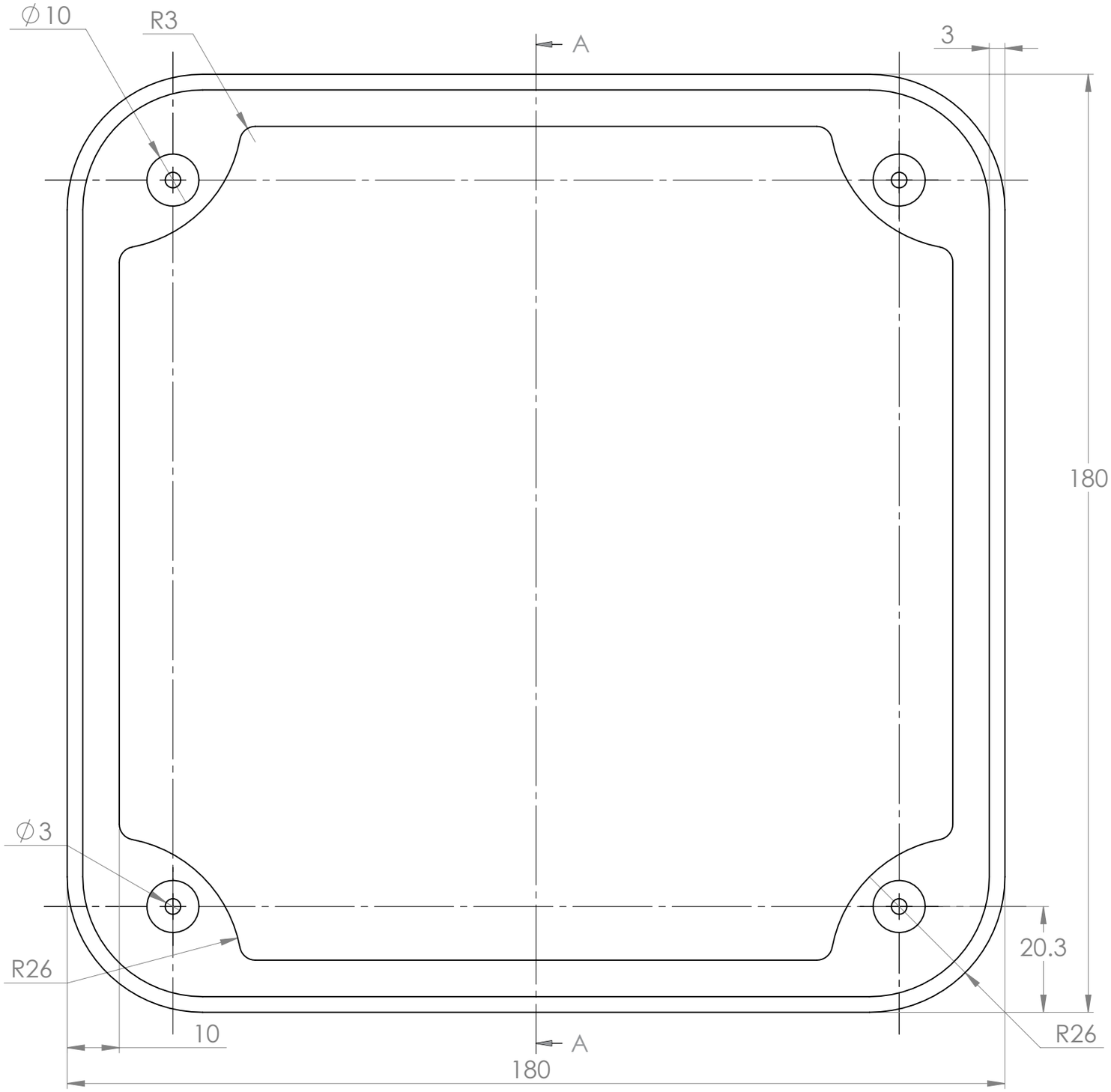


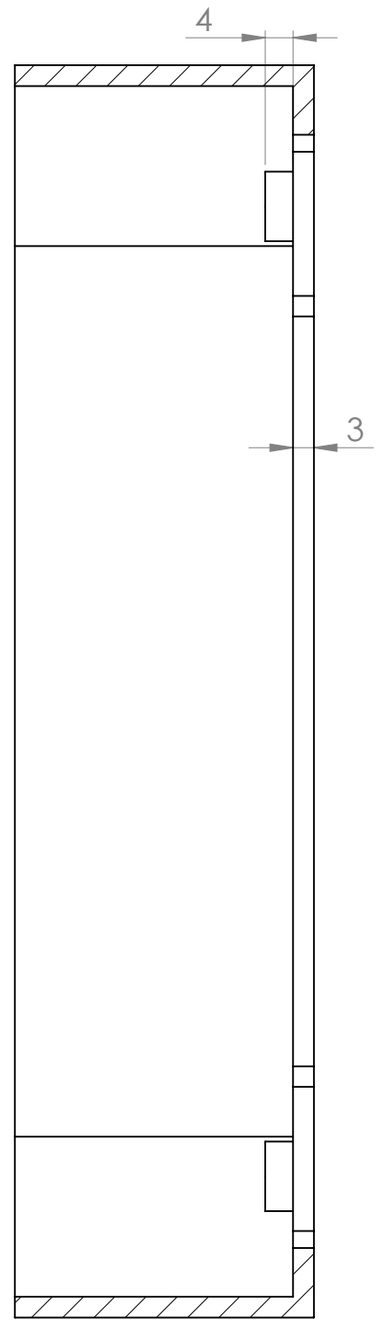
DETAIL A
SCALE 1 : 1





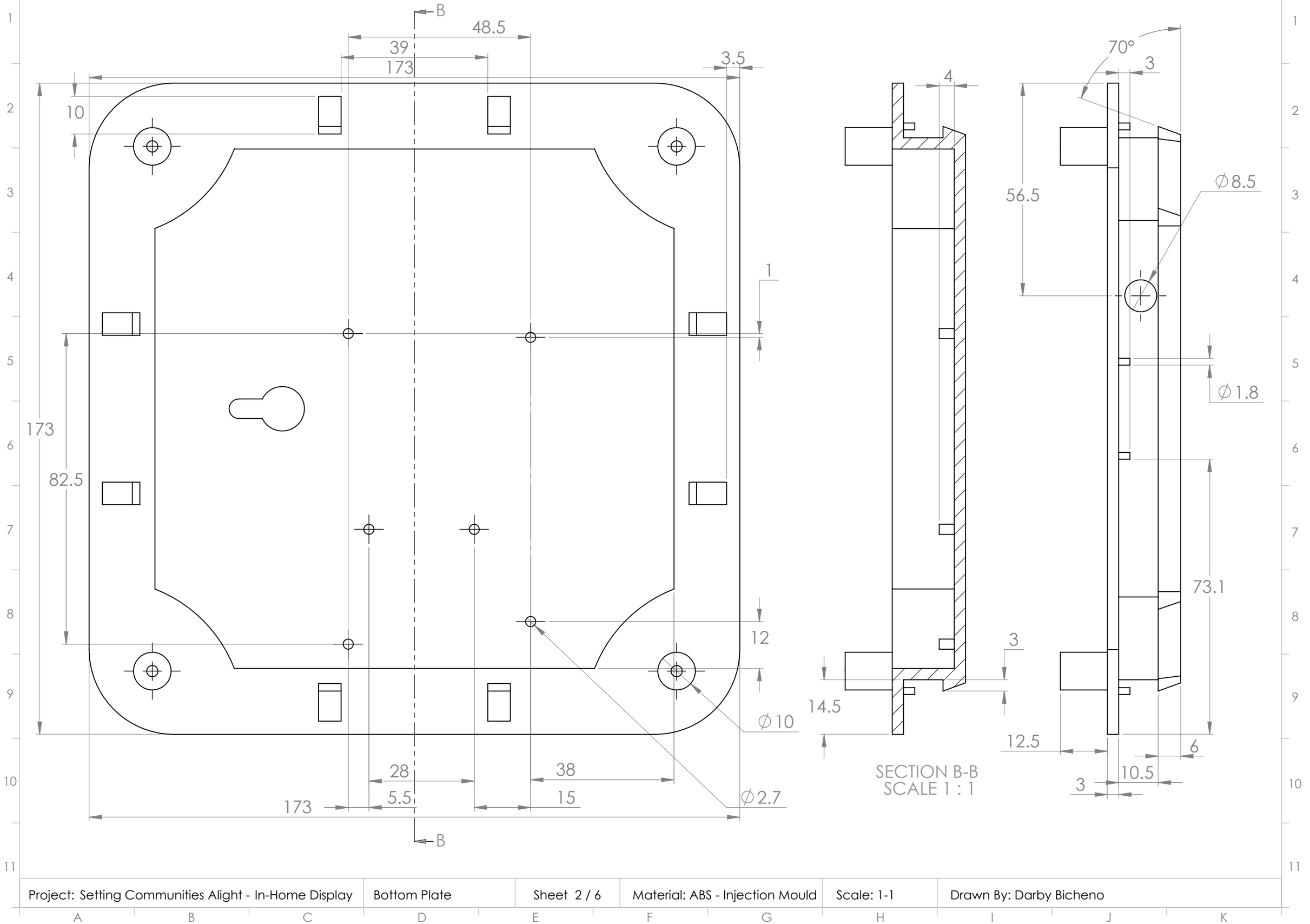
Project: Setting Communities Alight - Weather Station	Part Line	Sheet 2 / 2		Scale: 1-2	Drawn By: Darby Bicheno



