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Major Design Project 2019

Aquate

The smart fitness water bottle

INNOVATIVE . TRENDSETTING . NEW . CREATIVE . INSIGHTFUL

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Introduction

Aquate the smart fitness water bottle is a new exciting approach to water bottle design. One that holds great opportunity and demand. It shall be the smart companion for the fitness addicts of today and encourage those who aren't already. Its nifty features will provide a much-needed support for the tech-savvy and dehydrated. It is important to state that the design and manufacture of the bottle itself does not reflect my work. As to the limitations and economic constraints on the manufacture of a custom bottle. The MDP will focus on the functional and aesthetic aspects while ergonomics and sizing are negligible.

My Major Design Project is the reflection of my complete knowledge and skills before and after the development of this project. Areas of the MDP will are focus heavy on the technical / functional capabilities of the project. For optimum experience, a basic understanding of electronic concepts and bluetooth communication is ideal. I will strive to assist you with as much required knowledge for smooth exploration of the concept.


Project Proposal &
Management

In The Present

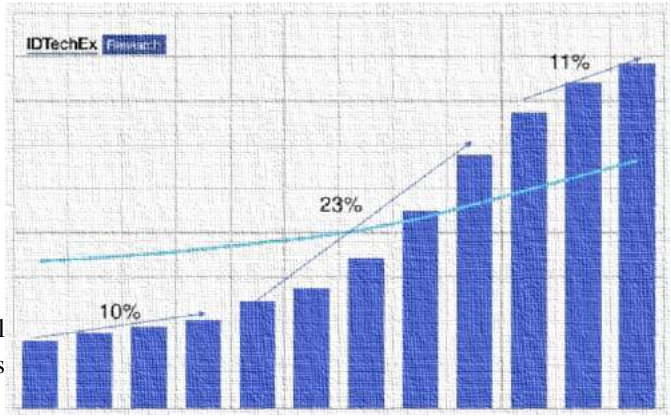
Our lives have been greatly influenced by the technology around us since the dawn of the first smartphone to the recent introduction to Artificial intelligence; our technological capabilities are rapidly growing with no signs of coming to an end. But as the saying goes with great power comes great responsibility, such abilities should be used for the betterment of our lives in a health and environment considerate attitude.

Technology has been revolutionised in its involvement in our day to day lives. It has seen the fitness industry undergo a massive transformation; shaping consumer behaviour like never before. People have seen and experienced its efficiency through ability and become habituated to its endless capabilities. The focus here is the rapid increase in the fitness technologies in the past Biennial. With integrated sensors and AI capable devices, the fitness-technologies grow increasingly fast. Comes to show why major companies like Samsung, Fit Bit, Nike, Adidas and others have shown interest in the fitness industry. Samsung stated that they are working to ease this demand, by offering remote health monitoring and by tracking indicators such as activity level, heart rate and sleep quality and that they see great opportunity here. As they seem to get better and more efficient the capabilities seem to widen in order to support not only athletes but the regular people of society.

Identification & Exploration of

THE NEED

Fitness gadgets such as trackers and sensors have shown great promise in the past biennial and their projected growth is even more astonishing. A statistical graph by a company IDTechEx (below) on the exponential growth of this industry in the future based on the 2016 to 2018 where it saw a 10% percent increase in demand. While its following years see a massive 23% increase in demand. Although major companies have taken control of majority of patents on the various technologies related to this industry. Innovative approaches from smaller companies seem to dominate the major companies; a real-life example of this are companies Fitbit and its rival Xiaomi (an electronics company). Xiaomi has approached the fitness industry and its consumers with a friendlier price range for its products while achieving the same high-tech features offered by Fitbit products. This competitive market is evidence that new innovative advancements to our everyday products will be received by consumers on a positive note; especially when its new.



IDTechEx Statistical graph on fitness product demand

Whilst these technologies undoubtedly have huge potential, most are treated as fashion accessories, it is important to see how these products will become essential items in the next five years. For this to work, there needs to be an ongoing motivation for the consumer and meaningful purposeful for use of the product.

Fun Fact: Water lubricates our joints

Identification & Exploration of

THE NEED

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Dehydration is a neglected issue in our lives. Not because we don't want quench our thirst yet it is our laziness to do so. It has become a hassle to drink water, to go fill and drink with no sense of conscious control over need. The young simply don't have the motivation to get up and drink water. As a young adult myself. I suffer from this very issue and honestly it is not in my views to not drink water rather I just see it as 'too much work'. This attitude is similarly reflected in terms of fitness and active involvement with physical activity. Reminders and notifications on phones and fitness watches have targeted this issue and majority of them have shown results. But what if you water bottle could replace such devices and rather be the go-to source for motivation. Why limit the ability of the water bottle? Why shouldn't we tackle these ongoing issues with a new and innovative smart water bottle

Although, present there is no one solution to the problems we face with our bottles, dehydration and fitness. There is no all in one versatile solution to the various issues that we face. Individually there are many all trying to solve one small problem e.g. a water bottle with a filtration system or a bottle that reminds to drink water. My question is why can't there be a bottle that solves both issues. When a quality bottle costs $25 to $50 why can't consumers expect more? This is where the need has really become evident to me and has inspired me to act upon it.

A guide for need analysis

Justification of
The Final Selection

Changing... The Way We See Things

This MDP has interested me ever since I started brainstorming for ideas for my year 11 design project. But due to its challenging aspects and time required for completion I chose to make it my MDP. My year 11 and home projects have always followed an electronics-centered need; mainly because I enjoy exploring and understanding the function of circuits and its components.

Also, I have learnt to appreciate my skill at design through small passion projects in my free time. This MDP is a embodies the knowledge and skills I have acquired so far and hope to learn through the progression of this one. I believe that through consistent effort and motivation this project is feasible.

As it is relatively small in size and cost, there is room for mistakes; and makes it easy to take to and from school. My belief is that technology gadgets such as this should promote the drive to think outside the box in order to further creation through innovation.

The target market of this project is directed at the physically active as well as those whose aren't and encourage them to do so. However, the likely target market is really anyone who needs an all in one reliable water bottle. Even companies that may choose to take my designs further and actually achieve a custom manufactured bottle casing and my MDP can help minimise their design costs and as a result producing cheaper solution as mine is only a one-off

Project motivation

My motivation for this project is to apply the practical and theoretical skills and techniques which I have learnt in D&T and engineering lessons and through in-depth critical analysis of detailed and appropriate research to successfully design and manufacture a cost-effective tech-savvy smart water bottle.

Project Purpose

The aim of this project is to design and produce a smart fitness water bottle that encourages consumers to drink water and stay fit.

Areas Of Investigation

SECONDARY INTERNET RESEARCH

Cost

I will look to investigate existing electronics of gadgets in the market and how they are being used. I will research how electronics is embedded into designs and what principles and techniques are involved in the process. As I will be dealing with small spacing, I need to understand how I will put implement the electronics in to the design while ensuring it is aesthetically pleasing. I will be using web tools to access this information and research in depth on the focus topic.

EVALUATION – I found that many of the fitness-based gadgets use sensor-based features such as pulse, touch, motion and other sensors that send and receive some sort of automated feedback based on user. I think I could manipulate appropriate sensor technologies in my concept design and create a closed-loop communication system. Seems like a promising approach towards idea generation. I also found that Inorder to reduce the size of the circuitry; companies are utilising circuit printing technology to create compact and custom PCBs. Although these seem to have an economical drawback.

SECONDARY MAGAZINE RESEARCH

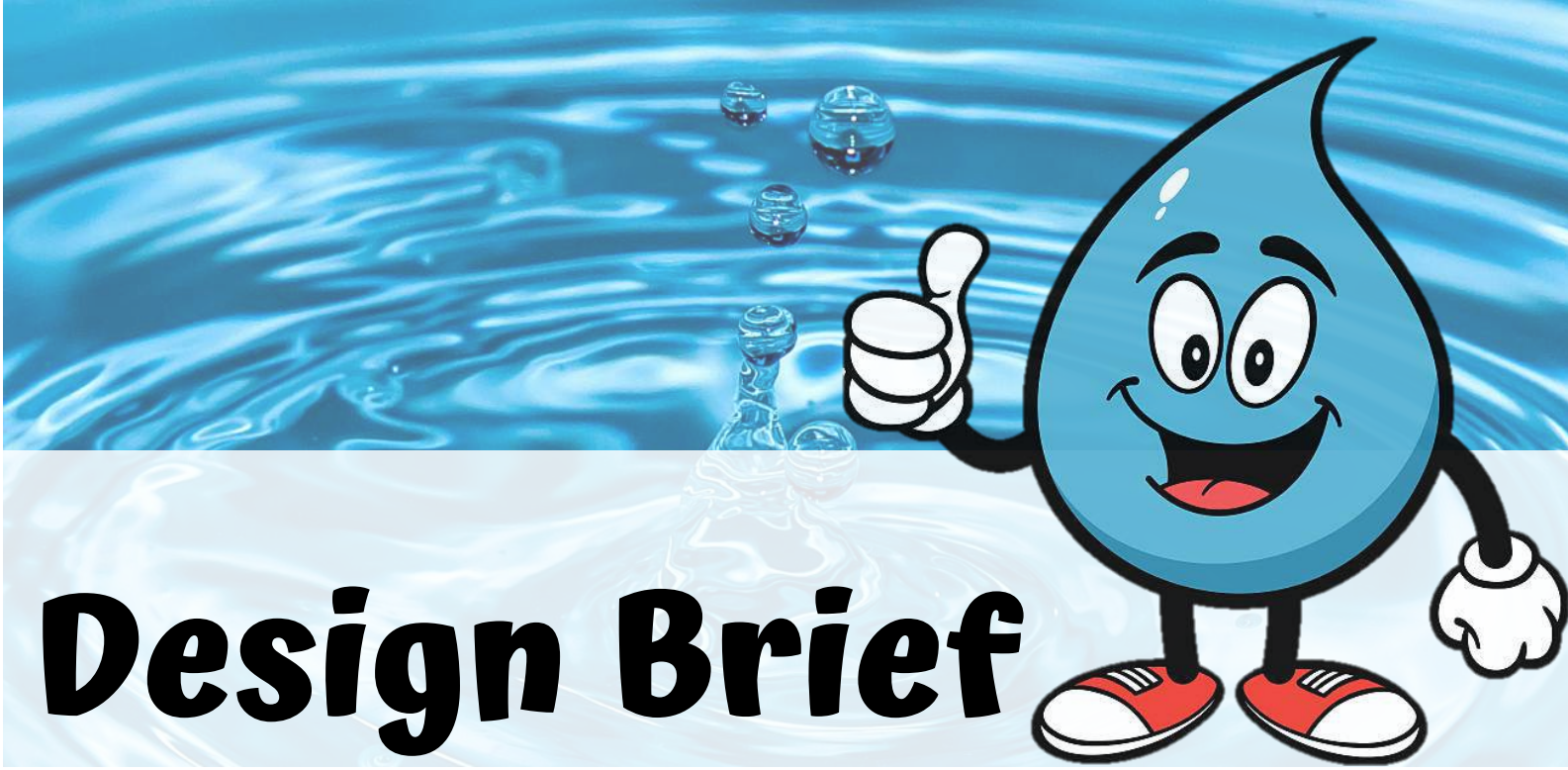
Current demand for Fitness products

I will investigate the current trends in the market in terms of design, functionality and cost factors that are attracting consumers using latest fitness magazines such as Muscle & Fitness and Women's Fitness. As I would like to target a wide consumer range as possible. Also, I will look into the designs for more day to day use water bottles and what factors are plus and minus.

EVALUATION – Through the research of magazines, I have come to an understanding that the consumers desire cost-effective and durable products that are easy to use yet function with great efficiency. Majority of the models posing with water bottles (Image to the right) are the target as the magazines would only advertise what is to be found ideal and trendsetting. The bottles and other fitness-based products are very linear in what they are capable of doing and this is an area that can be investigated later on in the design process ahead.

How will this help?

By identifying my areas of investigation i can deeper my understanding on the necessities demanded by my design brief, while creating a detailed plan that specifies areas to investigate in later stages of the design development. Hence providing a sense of direction for the design processes ahead.



Design Brief

Design and produce Smart fitness water bottle that encourages consumers to drink water and stay fit, while performing the role of a fitness product.

Smart technology – Smart technology is the collectively refers to electronic devices that can operate interactively and autonomously through a data communication medium

IoT –
The Internet of things (IoT) is the collective identification of the physical machines and devices embedded with electronics, software, sensors, and connectivity which enables them accumulate and transfer data.

Prototype – An initial functioning product based on preliminary concepts for evaluation and further development

Sensor – A sensor is an electronic device with the ability to identify and calculate properties such as temperature, pressure, heart rate, level or light and provide an open or close loop feedback

DESCRIPTION OF THE DESIGN BRIEF

The aim of this project is to design and produce a smart fitness water bottle that encourages consumers to drink water and stay fit. It is an everyday use product which nurtures a monitoring system for promoting water intake and exercise. With its embedded sensors and other supporting features it will remove the restrictions of what a water bottle can do.

The design will strive to meet the demand of the technology-craving consumers of the IoT industry with its creative and exciting approach to the fitness products. With the implementation of new and existing concepts the making of the smart bottle will hopefully drive creation through innovation.

Areas Of Investigation

SECONDARY INTERNET RESEARCH

Aesthetic Capabilities

The project is modular for its implementation therefore it will be important to ensure that parts fit seamlessly. The project is a development on an existing design and the new design must complement effectively. Components custom made can be worked to satisfy original colour theme of the water bottle or alternatively choose a colour scheme that can be applied at the end of construction.

EVALUATION – Research on modular electronic components has shown promising results with inspiration from major companies like Motorola and Google's concept design for Project Ara. These designs have incorporated the material, size and colour schemes to effectively produce seamless fitting s with components of the product. This shows that focus should not only be on the colour but also the texture of various components, their structural capabilities and other aspects that may lead to ergonomic standards. The conducted research has given a widened understanding on where focus must be made for positive aesthetic impression on consumers.

SECONDARY INTERNET RESEARCH

Materials

The MDP is a combination of various materials that work to satisfy the structural requirements it terms of strength and durability, aesthetic capabilities such as texture and various finishes that can be considered and the cost factor of each material. Material availability is also considered along with the technical skill set required to work with such materials.

EVALUATION –Research conducted on materials suitability with consideration to the previously outlined factors; has given a basic outlook as to what to expect of a material used for the bottle (e.g. durable and tough) such as aluminium as it offers options like polished finishes and thermal capabilities. and for modular casing, a suitable material could include plastic with later paint job to suit bottle theme. Plastic can be 3D printed although this may require additional CAD drawing skill set. Also, as there is minimal control over the material used for electronics, materials like rubber lining is also suitable for water sealing and grip for handling and base.

Although these are initial observations for suitable materials an extensive analysis will ensure their match in the justification of materials section.

SECONDARY INTERNET RESEARCH

Techniques

As mentioned earlier the technical skill set required will be determined by the materials used as well as it is function. With the ideas of a possible 3D printing aspect, ability to use CAD software fluently will be essential. There is minimal technical skill required at his stage in terms of construction-based skills (e.g. cutting, drilling etc) except this project is heavily focused on the skills required to solder, understand circuitry and design new circuits as well as program the designed hardware. Also, strong hold on aesthetics will help in the overall design of the project.

EVALUATION – Majority of the skills are already native to my individual abilities hence the selection of such a project. Although, further practice and research may be required during construction as more factors and issues may rise which require for a different alternative such as using a different software for CAD design or having to use new electronics.

Areas Of Investigation

SECONDARY INTERNET RESEARCH

Embedded electronics design

I will look to investigate existing electronics of gadgets in the market and how they are being used. I will research how electronics is embedded into designs and what principles and techniques are involved in the process. As I will be dealing with small spacing, I need to understand how I will implement the electronics in to the design while ensuring it is aesthetically pleasing. I will be using web tools to access this information and research in depth on the focus topic.

EVALUATION – I found that many of the fitness-based gadgets use sensor-based features such as pulse, touch, motion and other sensors that send and receive some sort of automated feedback based on user. I think I could manipulate appropriate sensor technologies in my concept design and create a closed-loop communication system. Seems like a promising approach towards idea generation. I also found that In Order to reduce the size of the circuitry; companies are utilising circuit printing technology to create compact and custom PCBs. Although these seem to have an economical drawback.

SECONDARY INTERNET RESEARCH

Existing concepts and designs

I would like to research on a web-based platform, the existing concepts and designs that may exist or any related and an interesting area that I can take inspiration from. As my initial motive for this smart bottle concept is to have an all in one capability statement; I would see it necessary to identify all related and even non-related technologies that may not be implemented into current bottle designs. As identifying their issues and solving them could provide me with a better understanding of how I can produce a more capable design myself. In terms of how I can thoroughly conduct this investigation, I believe using patent searches and web-browsing using key-word researching technique to effectively and properly identify existing designs.

EVALUATION – I did a brief investigation of existing designs and concepts that impact the validity and integrity of my concept. I found that there are a few manufactures who have implemented a closed-loop sensor technology that is capable of sending alerts via Bluetooth connection of device.

Although effective and innovative it consisted of the previously observed issue with such fitness products; they are very linear in their approach and also the cost factor which has let down the consumer demand. I believe with a better foundation for the existing concepts and an improved, critical and analytic approach to identifying their issues in the stages ahead I will be able to establish an optimum design.

SECONDARY INTERNET RESEARCH

Limitations and availability

As electronics are usually manufactured on a large scale its cost is generally practical, but since my design is a one-off, well at least for the moment. I believe that careful selection of how and where the sourcing of materials will be conducted, is vital for the success of the MDP.

EVALUATION –From a web-based inquiry into the issue I have found that majority of the components and materials I may need for the production of my design can be sourced from local retail and wholesale sellers. As a side-note it is also valid to understand the out-sourcing of materials and services of even my size has a notable effect and is conscious effort to promote local manufactures.

The project is minimal for its robust and entry level electronic solutions mainly for lacking manufacturing and technical expertise of professional and recognised individuals

Areas Of Investigation

Majority of electronics can be sourced form electronics specialising shops like Jaycar Electronics, while more custom and model-specific components should be sourced from global markets such as eBay. As for the equipment for production major parts such as soldering ion and related are available in school and anything beyond that should be considered with cautious analysis of necessity and then could be hired.

PRIMARY RESEARCH (INTERVIEW)

Cause of dehydration and lack of exercise

A first-hand investigation of this issue with the students and neighbours of my community has given me an insight into the reasons for dehydration. From their feedback the main issue was not only their laziness but the attitudes towards drinking water.

EVALUATION –Although my investigation was quite limited in this area, I really only wanted to identify a common reason to why dehydration occurs and I believe I have found the reason and will look to promote the solution to these issues with my final design in later stages.

SECONDARY INTERNET RESEARCH AND TEACHER CONSULTATION

Safety concerns

I will also investigate the safety concerns I will have to deal with. I will also investigate ways to minimize the risks involved. I also have to consider the effect on th water in the bottle as a result of the electronics.

EVALUATION –Some of the safety concerns I found were burns from solder, fume inhalation from circuit boards and solder and electric shock from a circuit. These could be minimised by simple safety precautions as identified. The electronics in the bottle is never directly in contact with the water and the bluetooth has no proven effect on water quality.

SECONDARY INTERNET RESEARCH

Possible environmental impacts

I will also investigate the environmental impacts of my MDP. I will also explore ways to minimize the impacts that may be posed.

EVALUATION –Electronic waste is major issue that is being dealt with minimal attention and in terms of my MDP I found that by reducing the overall consumption of electronics to bare minimum and only sourcing what is nessacry based on a set criteria; I should be able to reduce the environmental drawbacks it may pose. Also, a maintenance and obsolesce plan should be considered in final stages of the design process

Evaluation

PROGRESSIVE EVALUATION – Establishing my areas to be investigated as provided me with a clear direction to where I am headed and what I need to know and apply to get there. I will look to comprehensively approach major areas with much more depth during the idea generation stage.

CRITERIA FOR SUCESS

Prioritisation

It is also vital to prioritise and judge the importance of areas in a criteria to justify success fairly. For this I will be using a quantitative approach where importance will be marked based on time, cost and complexity of key area. As well as identify the consequential impact each categorical ranking may pose in the short and long term.

1 – It is of critical level and design will be compromised and brief cannot be met. It should address and evaluated upon once achieved. This aspect must be taken above other criterion of lower levels

2 – The measurement will impact on the functionality of the design however may not affect the success of the MDP. It is of intermediate rank, it would be good to evaluate this area through progressive evaluation. This criterion must only be considered after level 1 measures have been met.

3 – This criterion does not majorly impact functionality or success of the design. It would mainly be of aesthetic or other purpose. It must only be considered after level 1 and 2 measures have been met.

Level of concern	Criterion	Description
1	Functionality and aesthetic	Electronic components need to function as planned and should complement the aesthetic aspects of the design.
2	Fast and Durable	The sensors are quick and durable with fast feedback
3	Economical	Design is practical to manufacture in terms of budget
2	Ergonomically efficient	Heat sensitive imprint functions effectively
1	On track	Follow set schedule and finish on time
2	Safe and secured	Surge/circuit protection considered
1	Durable against elements	Embedded electronics is sealed and is waterproofed

What is expected?

FUNCTION

The Smart fitness water bottle will monitor the heart rate of it user as he/she puts his finger on the sensor and this will prompt the read **temperature** of liquid as well as his **heart rate**. Once pressure is released the sensor will automatically reset and ready to measure again. The readings will be received via Bluetooth to the users device through a Bluetooth Terminal app. The app will prompt user for regular water intake and notifications/reminders. The readings will also be displayed via an **OLED display**

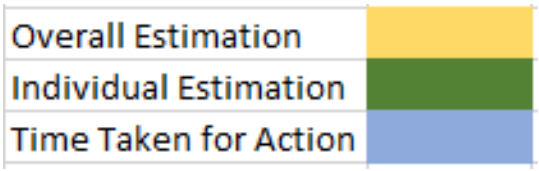
AESTHETICS / ERGONOMICS

The bottle and its casing will have polished surface finish with rubber lining for water sealing as well as for grip when holding and grip on the base for sturdiness. The MDP will follow a dark - colour scheme with colours ranging between dark grey to matte black this will be finalised later on in the design stage. Components will be placed so they adhere to user and his grasp of the bottle. Although size is to consider, for this implementation **function** is to be given **higher priority**

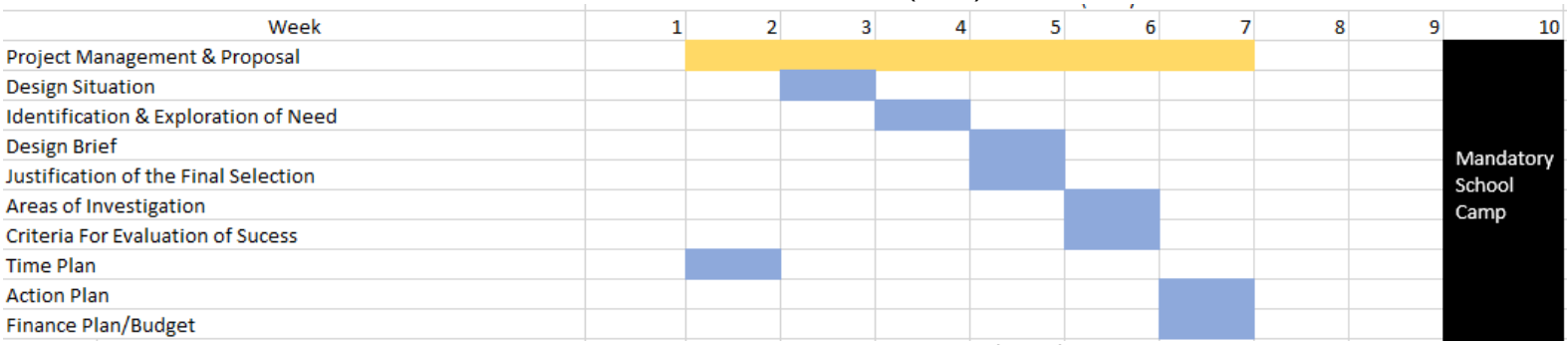
Quantitative and qualitative analysis and evaluation

In order for calculated success and security in terms of design development it is important to consistently evaluate progress based on a set criteria which clearly identifies the measures for success. Through quantitative and qualitative methods actions can be executed with confidence this includes surveys and feedback sessions. As success of the project can be comprehensively measured and analysed.

Time Plan

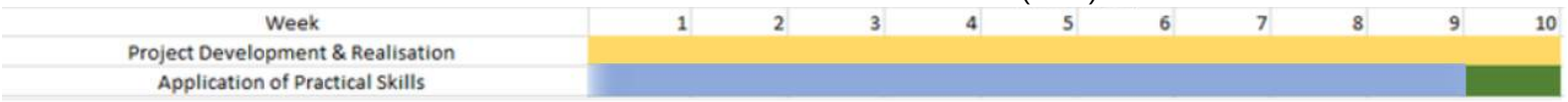


Term 4 (2018)

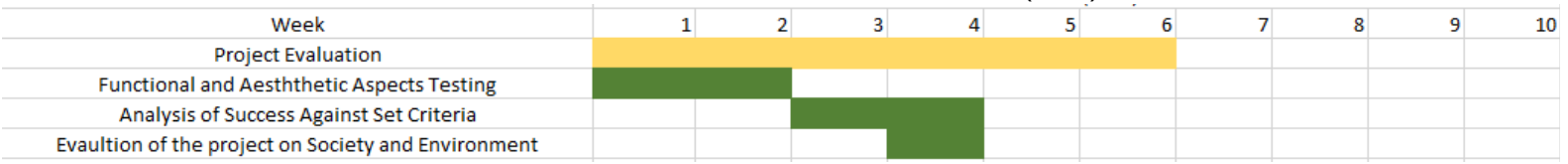


Term 1 (2019)

Term 2 (2019)



Term 3 (2019)



EVALUATION - A detailed and practically accurate plan for MDP progression throughout its course will provide me with set goals to achieve at each checkpoint while keeping a clear direction and track of progress during the R&D processes.

Action Plan

ESTIMATED/ACTUAL TIME : 1/1 WK

Creating and Researching the Present

- Identify potential social, ethical, environmental and other appropriate impacts
- Identify the importance and the current role of fitness and hydration in day to day life with specific reference to the Smart bottle concept.