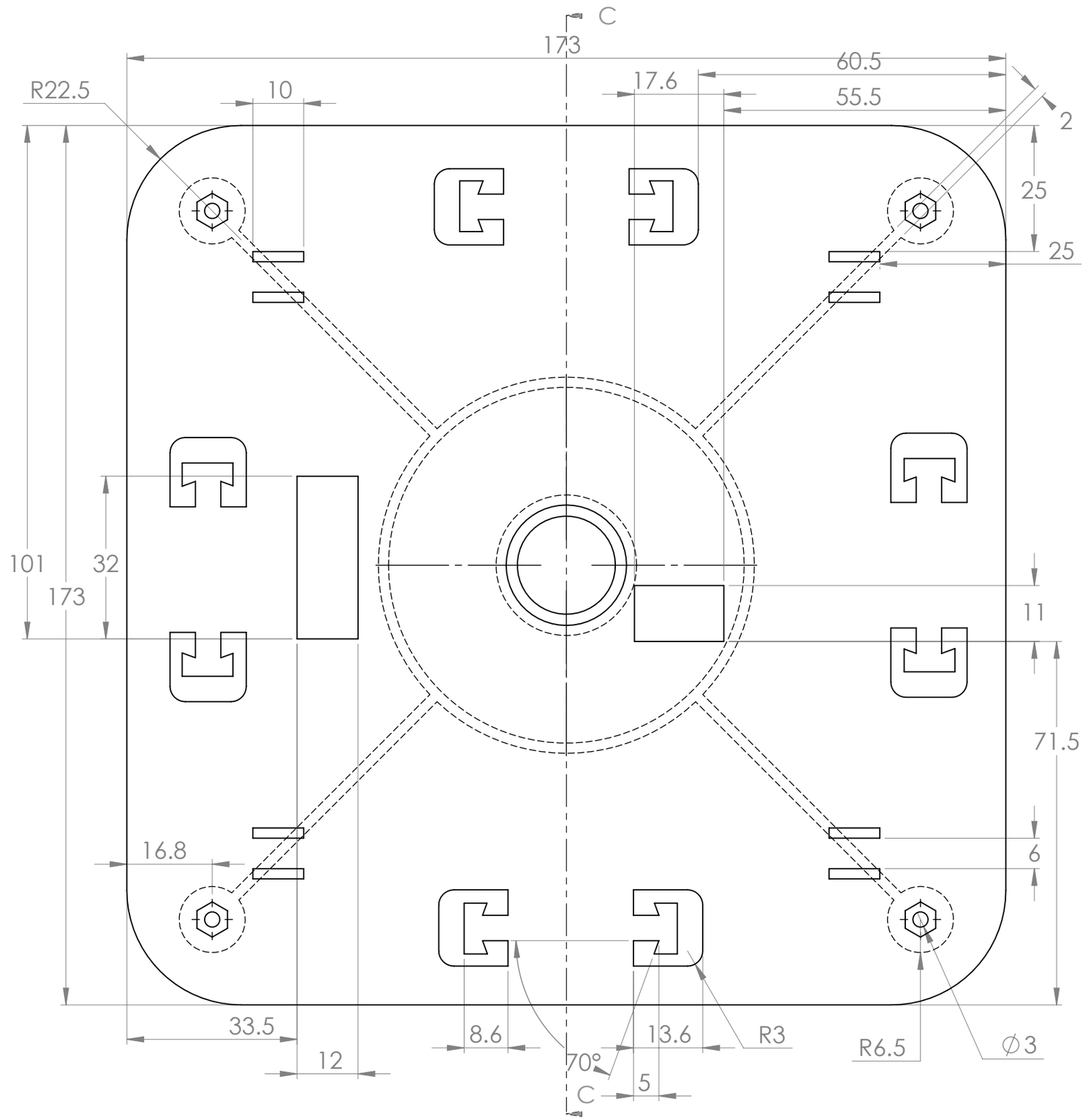


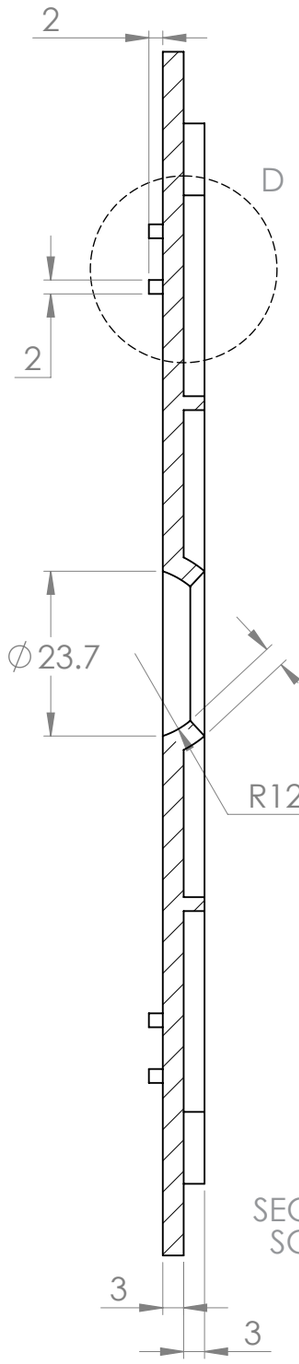
SECTION A-A
SCALE 1 : 1

Project: Setting Communities Alight - In-Home Display	Part: Outer Wall	Sheet 1 / 6	Material: ABS - Injection Mould	Scale: 1-1	Drawn By: Darby Bicheno



Project: Setting Communities Alight - In-Home Display	Bottom Plate	Sheet 2 / 6	Material: ABS - Injection Mould	Scale: 1-1	Drawn By: Darby Bicheno