EVALUATION – To start with, I did a web-based search to find information about fitness product designs, current trends in the fitness gadget industry and discovered that my concept has little exposure on the highly demanding market. Thanks to my research I found that the fitness gadget market has enormous potential and my research allowed me to create a concise brief that gave me direction in my MDP.

ESTIMATED/ACTUAL TIME : 1/1 WK

Creating Design Brief

- Outline the project motivation, target market and purpose
- Using the situational context produce a brief that summarises the intent and direction of this project.
- Define the key terms associated with the MDP

EVALUATION - I have drawn conclusions from the study of the present and applied them to make a brief. I synthesized my own ideas into what I thought was best suited to the market situation, I also identified the system's target market and outlined my motivation and purpose. In my project, doing these things gave me a sense of direction and enabled me to find a sense of motivation in the project and confirm my selection by discussing my ideas with my

ESTIMATED/ACTUAL TIME : 1/1 WK

Explore and Justify the Need

- Analyse the current fitness technology industry in depth
- Outline the associated pitfalls and identify the need
- Justify the need through theoretical application in the situation and justify its appropriateness for final selection
- Explore the need further to develop a concrete understanding of exactly what is required to address the identified need

EVALUATION –I put all my research together in a coherent piece, which at this stage formed this section. Further analysis of the fitness technology industry enabled me to analyse the major companies and their market contributions even more thoroughly.

I also stated exactly what was needed and how the current situation could be improved. and identified how the need could be solved.

ESTIMATED/ACTUAL TIME : 1/1 WK

Areas Of Investigation

- Describe areas to investigate that relate to the identified need
- Identify ways in which to explore these areas
- Analyse the impact of these areas on the MDP

EVALUATION - When I applied what I found in the previous phase, I used it to push my project in the right direction. I outlined the areas I wanted to investigate and explained in detail what I wanted to achieve through research and how I would do it. Then I used the knowledge I gained to draw conclusions and analyse how my results are influenced by my design brief and related motives

ESTIMATED/ACTUAL TIME : 1/1 WK

Creating a Time Plan

- Create a plan which outlines the required project stage goals over time
- Allocate time appropriately over the entire MDP

Action Plan

EVALUATION – The making of the time plan is very important as it can visually represent and provide an scheduled progress plan that provides small and consistent goal to complete while highlighting the overall importance of time management

ESTIMATED/ACTUAL TIME : 1/1 WK

Criteria To Evaluation of Success

- Develop criteria to measure and evaluate against as a means to determine success in achieving the brief and addressing the need.
- Develop a system of identifying which criterion is a priority and which is not and as a result set goals.

EVALUATION –I brought together all previously discussed factors into simple criteria for success. I used my research information and my design brief to develop initial success criteria. And decided to leave a section open for progressive editing. As I may think of other important factors as I proceed with the design and production stages. This stage was crucial for the success of the project, it was important that I obtained the correct criteria, otherwise I could not effectively evaluate my design at the end.

ESTIMATED/ACTUAL TIME : 1/1 WK

Create a Action Plan

- Create a plan which analyses in depth what is required at each stage of the design process
- Contrast time predicted with time applied
- Outline how the action was proceeded

EVALUATION - It was integral that I budget my time effectively and contrast actual and estimated time. The evaluation section also allowed me to think about my progress. I found that this gave me a sense of satisfaction and helped with the overall project. I also set goals as to where I needed to proceed and what needed to be completed where.

ESTIMATED/ACTUAL TIME : 1/1 WK

Create a Budget Plan

- Create a detailed initial budget plan which can be progressively updated and evaluated upon.
- Make sure to include details such as cost, amount, availability, shipping and feasibility of necessity

EVALUATION - My initial plan consisted of two options, one describes the use of printed circuit board or Arduino. The PCB is very expensive although suggests a much easier method. It was abondoned after investigation in idea generation

ESTIMATED/ACTUAL TIME : 1/1 WK

Existing Ideas and Concepts

- Collect and analyse various designs similar to MDP
- Identify and justify the differences within each

EVALUATION - various designs were considered with close attention to those that seem applicable in my scenario and skill set. Majority of existing design plus-points were that the manufacturing budgets were much difference.

ESTIMATED/ACTUAL TIME : 6/6 WK

Idea Generation (including sketches)

- Develop ideas based on prior research and analysis
- Design solution presented through hand sketches
- 3D sketches on individual parts that would be required to be printed at later stages

EVALUATION - This was a long process, involving great amounts of work as designs were tested through prototypes after sketching. The bottle structure was crucial in order to effectively design its aesthetic and functional capabilities and progressive testing of the bottle delayed the process of sketching the bottle. Fortunately the time period estimated was satisfied as following tasks were being attempted in this process.

Action Plan

ESTIMATED/ACTUAL TIME : 2/2 WK

Materials, Tools and Techniques Justification

- Identify the materials, tools and techniques required
- Justify its significance and other factors such as sourcing and availability.

EVALUATION –By considering all factors related to this area, the related information was presented in tabular form in order to effectively and easily present content. Majority of the sources were from online based stores which created issues in terms of shipping and material testing. As they tend to be expensive in terms of shipping time once materials are damaged. Comprehensive research was undertaken to extrapolate the various techniques needed and what tools are required through web search and YouTube tutorials

ESTIMATED/ACTUAL TIME : 1/0.5 WK

Experimentation and Testing

- The selected materials and required techniques practiced
- Comprehensive testing of components in production simulated scenario

EVALUATION – Through this a detailed understanding was gained and confidence grew as familiarity with material and techniques were developed.

During testing a few late changes were made to design and component choices such as the PCB and 3D printing component. Although late this process ensured future issues were prevented

ESTIMATED/ACTUAL TIME : 1/1 WK

Application of Conclusions

- A re-evaluation of the prior design solutions and required modification based on research, experimentation and testing

EVALUATION - looking at design solutions at various design areas and reconsidering their choice based on new research and test results provided evident support for the upcoming construction process.

ESTIMATED/ACTUAL TIME : 1/1 WK

Selection and Justification of Ideas

- Through final justification of ideas and materials with consideration to prior extensive research and testing and its resulted conclusions

EVALUATION - The final overview of ideas selected through the process of research and experimentation stages provided added confidence in proceeding to the construction of design stage with assurance that all has been proofed for success.

ESTIMATED/ACTUAL TIME : 1/1 WK

Industrial Procedure in Production and Safety

- Analysis of procedures undertaken in industry and how they can be implemented for the MDP's production

EVALUATION - Researching the processes undertaken industry for designs such as Smart fitness bottle aided in providing a role model to which safety procedures and production methods can be inspired and learnt from.

ESTIMATED/ACTUAL TIME : 10/9 WK

Evidence and Application of Practical Skills

- Based on final design sketches begin programming code for PCB
- Assemble components an test code for success
- Simulate function till successful
- 3D print final design
- Combine various aspects together
- Effectively demonstrate construction process for reproduction through diagrams and progressive photos to aid in communicating of ideas to the reader.

EVALUATION - Progress in this area took time as expected as their were various aspects to consider and several issues may arise that were expected through prior testing. Due to school exams , the construction was delayed on some days but long allocated time was effective in managing this issue

Action Plan

ESTIMATED/ACTUAL TIME : 6/4 WK

Project Evaluation

- Analyse functional and aesthetic aspects of the MDP
- Conduct through functional and aesthetic testing
- Compare and justify success of MDP based on criterions for success
- Describe Social and Environmental Infleunces of the MDP

EVALUATION –
Functional aspects of the MDP were discussed in terms of how they were to contribute in the function of the smart fitness bottle.

Main areas discussed included the sensor and bluetooth connectivity and user interaction.

The preset dimensions of the components caused difficulty as it did not allow for a large working space. Components were to be skillfully soldered and layed out such that the bottle would fit and look aesthetically pleasing.

The position of components were to add compliment to the users grasp of the bottle and their placement on the 3d printed casing is evidence of this.

EVALUATION (continued) –
Functional testing of the MDP was conducted by testing all criterions as required by the initial criteria for success. Sensor reading accuracy and speed of read measurements were considered to make a judgement on its level of success in comparison to the criterions. These were recorded on to a table and appropriate changes such as heart rate reading calibration and temperature sensing algorithms were altered so better readings can be found.

Aesthetic testing was mainly inclined to examining the surface finish and whether sufficient sturdiness and pleasing appearance was achieved.

By peer and individual evaluation the testing in both areas was effectively carried out. Results from the evaluations were pleasing considering that peers have taken into consideration the layers involved in this MDP such as

- Designing Case using 3D software
- Using fixed component sizes to design a aesthetically pleasing and functioning product
- Limited time as the coding stage took longer than anticipated due to the many operations of the sensors and their subsequent calculations
- Using Bluetooth technology to communicate to third-party applications
- The combining of the various components and ensuring it is compatible for use on all devices for the majority of users.

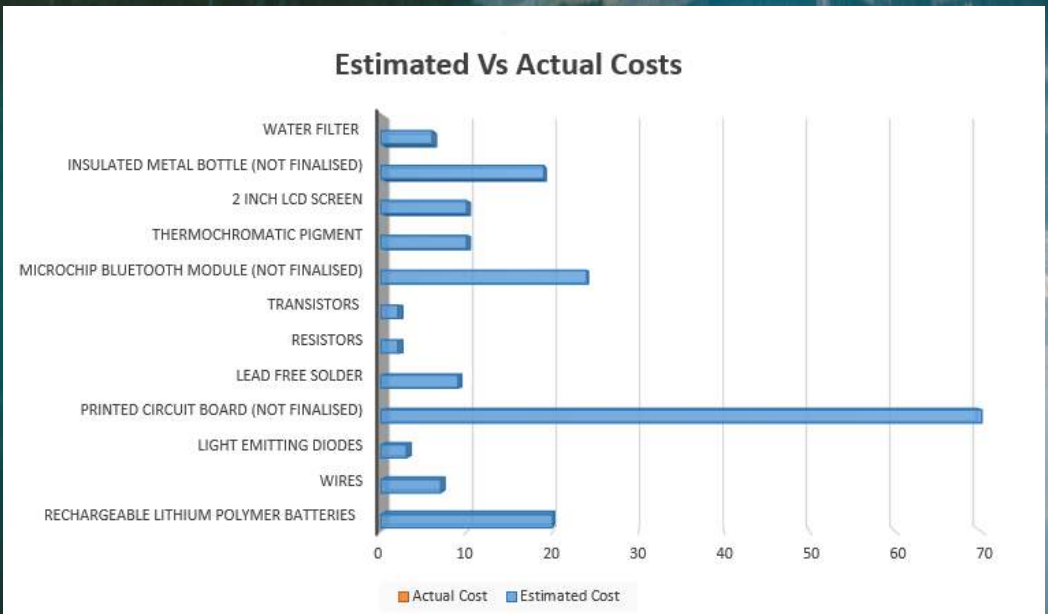
After this analysis a discursive study in to the Social and Environmental influences of the MDP allowed for a consideration the life cycle analysis and the overall impact on the delivering to the social trends/conscience.

Budget Plan

As previously discussed, the electronics of my MDP can be economically concerning especially because it is one-off product and the printing of PCBs could seem costly. From the brief investigation of limitations done beforehand, I have formulated a plan to out-source the printing through a custom third-party manufacture of PCBs. I have found a few possible candidates and have done a brief inquiry on the estimated cost price. I have also done a rough list on the materials and components I will need as well as the equipment and its miniatous cost if any. As my project is really concerned with the technology that operates the bottle itself, I have also considered the economical aspect of the bottle and its materials and related components

Product: Smart Fitness Water Bottle
ESTIMATED COST: $182 (with non finalised components/materials)
ESTIMATED COST: $69 (without non finalised components/materials)

	Estimated Cost
Rechargeable Lithium Polymer Batteries	20
Wires	7
Light emitting diodes	3
Printed Circuit Board (not finalised)	70
Lead Free Solder	9
Resistors	2
Transistors	2
Microchip Bluetooth Module (not finalised)	24
Thermochromatic Pigment	10
2-inch LCD screen	10
Insulated Metal Bottle (not finalised)	19
Water filter	6



Evaluation

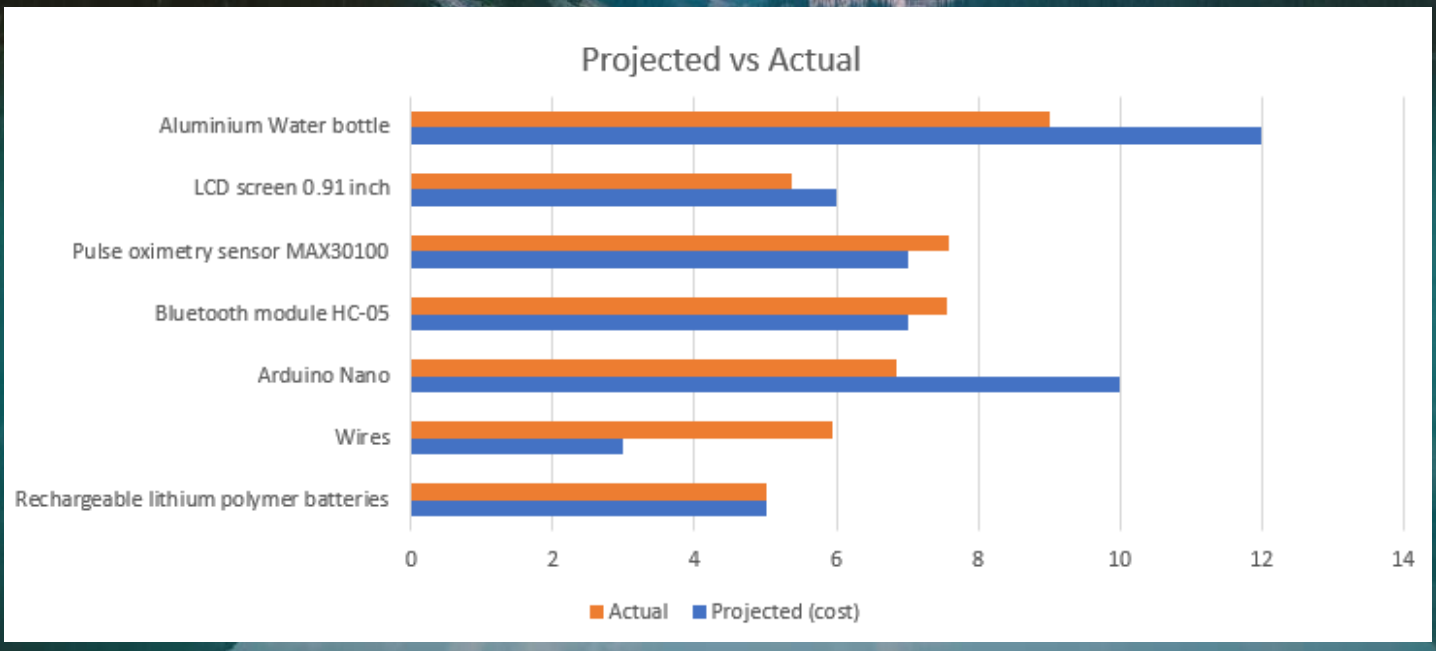
The initial idea was to get the circuit printed custom but due to the expense, a change to micro controller development boards (e.g. Adriuno) was made that way there was more flexibility with what I can do. This initial plan for the budget was very rough although gave a wide range of options that I could take into consideration.

Final Budget Plan

The rough budget plan was made only to visualise the kind of direction that could have been taken if greater economic and technical support was available. Although its predictions are unreasonable several aspects can be extrapolated here.

- To make use of development components such as Arduino rather than a custom PCB
- Select location of purchase with consideration of product quality
- Try to exclude shipping costs as much as possible (Go local)

Item	Quantity	Supplier	Unit cost (cost $)	Projected (cost $)	Actual (cost $)	Projected vs Actual (cost $) Evaluation
Rechargeable lithium polymer batteries	2	Ebay	2.50	5	5	Prices were as excepted; this component was actually reused from an old speaker system. The cost is of a similar product from Ebay.
Wires	10	Jaycar Electronics	3	3	5.95	This was shock considering I only needed wire for testing on breadboard. the cost was for a 50 pack when I really only needed about 10.
Arduino Nano	1	Ebay		10	6.84	This was very fortunate as it was the main component for the electronic functioning and it was very affordable
Bluetooth module HC-05	1	Ebay	7	7	7.55	Price was ranged similarly to estimation overall build quality was satisfactory
Pulse oximetry sensor MAX30100	1	Ebay	7	7	7.58	
LCD screen 0.91 inch	1	Ebay	6	6	5.38	
Aluminium Water bottle	1	Kmart	12	12	9	The actual price was reasonably low compared to estimation which enables the option of testing
TOTAL			37.5	52	47.30	



Bills

ORDER DATE
02 Mar, 2019

ORDER TOTAL
AU $6.84

1 item sold by asiasellcomau

1pcs Useful Device for Arduino Nano V3.0 with ATMEGA328P Mini Module AUSSIE
(132917151704)

ITEM PRICE:
AU $6.84

Estimated delivery **Thu, 07 Mar - Tue, 12 Mar**

This item has been sent.

ORDER DATE
02 Mar, 2019

ORDER TOTAL
AU $7.58

1 item sold by finetech007

2PCS High Precision MAX30100 Heart Rate Sensor Heart Rate Click Module GU
(323563277102)
Select: 1 set

ITEM PRICE:
AU $7.58

Estimated delivery **Fri, 08 Mar - Fri, 15 Mar**

This item has been sent.

ORDER DATE
21 Mar, 2019

ORDER TOTAL
AU $7.55
Free postage

1 item sold by s-2worldwide

1pcs HC-05 6 Pin Wireless Bluetooth RF Transceiver Module Serial For Arduino AZ
(113093375814)

ITEM PRICE:
AU $7.55

Estimated delivery **Thu, 28 Mar - Wed, 03 Apr**

This item has been sent.

ORDER DATE
02 Mar, 2019

ORDER TOTAL
AU $5.38

1 item sold by sale4women

Iic I2c 0.91" 128x32 White Oled Lcd Display Module 3.3v 5v For Arduino Pic CM
(153241549007)
Select: white

ITEM PRICE:
AU $5.38

Estimated delivery **Fri, 08 Mar - Fri, 15 Mar**

This item has been sent.

---

jaycar

Blacktown Phone: (02) 9672 8400
Shop 2, 102
Sunnyholt Road
Blacktown 2148
ABN# 65000087936 Tax Invoice: 1121262

Branch: 438 Till: 1 Date: 04/05/19
Operator: 1243 Time: 11:56

Sale

Code	Qty	Price	Extn
WC6028	1	$5.95	$ 5.95
LEAD JUMPER PLG - SKT 40 PC KIT 150MM			

Purchase Total: $ 5.95
Includes GST of $0.54

Payment Tendered:

TOTAL ITEMS = 1

TOTAL 9.00
KMART
BLACKTOWN NSW AU
17/02/19 15:39 21135163 K00287
***** 0164 MASTERCARD
CREDIT ACCOUNT Bankwest Credit
APSN 0000 ATC 1146 A0000000041010
PURCHASE AUD$ 9.00
RRN 000087000601 (00)APPROVED
AUTH 195454
NO PIN OR SIGNATURE REQUIRED
EFT 9.00
%TAXABLE ITEMS - GST AMOUNT .82
flybuys card #279******913
TRANSACTION AMOUNT 9.00
FOUND A TROLLEY? CALL 1800 876 553

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Development &
Realisation

Evidence of Creativity

Existing Designs

To comprehensively find a solution to the problem I have researched the various existing concepts and designs that related to aspects of the MDP. In doing so I have chosen the most suitable option with regards to their strengths and weaknesses

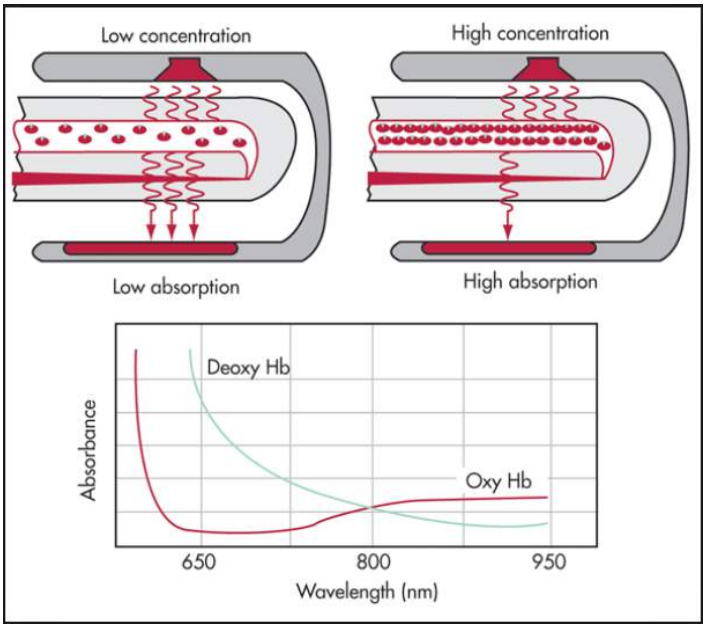
	Existing Design/Concept	Plus	Minus	Improvement and Design Application
	Ozmo Active Smart Water bottle	• LED lights that communicate achievement without App • Vibration alerts that remind you to stay hydrated throughout the day • Automatic detection of water or coffee, with optional manual input for other beverages • Convenient carrying handle for life on the go • Long battery life	• Expensive • Software for communication noncompatible with android devices • Small capacity • Durability questionable in comparison to Aluminium	• Ensure long battery life • Ergonomic design for hand • Compatible app • Hidden electronics compartment
	Ted Baker Insulated Water Bottle	• Coated Black Onyx design • Knurled leak-proof lid • Laser-etched logo • Double-insulated to keep drinks hot or cold for up to 12 hours	• Small capacity • Heavy • Expensive for what it offers • Not suitable for fitness/ sport due to its robust design. • Aesthetically plain	• Polish surface finish • Suction lock system for cap • Double wall insulated
	Contigo Kangaroo Autoseal	• Flip up handle with carabiner to clip to gym bags and backpacks. • Spout cover keeps spout clean when not in use. • Measure markings help gauge water intake. • Water bottle is top-rack dishwasher safe. • Made out of 100% FDA-approved materials. • 100% BPA free. • Water bottle features a built-in compartment	• Durability questionable in comparison to Aluminium • Hinge- based locking system for compartment seems inappropriate for regular use. • Bottle mouth cap poses hygiene issues as seal is not completely sealed due to no suction cap.	• Measure markings on bottle • Built- in compartment • 100% FDA-approved materials
	LifeStraw Go Filter	• Chemical-free • Microfiltration membrane technology to filter down to 0.2 microns • Removes 99.9999% of waterborne bacteria • Removes 99.9% of waterborne protozoan parasites • Reduces turbidity	• Expensive for what it offers • Bottle material is plastic not as durable as aluminium • mouth nozzle attracts bacteria and dirt (no cover)	• Filtration system • Chemical-free

Evidence of Creativity

Existing Designs

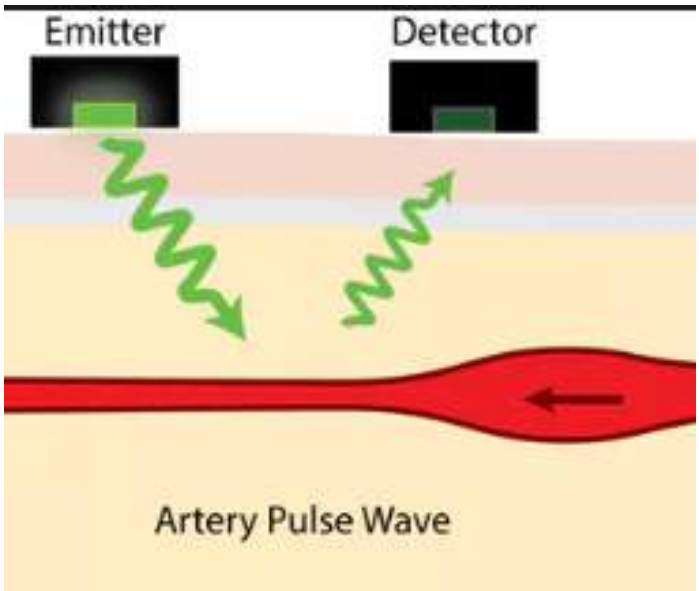
Conclusions - I researched similar designs and also existing technologies related to this MDP. Found a lot of information although majority of information was biased (e.g. number one in bottle technologies or strongest plastic ever used). Using recognised researching methods such as descriptive and cor-relational to achieve reliable information to analyse.

TWO EXISTING METHODS TO MONITOR HEART PULSE



TRANSMISSION

- Uses PPG (Photoplethysmography) sensors
- **Need professional interpretation**
- **Commonly used in medical field**
- (Electrocardiography) sensors measure bio-potential generated by electrical signals controlling the expansion and contraction of heart chambers.
- **Extremely accurate** but also requires **additional support (e.g. chest band with sensor)**
- **Expensive**



REFLECTIVE (CHOSEN)

- Also uses PPG (Photoplethysmography) sensors. Use a light-based technology to sense the rate of blood flow as controlled by the heart's pumping action.
- Use optics to measure heart rate by which measures changes in blood flow by shining a light from an LED through the skin and measuring how it scatters off blood vessels.
- **Measure blood oxygen saturation (SpO2).**
- **Compact**
- **Cheap**

EVIDENCE OF CREATIVITY

IDEAS GENERATION

INITIAL

Concept designs for bottle prior to adjustment. That is to focus more on the electronics than bottle design (modular concept). Modification to concepts evident in Selection of Ideas stage.

45

Concept sketches were made prior to final design solution! Presentable versions of these follow

Conclusions - That bottle designs above were very rough concepts as the designing of the bottle was an option at initial stages evident in ideas selection stage. Although they provide a more comprehensive outlook on the different ways the display and electronics can be attached. Below, is the brainstorming on the mot suited bottle cap, even if the bottle was to be developed upon, if the bottle cap wasn't suited to criteria or would have an impact on the measures of success then a 3D printed solution for the cap would be chosen

Pull - Top Cap

+ Easy to use
+ effective
- Pull component can be lost & broken
- attracts bacteria and dust on mouth area.