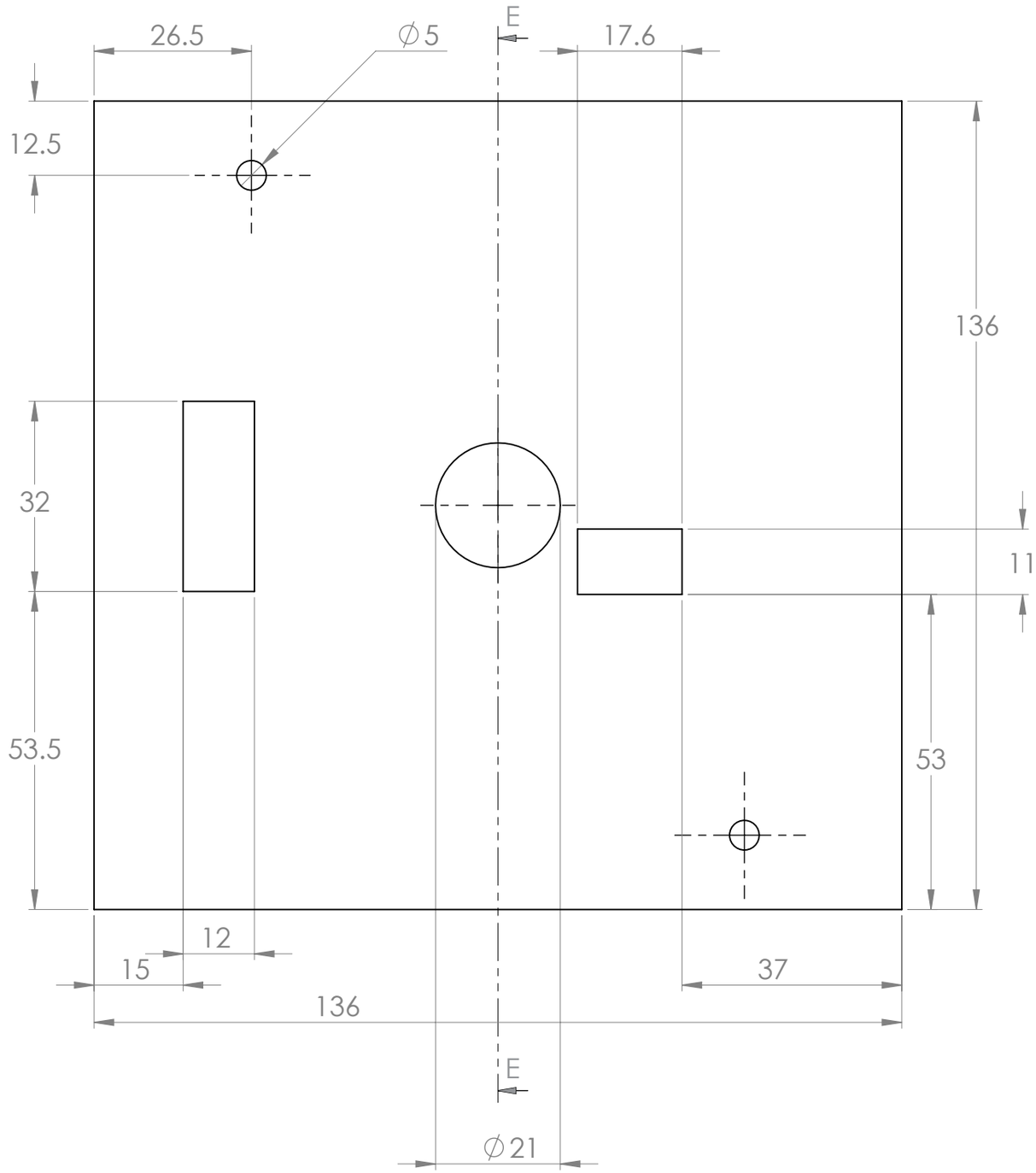


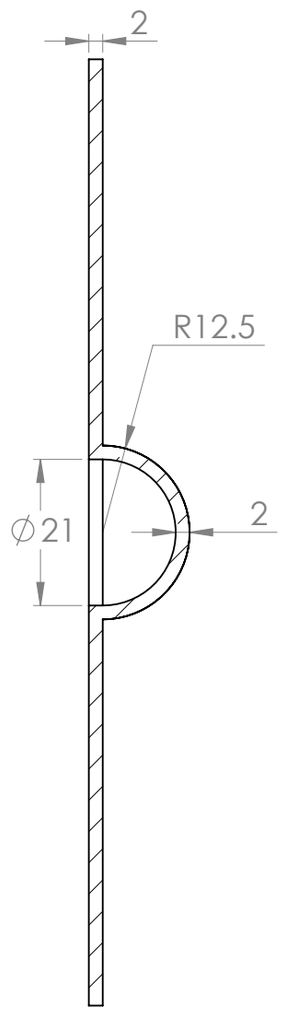


DETAIL D
SCALE 2 : 1
(SECTION)