Flip top Cap

+ easy to use
+ quick
- attracts dust & bacteria
- Can break easily due to hinge the system

Screw-on Cap

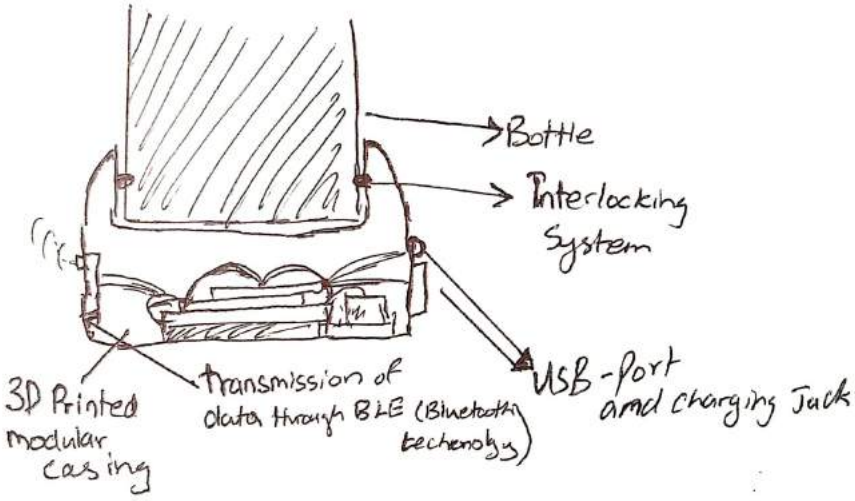
+ effective
+ easy to use
+ reliable
- Cap can be lost

Suction-based Cap

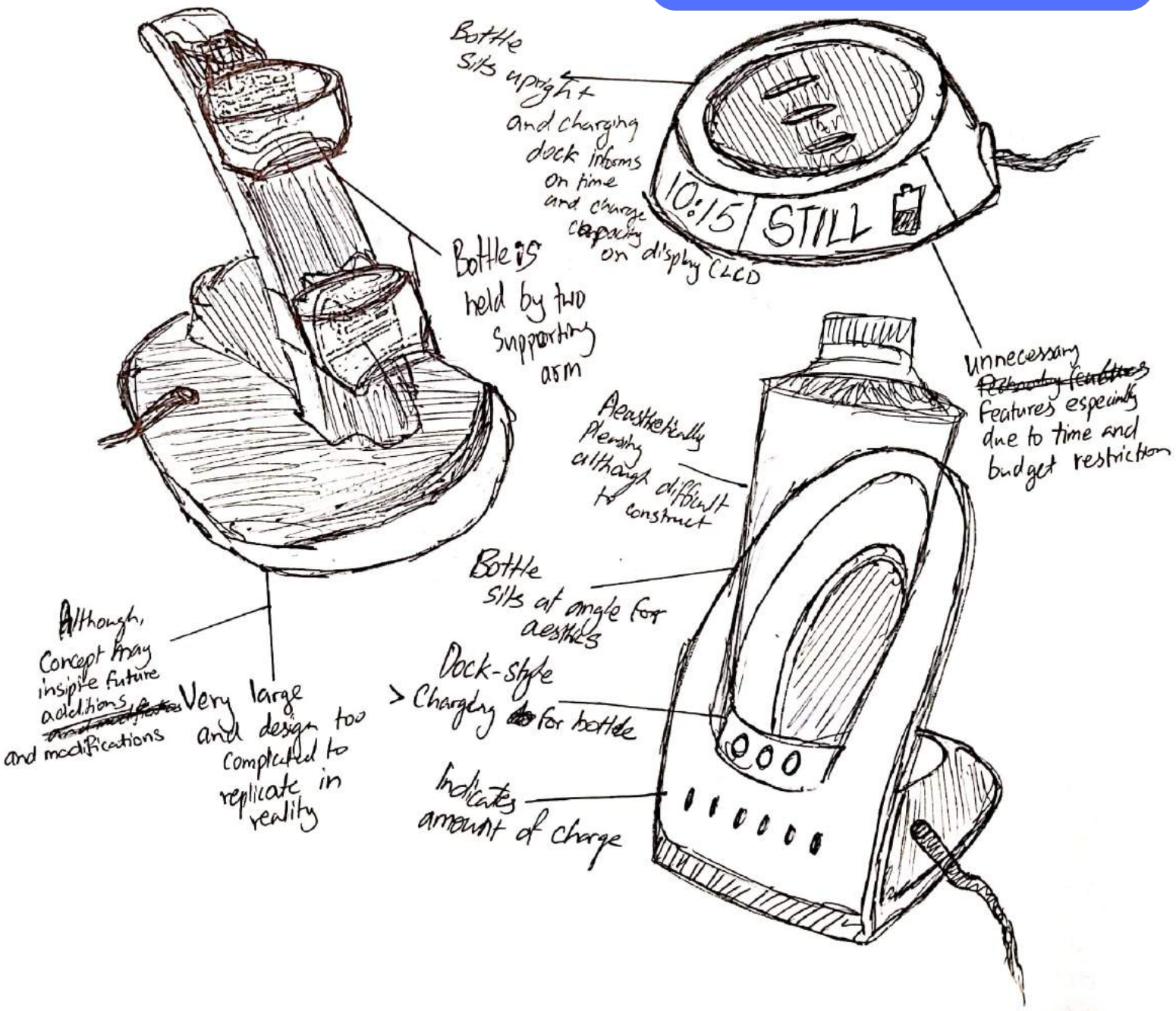
+ easy to use
+ ensure thermal temp.
+ effective
+ reliable
- Cap can be lost (hard to replace)

EVIDENCE OF CREATIVITY

IDEAS GENERATION

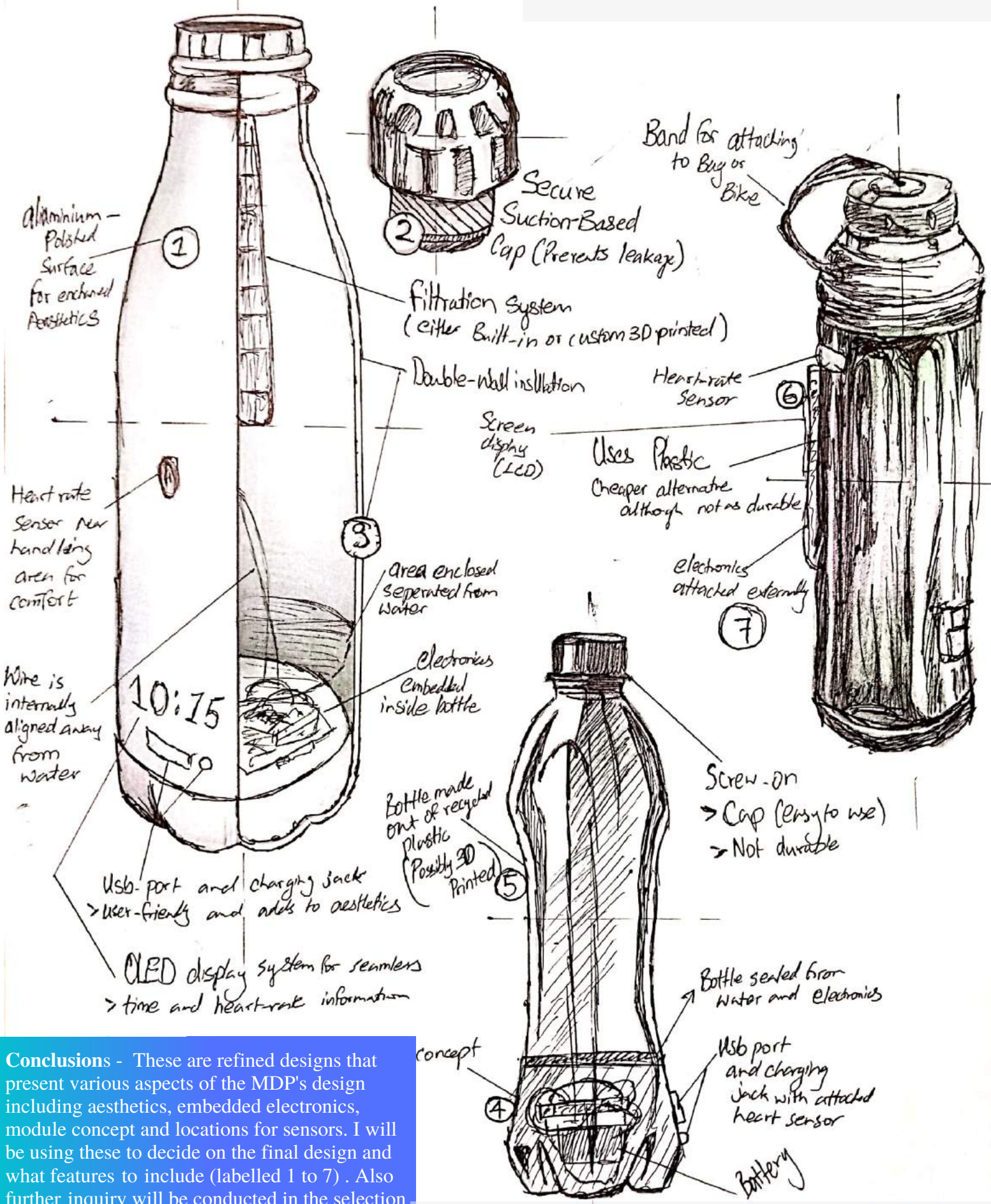


Conclusions- These are preliminary concept for the charging feature for the bottle. To the left is the representation of how the bottle would sit in the 3D printed attachment which also serves as the casing. In the front USB and charging jack with allocated cut-outs for each input (shown in CAD drawings in the following pages). The rear end is for the Bluetooth transmitter.