SECTION C-C
SCALE 1 : 1

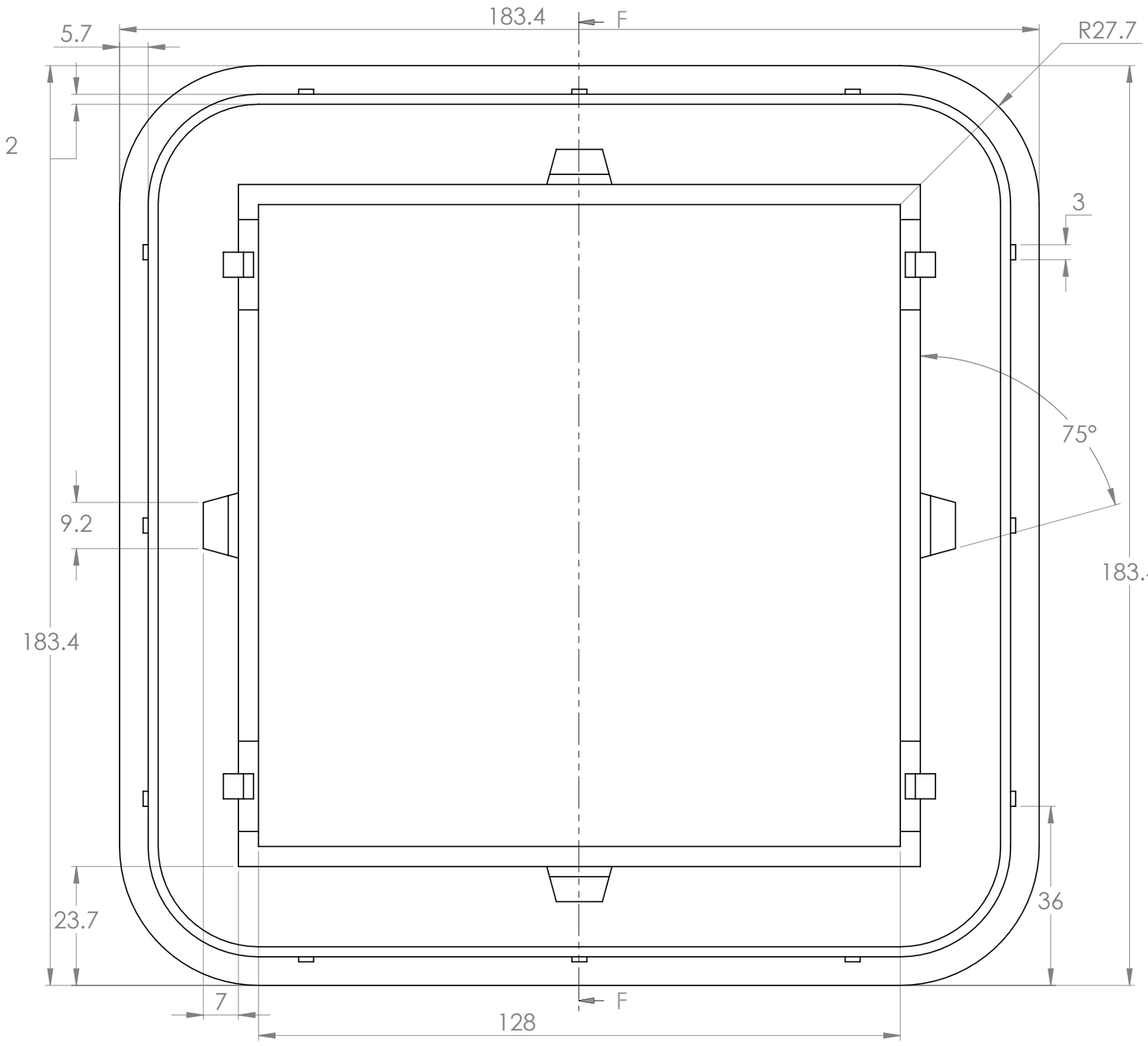
Project: Setting Communities Alight - In-Home Display	Internal Bracket	Sheet 3 / 6	Material: ABS - Injection Mould	Scale: 1-1	Drawn By: Darby Bicheno