EVIDENCE OF CREATIVITY

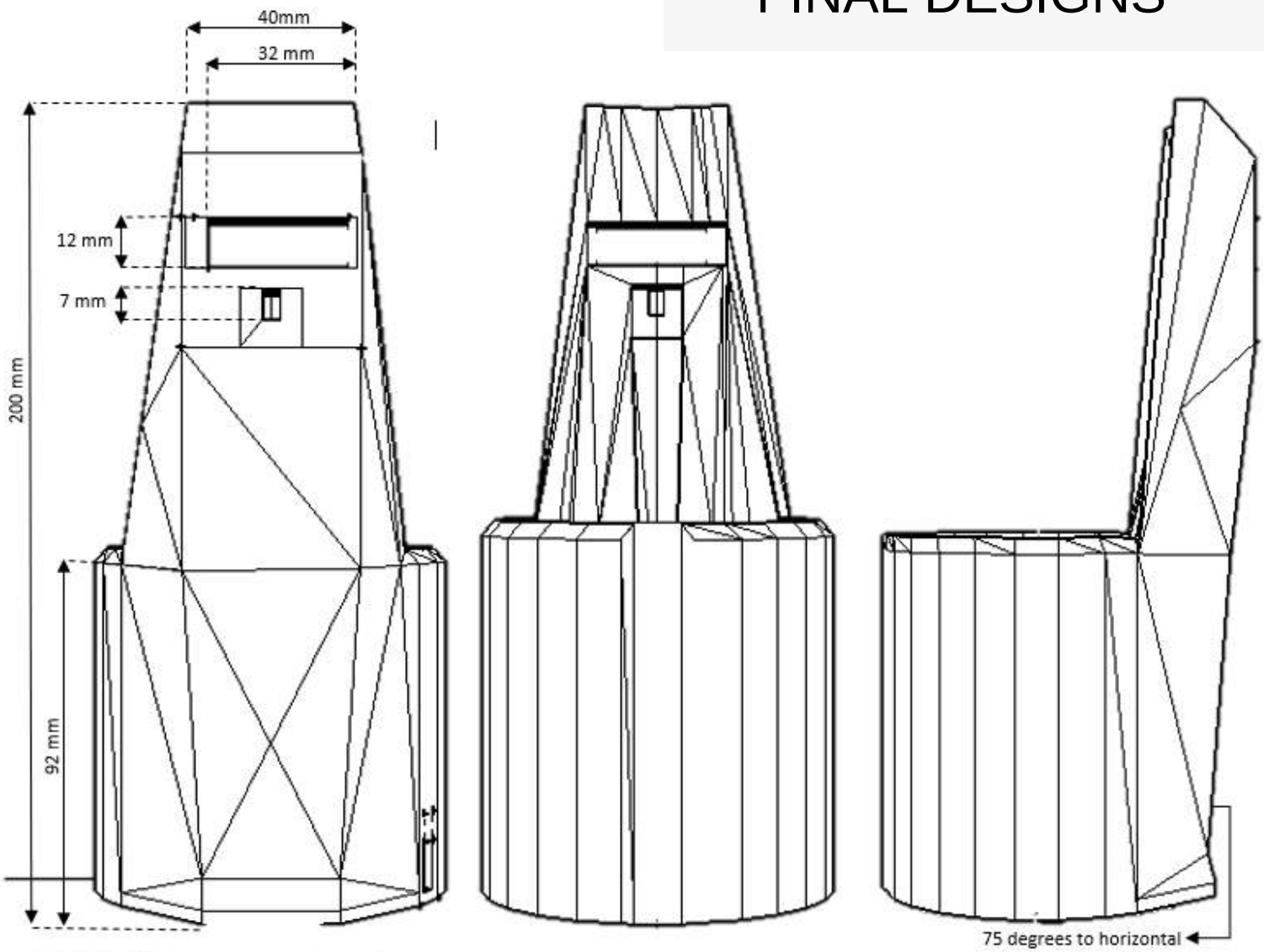
IDEAS GENERATION

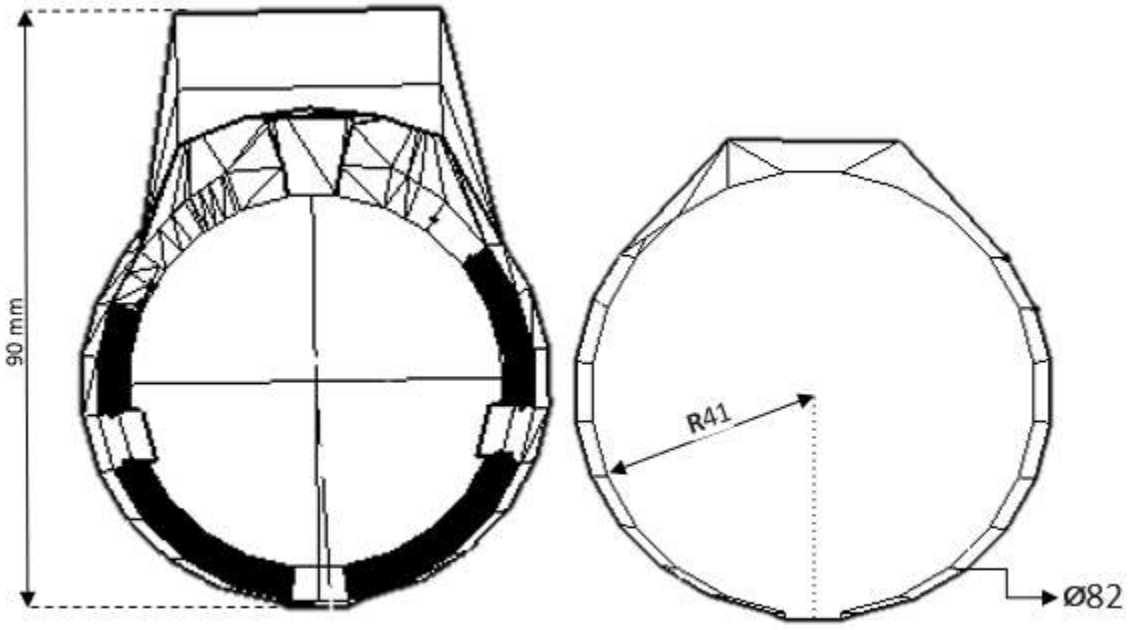


Conclusions - These are refined designs that present various aspects of the MDP's design including aesthetics, embedded electronics, module concept and locations for sensors. I will be using these to decide on the final design and what features to include (labelled 1 to 7) . Also further inquiry will be conducted in the selection of these ideas shown in Justification of Ideas stage.

EVIDENCE OF CREATIVITY

FINAL DESIGNS





Conclusions - The following are the final designs for the casing of the bottle in orthographic and isometric projection.

EVIDENCE OF CREATIVITY

FINAL DESIGNS

Display- provides the user with heart rate, temperature of liquid and daily goal and/or notifications.

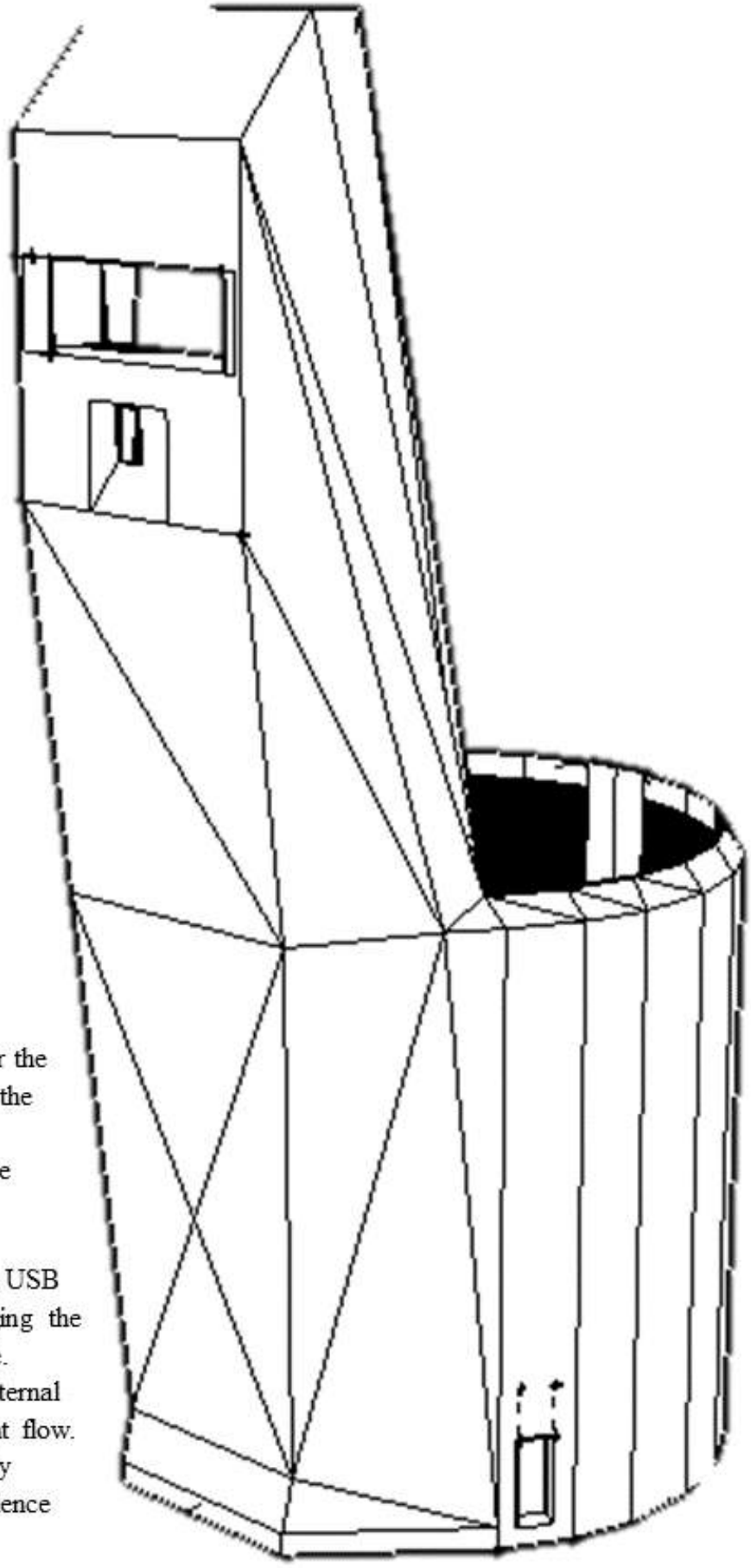
Heart rate sensor – positioned such that when the bottle is held, the thumb rests on top of the sensor. The readings can then be read on the above display immediately without the need to open phone device.

Bluetooth – Although live readings are visible on the display itself. The readings can also be viewed on the phone device via a Bluetooth terminal application which mediates Bluetooth communication; once the device is paired.

The indication of Bluetooth connection being successful will be through an led light flashing pattern. (blinking for searching and continuous light for connected)

Switch – A switch will be attached near the Bluetooth light indicator which allows the user to switch between heart rate/temperature sensing mode to device charging mode.

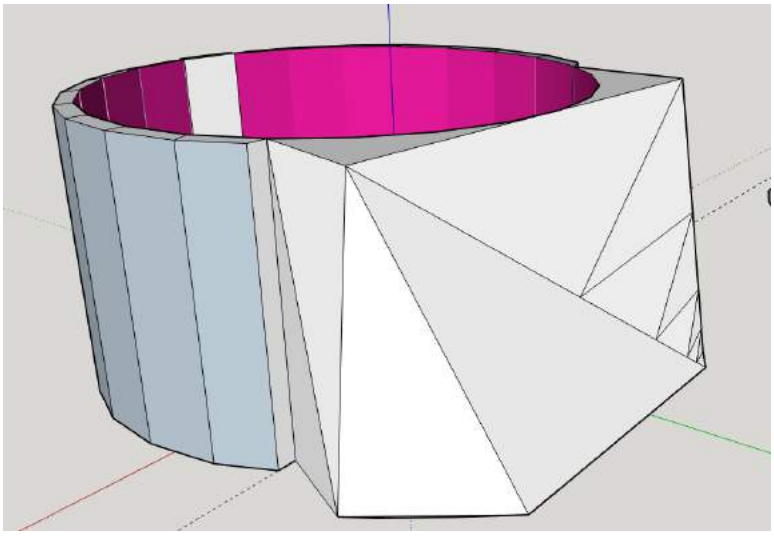
USB port – The user would connect a USB male to the USB female for both charging the system battery and charging the device. Depending on the power source, the internal circuitry decides on direction of current flow. An internal voltage regulator and safety resistor allows for safe charging experience

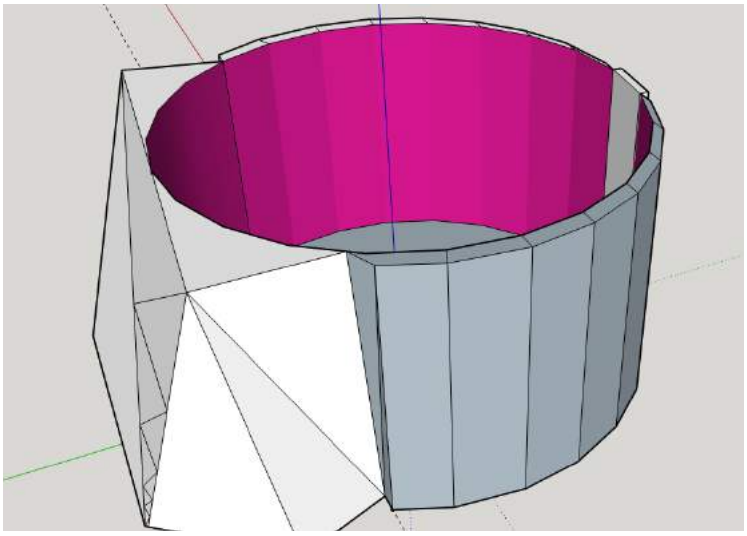


EVIDENCE OF CREATIVITY

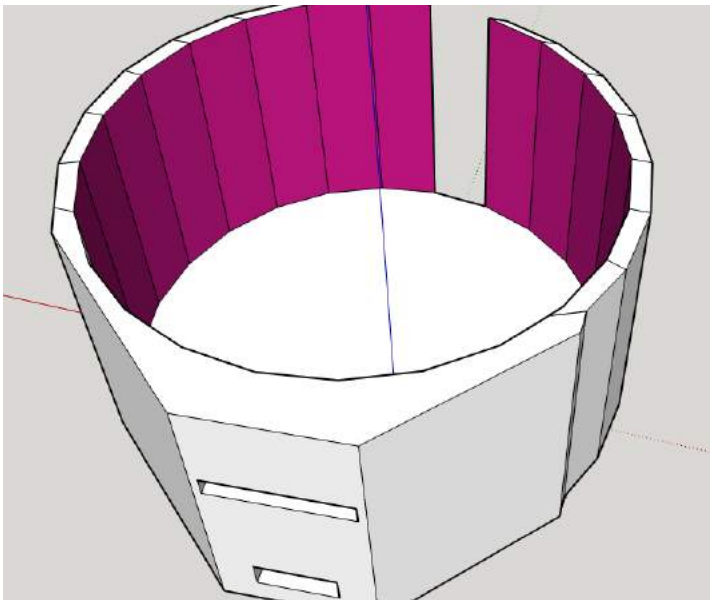
IDEAS GENERATION

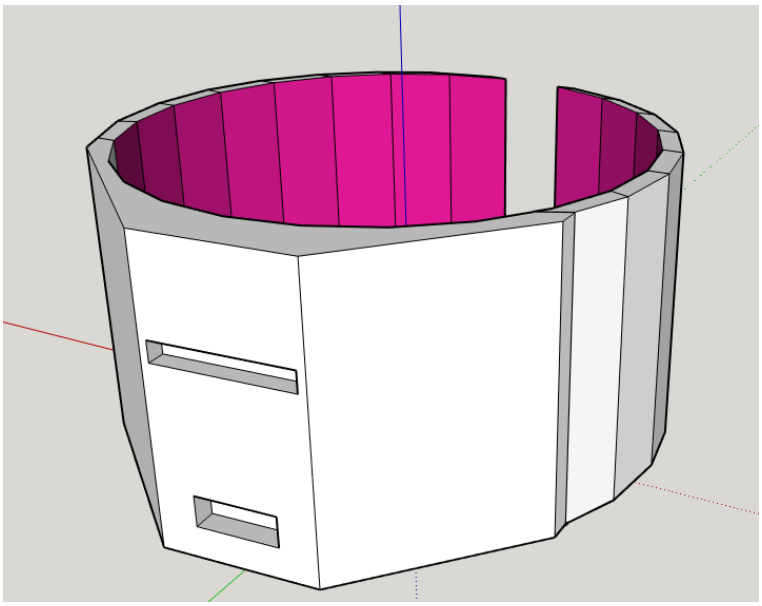
As issues in the IoT world continue to grow, we must approach our solution development in more efficient ways. For this reason I have used CAD modelling software such as Sketchup and Fusion 360 on Student subscription.