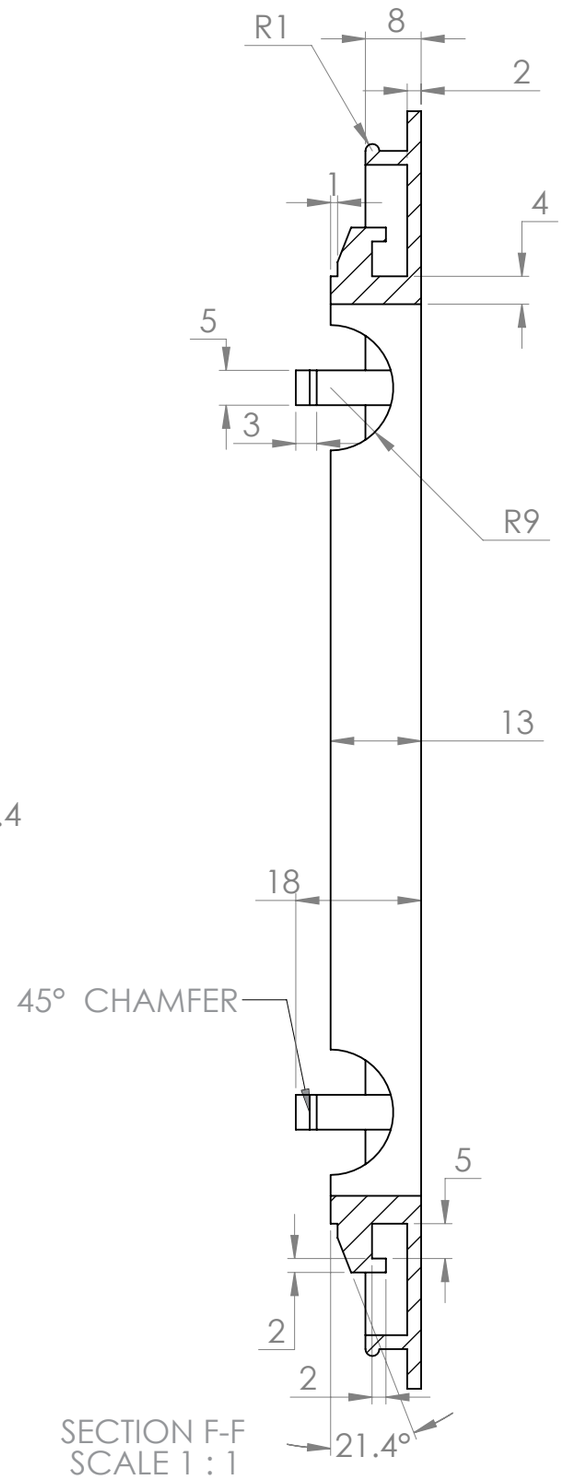




SECTION E-E
SCALE 1 : 1

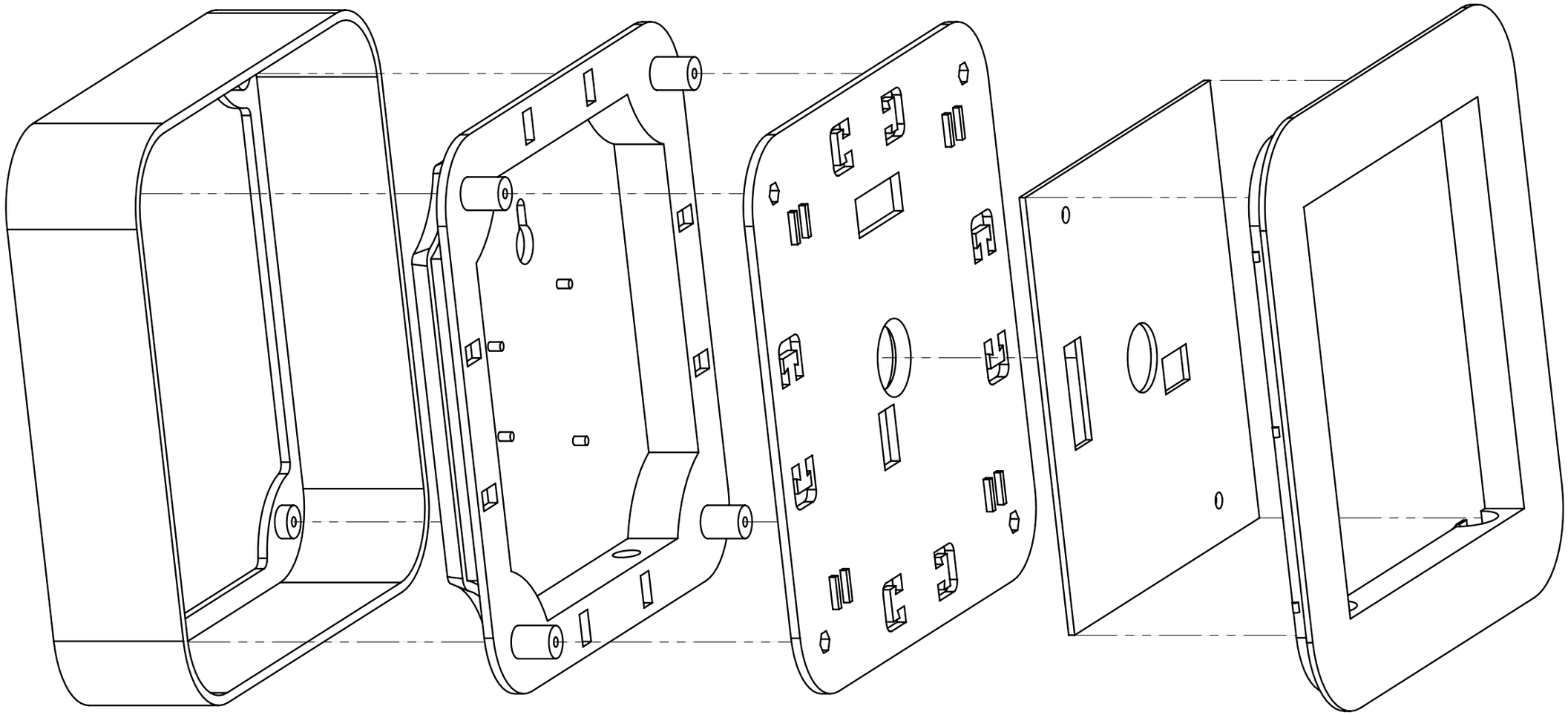
Project: Setting Communities Alight - In-Home Display	Part: Sliding Plate	Sheet 4 / 6	Material: ABS - Injection Mould	Scale: 1-1	Drawn By: Darby Bicheno





SECTION F-F
SCALE 1 : 1