The images above are the initial stages of designing casing for the electronics. These are the result of several practice drawings. Below was the final prototype design ready for printing and testing.



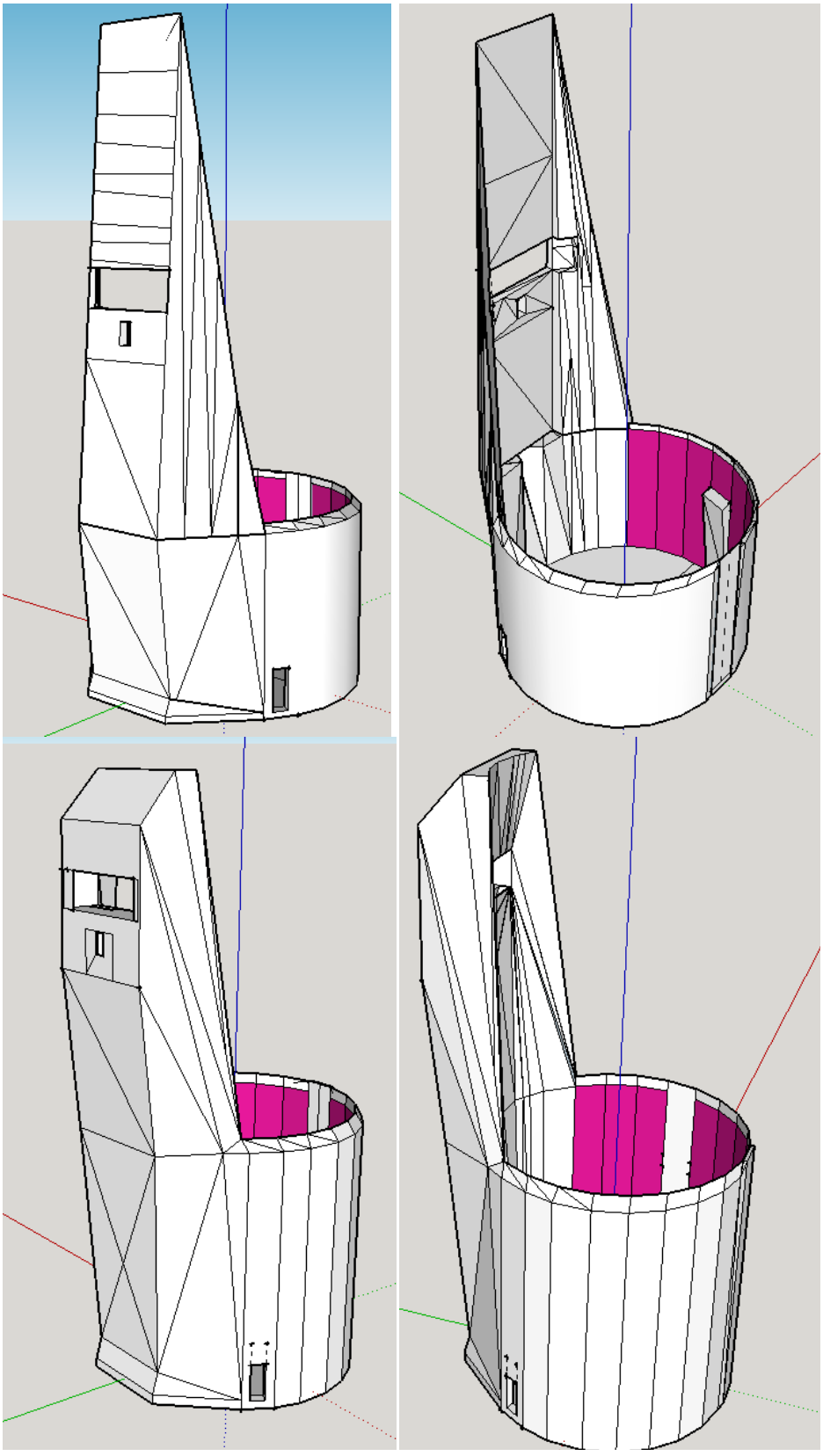


Conclusions - The CAD drawing was difficult at first as their were many curvatures that were to be symmetrical about the outlets. I've tried to create a interesting design for the surrounding walls of the casing, where the width reduces as it approaches the rear. It was an attempt to achieve a seamless look after it was attached to the bottle.

EVIDENCE OF CREATIVITY

IDEAS GENERATION

Secondary CAD design for the casing was very satisfactory in aesthetics and sizing although their was not enough space for inserting all components



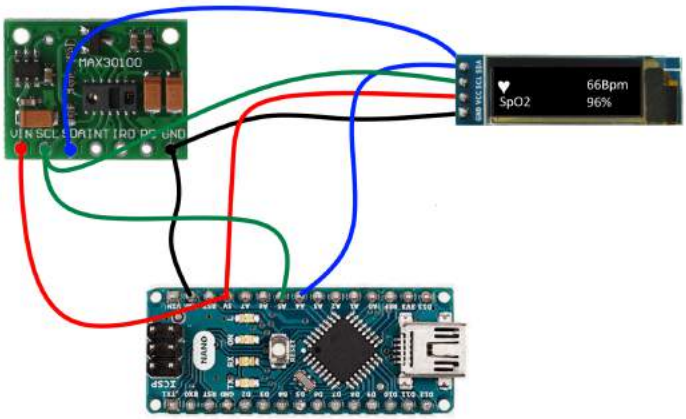
Conclusions - This CAD drawing was improved upon by increasing the spaces for components insertion although this increased the size of the CAD. This was an issue, but according to the Criteria for Success the function is to be given priority over size. Therefore, it was decided to design it to be as space efficient as possible

EVIDENCE OF CREATIVITY

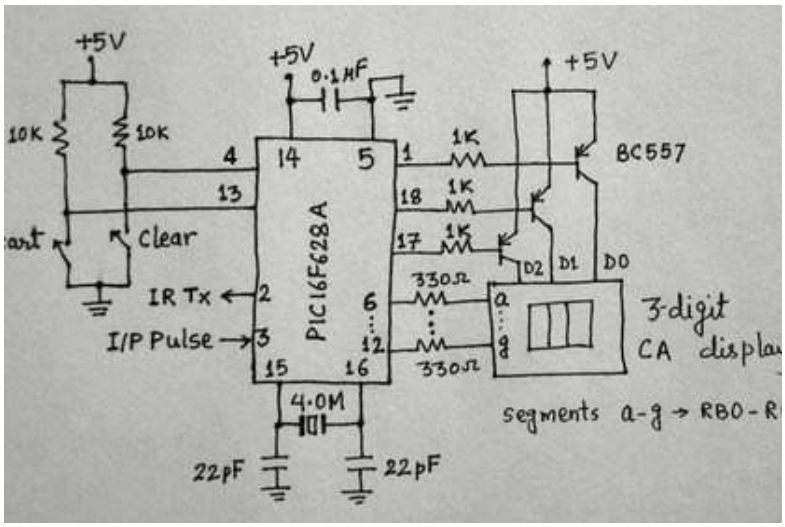
IDEAS GENERATION

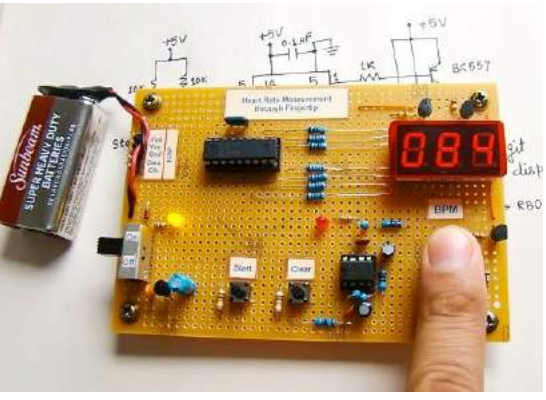
Two methods for circuit design; one uses development board (adriuno nano) while the other alternative is more complicated design that uses individual components without digital outputs. The following is the analysis of the two, its relevance and suitability to the MDP

Using development board method -
When the three devices (Arduino, OLED display and MAX30100 sensor board) are connected . At start up, the display prompts the user to place their finger on the sensor. When it detects a heart beat, it updates the heart symbol on the display to show that and then calculates an average for both the heart rate and the SpO2 values and finally displays that on the OLED. Design for circuit diagram and image below
https://hackster.imgix.net/uploads/attachments/264805/heart_rate_monitor_qIiEoJGZUV.png?auto=compress%2Cformat&w=1280&h=960&fit=max



Using microcontroller method (more complicated) -
The sensor unit consists of an infrared light-emitting-diode (IR LED) and a photo diode, placed side by side, and the fingertip is placed over the sensor assembly, as shown below. The IR LED transmits an infrared light into the fingertip, a part of which is reflected back from the blood inside the finger arteries. The photo diode senses the portion of the light that is reflected back. The intensity of reflected light depends upon the blood volume inside the fingertip. So, every time the heart beats the amount of reflected infrared light changes, which can be detected by the photo diode. With a high gain amplifier, this little alteration in the amplitude of the reflected light can be converted into a pulse.
Design for circuit diagram and image below - (https://www.instructables.com/id/Microcontroller-measures-heart-rate-through-finger/)





Evaluation - These designs have been singled out from various approaches and although simple in their approach with proper development these can be improved greatly, these designs have been well presented by their makers, but using the design concepts and research conducted I will be using a combination of the two methods as the Arduino offers great flexibility and is easy to add on while the other is useful but only relevant if re-designed for compactness through custom PCB printing which is ruled out due its cost (evident in budget plan). Only issue faced here is that majority of designs researched have not implemented any Bluetooth communication between slave and main user devices. Which means that this feature will be ambitious to achieve but I will be using aid from my robotic teacher at school and these encounters will be documented in the final designs used for implementation of MDP.

DEGREE OF DIFFERENCE

The smart fitness water bottle is unique for it presents the approach to finding a solution to issue of dehydration and lack of exercise. One that has been addressed before by companies like Ozmo and Hydrite. They have approached the issue using complex technical and high budget solutions.

This MDP will encourage fitness and regular water intake through consumer-centered solutions. The design is unique for it targets the interest of fitness technologists and their respected consumers on a simple, effective and affordable scale.

• This project uses the readily available development electronics to demonstrate the flexibility of modern electronics and how they can complement our everyday appliances

• It serves as an all-in-one bottle capable of charging your phone and indicate heart rate live to user device.

• It is efficient in its size-to-budget and utilised components but comprehensive in its functionality and design, with only consideration to necessary and useful features that can actually benefit user than its opposite.

• In this project various electronic micro-controllers and sensors are designed to work in unique combination as they are enhanced to achieve more than ever before.

• The MDP brings to light the power of modern technologies and their impact on society. The MDP is a result of consulting various solutions and concepts for achieving all aspects of the criteria of success.

• The MDP is combination of known ideas and technical solutions as they are developed and improved upon to serve the rising issue of obesity and dehydration irrespective of age groups. This versatility and compatibility it offers to consumers is the true key for its potential for success in the ever-growing market.

• The MDP widens user interaction capabilities on a product with less innovation in terms of technology and provides the user with information that is accurate, live and reliable

Progressive Evaluation (Self)

• The MDP widens user interaction capabilities on a product with less innovation in terms of technology and provides the user with information that is accurate, live and reliable This section reassured what my motivation for this MDP and gave me confidence and remembrance for what it means to me on personal level and how it will effect my career and future endeavors

CONSIDERATION
OF DESIGN FACTORS

Functionality

The Smart fitness water bottle will monitor the heart rate of it user as he/she puts his finger on the sensor and this will prompt the read Sp02 level and temperature of liquid as well as his heart rate. Once pressure is released the sensor will automatically reset and ready to measure again. The readings will be received via Bluetooth to the users device through a Bluetooth Terminal app. The app will prompt user for regular water intake and notifications/reminders. The readings will also be displayed via an OLED display

Aesthetics/ Ergonomics

The bottle and its casing will have polished surface finish with rubber lining for water sealing as well as for grip when holding and grip on the base for sturdiness. The MDP will follow a dark - colour scheme with colours ranging between dark grey to matte black this will be finalised later on in the design stage. Components will be placed so they adhere to user and his grasp of the bottle. Although size is to consider, for this implementation function is to be given higher priority

Cost

The various components for the construction of smart fitness bottle will be sourced form large retailers such as Ebay and Bunnings as they offer comprehensive range of products and are very affordable in comparison to local retail stores. As majority of components for this project will be usually sold in bulk it is difficult purchase necessary amount of electronics from retail. Although, stores like Jaycar do provide fast delivery and efficient inquiry process which are also aspects to consider for any issues that may arise. The initial idea for accustom printed PCB was abandoned for the economical pressure that it puts on the entirety of the project. As a one-off it is not feasible to approach this manner and hence development boards will be used instead which offer greater flexibility and security. This MDP is designed and constructed with close consideration to the approximation of consumer budget of $35 to $45 and this limitation is vital to stay on track and economically feasible

CONSIDERATION
OF DESIGN FACTORS

Obsolescence

It is likely that this MDP and its design concepts will become obsolete, however this is inevitable. In the world of IoT, technology rapidly improves and new ideas and concepts are given the freedom to upgrade. With an abundant supply of researchers, designers, universities and major companies all in search for the next big thing in IoT of things, similar to this design. Also, with consideration to the large-scale manufacturing, professional expertise and budget it is feasible to assume that one would eventually bring a better solution to the problem. Although projects such as these attempt to replicate and/or present solutions to issues one smaller and efficient scale which in result will be encouraged as future contenders learn and get inspired of such ambitious projects as mine..