Project: Setting Communities Alight - In-Home Display	Screen Bracket	Sheet 5 / 6		Scale: 1-1	Drawn By: Darby Bicheno



Project: Setting Communities Alight - In-Home Display	Exploded View	Sheet 6 / 6		Scale: 1-1	Drawn By: Darby Bicheno

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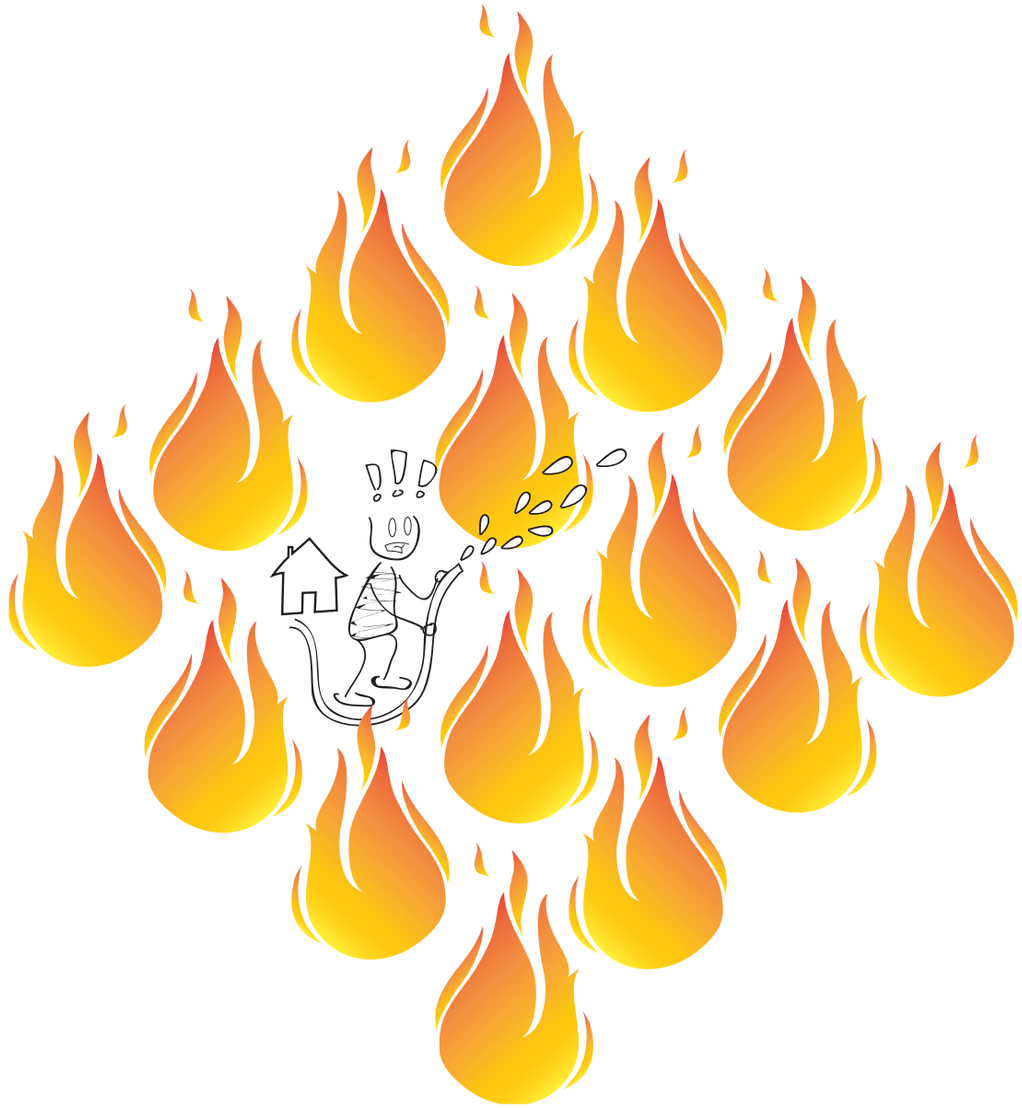

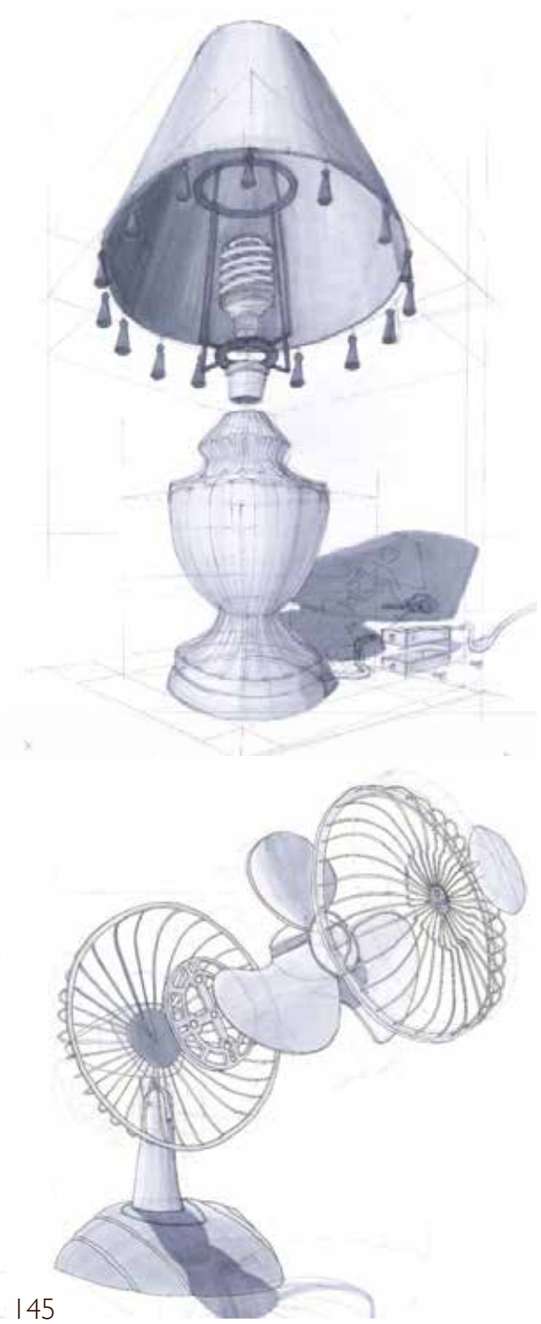

To finish up, I'm going to contextualising myself and my practices in this short reflective chapter. I'm happy to admit that it wasn't my prerogative to include something like this in my work, but I've found that following the advice of my lecturers generally bears out in ways I hadn't anticipated.

I'm writing this chapter having halfway completed the text with Phillip Glass' 'Morning Passages' playing in the background, and the manifold intentions of my reflection are starting to become apparent. Its partly to help you, the reader, understand the context and direction that my proposal was formed in, as well as to shamelessly sell myself and my skills to potential employers. Perhaps more important to myself however, is the action of thinking about, talking about, reflecting on, and understanding myself and the achievements I've made to date.

I discovered industrial design as a career choice early on in high school, and immediately decided that tackling problems through the development of tools was what I wanted to study. From that point till my high school graduation I focused on my design and photography classes above all others, but ID was not a profession that existed in the eyes of my teachers. In hindsight this wasn't such a bad thing, because it forced me to learn the fine art of explaining the role of an industrial designer to observers from an early stage.

It's easy to recognise the usefulness of drawing to the designer, but it's never been a strong point of mine. I've had to push myself through the mental roadblocks that disabled me from putting pen to paper, the result being that drawing as a means of ideation has become an important tool in my design process. Most of the drawings I do are really meant for internal use only though, and serve as a means of concreting my ideas. It's a very

iterative process for me, with each doodle an update of the last, working as a tool to keep my train of thought from derailing and to be able to pick up where I left off at another time. Developing informative and detailed drawings for internal use, and to guide construction in CAD is where my drawing skill is best applied, and the job of rendering for clients and marketing use is not something I put my hand up for.

CAD is a space that I thoroughly enjoy working within, as it's such a definite medium, but one that is also infinitely malleable. I've played around in a few different packages (and would really like to spend more time in AutoDesk Alias when I have the time), but Solidworks has definitely become my tool of choice. When I'm thinking about my ideas and designs, its always in a three dimensional manner, as I envisage form and aesthetic in my minds eye. CAD is a perfect complement to this, as I enjoy planning for and visualising how I will work form into my models through additive or reductive methodologies within the software and in manufacture. It's also a medium that allows me to create flashy presentations of my work, that I cannot achieve through drawings. I have experience with creating models that serve as prototypes and design tools, models that are made to elicit a 'Wow!' from viewers, models complete with animated exploded views and usage scenarios, and models that are made for manufacture with succinct, detailed engineering drawings and instructions.

Physical model making is something that I really enjoyed doing in the first two years of my course, but most of my projects since then have not relied very heavily on hand crafted prototypes and models. The advent of 3d printing has changed the ways that many designers, including myself, demonstrate their ideas. I still feel though that being able to craft objects by hand is a crucial skill to have, similar to the way that hand drawings and CAD complement each other. Because of this, I've make a point of directing this project towards something that will require time in the workshop, so I can re-explore and demonstrate these skills again before I finish my degree.

In my second year of study, I took an opportunity to study as an exchange student at KAIST university in Daejeon, South Korea. As a huge fan of Asian culture, having traveled extensively throughout southern, eastern and northern Asian countries, I couldn't pass up the chance to visit another place I'd never seen. Studying at KAIST was an eye opening experience for me, as it's (unbeknownst to me at the time) well regarded as one of South Korea's top research institutions. What this meant for me was sleepless weekends working on data analysis, studying and practicing user experience testing methods, and focusing on interface and interaction design. Without any doubt this 6 month pressure cooker of study taught me to confront and bypass the affliction known as procrastination, and introduced me to an entirely different notion of what it means to be an Industrial Designer.

This focus on user experience testing was something that really stuck with me, and really helped shape my philosophy of good design being tools that work for their users, rather than the other way round. KAIST's focus was primarily on the functionality of devices, and the ways that users interpret interfaces, which was fascinating to me, but the thing I really took from it was the study of the actual experience of use, and the emotions both good and bad that can be elicited through design. I have since spent my time poring over the works of the likes of Donald Norman, Donald Chapman, and Pieter Desmet to learn

about using design thinking to intentionally apply emotion and feeling to product design.

One element of emotional design that I see as having huge potential is the idea of designing objects that last. Objects that the user specifically never wants to throw away. In our future of sustainable sensibility, a shift away from reckless materialism is going to be a necessity, and one way of doing this is to create products that users develop bonds with and emotionally connect with.

I'd like to say, believe in-fact, that sustainability has always been a paramount issue for me. In reality though, the word meant little more to me than 'save the whales', and 'petrol is bad' until I started at RMIT. Until I'd spent time watching and studying the processes that go into making everything around us, and developed a comprehension of the scope of how many replications of any given thing are produced on a daily basis around the globe I really didn't know what it meant to be unsustainable. I'm highly convinced of the fact that of all industries, industrial design has one of the greatest potential capacities to change global waste and excess, and fully intend to push for such change throughout my career.

In line with this, I've developed a pretty wide set of hobbies that involve the great outdoors, and spend allot of my spare time hiking or climbing throughout Victoria in appreciation of its natural wonders. The industry of product design within these sports also fascinates me, in that many of the things that enthusiasts buy are tools that allow them to put themselves in extremely dangerous positions. This idea of designing objects that prompt the user to seek out adrenaline, while doing its best to keep them alive is one I really like.

Photography is still a major hobby of mine, and my camera comes with me whenever I'm out and about. Having spent so much time behind this lens has given me an alternative perspective of the world around me, and I rarely interpret things solely from head height, but also picture them from different angles, situations and mindsets. Perhaps more relevant to my work, I've also spent allot of time photographing objects and models in studio situations, and understand the importance of good photography as a communicator of ideas.

Another result of my focus on design and photography in high school was the head start it gave me in graphic design sensibilities and proficiency with Adobe's software. Throughout my bachelor's course I have supplemented my income by working for myself as a freelance graphic designer. Most of this work has been in the hospitality and retail marketing space, which means short deadlines and a need to sell ideas. Bringing this experience into my degree has been fantastic in that it has taught me the benefits of having a tightly organised InDesign document, with layouts and styles that are consistent throughout a document. Most of this work has been made for print, and I've spent allot of time talking to professional printers about the things they want, and about how to simplify the pipeline between designing and publication. I've spent lots of time with the Adobe Creative Suite, though Photoshop, Illustrator and InDesign are where most of my experience lies. I'm quite proud to say that I am extremely proficient in using all three, and know how to play to their individual strengths, avoid their pitfalls, and use all three side by side to complement each other on projects.

Looking back at this list of skills, I'd like to conclude this chapter by stating that one of the best things I've been able to take out of this course is the ability to learn new skills in a heartbeat. Whenever I take on a project, and brainstorm all the possible results, its inevitable that I'll need to seek out new knowledge to get it done, and a major part of my design process is to rapidly explore new techniques and teach myself as I go along. At the same time, I've also developed the ability (thanks in part to working as a waiter in fancy restaurants for so long) to explain and discuss complex topics with others. This is great for when I'm talking to nearly anyone outside of the design industry, as I know what terminology to use, and can preempt the sorts of things that others will not understand.

Thats it!, it's all done!

Thanks again everybody, and to future students,
best of luck with your projects

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2014

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