Life Cycle Analysis

This MDP is comprised of three stages which include sourcing of material for components such aluminium, silicon and plastic. Material is extracted, worked and manipulated to serve manufacturing purposes. Next, materials are manufactured to specific designs and assembled for distribution. Companies would purchase these components and material packages for their product. The product is manufactured with imported products and redistributed for consumer sale. Product is purchased and used till user deems it unnecessary or damage occurs. the product is responsibly placed in recycling bins. The product is dismantled from its electronics module component and organised for recycling. Plastic and aluminium will be reused for other uses, while e-waste is exported to e-waste management services. Although 100% of product will not be recycled it designed to serve a long life and at least 60 to 70 percent will be recyclable.

Safety

Safety is always the first priority in any project. The MDP deals with electronics, aluminium and 3D printed plastic. Electricity is an unstable energy and it must be used with precaution to prevent any shock. These include wearing rubber gloves and safety glasses. The power source used in this MDP is below 5V which is harmless to human touch also since all electronic components use low current charges there is minimal risk. For the extended use of the product safety resistors will be implemented and bare wires will be sealed and open cables and connections will be encased in a custom printed 3D printed case. Also, when using the 3D printer, it is important to follow procedure that is to wait till printer has cooled before handling printing nozzle and printed component.

Documentation of

Research, Experimentation & Testing

Techniques

- Using hammer and chisel without denting the bottle (skill acquired by D&T teacher and practice)
- Using CAD software and efficient with scaling. (practice and tutorial videos)
- Ability to solder efficiently with minimal usage of solder with clean joints (practice and prior expertise)
- Easy to cut wire but need to practice making neat wire joints with minimal wastage. (practice)
- Careful trimming according to shape desired may practice on test piece.
- Make flush finish with minimal wastage
- Designing intricate aspects of CAD design that allow seamless fitting to components and bottle

Materials

- PCBs and Micro controllers are made from an insulating sheet material layered with conducting copper tracks.
- Aluminum and copper, and tin, gold, silver and zinc are used for switches and connections. ABS thermoplastic or a woven fiberglass material bonded by epoxy resin called FR-4 are the most common materials used in PCB boards, though ABS is more preferable because it is way more recyclable.
- Tantalum used with silicon for resistors and capacitors
- Lead and Tin for solder
- Information on materials sourced from engineering.com (https://www.engineering.com/Hardware/ArticleID/17668/What-Raw-Materials-Are-Used-to-Make-Hardware-in-Computing-Devices.aspx)

Costs

- Designing custom printed circuit boards is inexpensive but production for a one-off would have a substantial economic pressure especially for a student. Although, production lines are capable manufacturing thousand of electronic products with inspiring efficiency and on a large scale this can be very profitable. This MDP would cost much less if manufactured on larger scale as components can bough tin bulk and work can be automated by machines.

Documentation of

Research, Experimentation & Testing

Identifying and Investigating Manufacturer's Specification Literature

Possible Options for Manufacturers

Shipping time (long)	Ebay based manufacturing outlet	Cheap Huge range
Expensive Buy in bulk	Jaycar Electronics	Refundable Local

BLE HC-05 Transmitter
Bluetooth Specification v2.0+EDR.
Frequency: 2.4GHz ISM band.
Modulation: GFSK(Gaussian Frequency Shift Keying)
Sensitivity: ≤-84dBm at 0.1% BER.
Speed: Asynchronous: 2.1Mbps(Max) / 160 kbps, Synchronous: 1Mbps/1Mbps.

Adriuno Nano
Operating Voltage (logic level): 5 V.
Input Voltage (Recommended): 7-12 V.
Input Voltage (limits): 6-20 V.
Digital I/O Pins : 14 (of which 6 provide PWM Output)
Analog Input Pins: 8.
DC Current per I/O Pin: 40 mA.
Flash Memory 32 KB (ATmega328) of which 2 KB used by bootloader.

MAX30100 Pulse Oximeter
Integrated LEDs, Photo Sensor, and High-Performance Analog Front-End
Tiny 5.6mm x 2.8mm x 1.2mm 14-Pin Optically Enhanced System-in-Package
Ultra-Low-Power Operation Increases Battery Life for Wearable Devices
Programmable Sample Rate and LED Current for Power Savings
Ultra-Low Shutdown Current (0.7µA, typ)

Information sourced manufacturer component specifications -
http://www.designfx.com.au/jaycar/cat_pdfs/mobile/J16_components_m.pdf
https://datasheets.maximintegrated.com/en/ds/MAX30100.pdf

Documentation of

Research, Experimentation & Testing

Material Testing

General Aim - To investigate the interior structure of the bottle and its base. Also to determine if the base is removable

Description - As the bottle will be developed upon a general idea of how the bottle cap casing and whether the bottom cap is removable so the 3D printed modular design can be implemented.

1 Experiment

Aim - To investigate the interior structure of the bottle and to attempt to remove base cap using heat method

Method - oxy-acetylene welding (for heating)

- The required safety precautions are taken (safety glasses, gloves and leather shoes)
- The gas is connected to the welding torch away from in-flammables (ventilated workshop)
- The welding torch is sparked using igniter.
- The torch is set to thin flame
- The bottle is slowly spun around in the hand as the torch is guided across the joint rim causing the metal surface to expand and hence weaken joint.

Results - Cracking sounds were heard indicating the expansion of metal, yet the joint was still to strong to open.

Conclusions - Since the aim was unsuccessful another method was required. Since, promising sound of metal expanding was heard, it meant it was separate from bottle and it could be opened

2 Experiment

Aim - To investigate the interior structure of the bottle and to attempt to remove base cap using heat method and quenching

Method - oxy-acetylene welding and quenching

- The required safety precautions are taken (safety glasses, gloves and leather shoes)
- The gas is connected to the welding torch away from in-flammables (ventilated workshop)
- The welding torch is sparked using igniter.
- The torch is set to thin flame
- The bottle is slowly spun around in the hand as the torch is guided across the joint rim causing the metal surface to expand and hence weaken joint.
- Then quickly quenched in water

Results - This quenching technique caused the hot surface of the bottle to start making sounds of contracting metal (informed by teacher and rim size was larger).

Conclusions - This new improvement lead meant that the base cap was separable but required alternative method

Documentation of

Research, Experimentation & Testing

General Aim - To investigate the interior structure of the bottle and its base. Also to determine if the base is removable

Description - As the bottle will be developed upon a general idea of how the bottle cap casing and whether the bottom cap is removable so the 3D printed modular design can be implemented.

3 Experiment

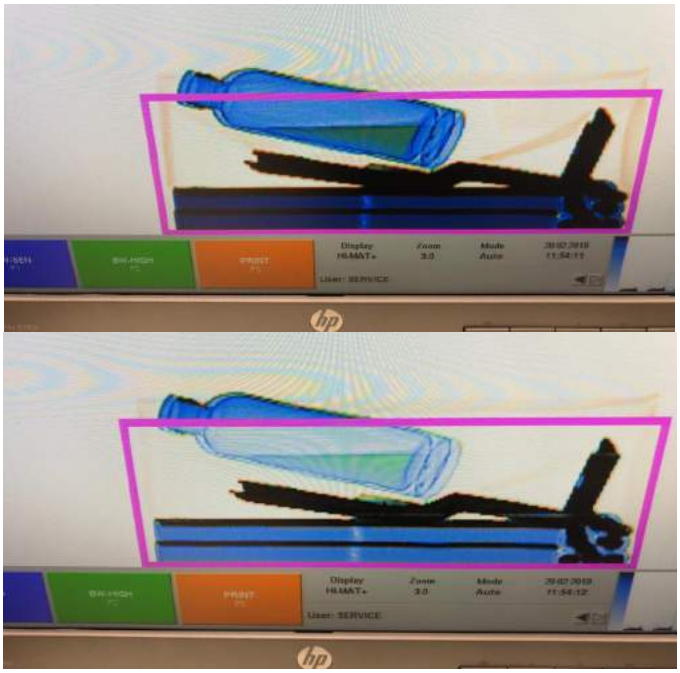
Aim - To investigate the interior structure of the bottle using X-ray

Method - X-Ray

- The bottle was given to professional x-ray machine user in local metal inspection warehouse in my area.
- The bottle was examined on two filters that indicated density and material properties.
- Photos were taken of the results

Results - This investigation was extremely useful as it provided clear guidance to the inner structure of the bottle and whether cutting it would damage its structural and functional integrity.

Conclusions - The images show that cutting the bottle to embed electronics would damage its structural and functional integrity. And also shows where to target in order to open bottom cap.



4 Experiment

Aim - To open bottom cap of bottle using hammer and chisel method

Method - Hammer and Chisel

- Experiment 1 was conducted
- Next bottle was secured at base with vice
- Chisel was placed at rim and hammered carefully without denting
- This was repeated around the bottle till cap came off.

Results - This method was successful and cap came of with ease although few dents were made in the process

Conclusions - The successful method was noted and issues regarding dents were considered for the actual project as test bottle was effective for testing and experimentation

Documentation of

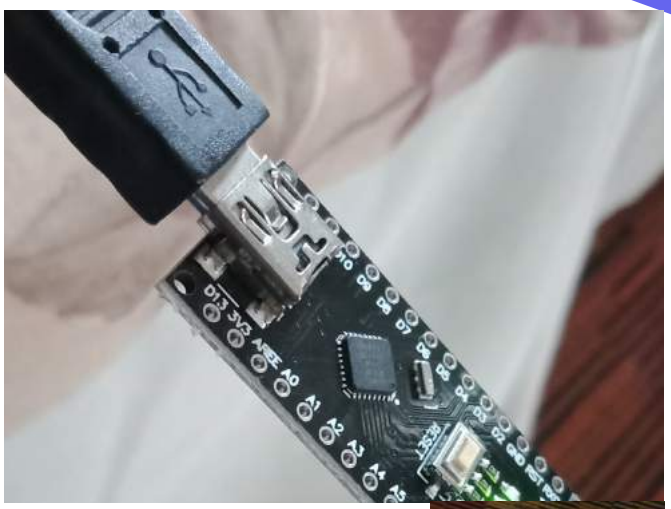
Research, Experimentation & Testing

Process Testing

General Aim - To identity and practice methods to programming electronics

Description - Several sketches (code files) were tested to assess components' function and get familiar with them

1 Program



Aim - To assess component function through blink sketch

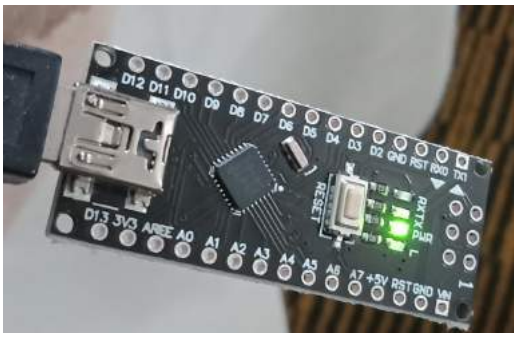
Method - Blink test

- Arduino Nano is connected to computer using micro USB cable
- Either upload sample sketch (pre-download on software Ardiuno IDE) or alternatively code yourself
- For this implementation, code is used to test receiving and transmitting LEDs by pressing on allocated buttons

Results - All LEDs on component work as expected

Conclusions - This testing and practice task has brought familiarity to the programming of these components and as-sureness on their reliability

2 Program



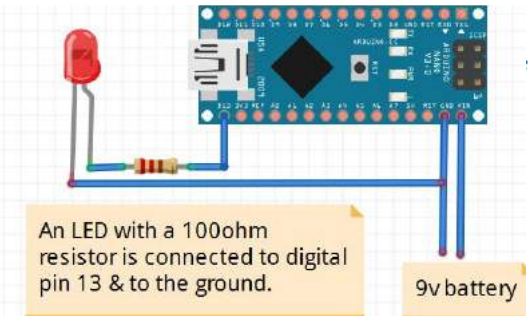
Aim - To assess component function through computation sketch

Method - Computation sketch

- Arduino Nano is connected to computer using micro USB cable
- Code the desired program
- For this implementation, code is used to test whether multistage computation such IF number 1 times number 2 is greater than 10 then display drink water as text.

Results - Found that although code was correct, INeeded to reassign COMs for the microsontroller and drivers and other support files were missing. Although final results were

Conclusions - This test was useful in identifying and solving several issues beforehand, rather than struggling during construction stages.



Source for circuit design of led and microcontroller
(https://cdn.instructables.com/F7M/2590/IKRNP7P3/F7M2590IKRNP7P3.LARGE.jpg)

Evaluation for Process Testing - Tests and investigations conducted have given very useful insight into issues that were ignored/undervalued during idea stage. A more realistic outlook on the electronics design and functionality of the Smart fitness bottle can now be considered for a final design with the results and conclusions gathered. Also valuable practice coding has also been achieved.

Documentation of

Research, Experimentation & Testing

Technique Testing

General Aim - To identity and practice methods to soldering, de-soldering and current skill set

Description - Several attempts at soldering wires and connection and reversing them to identify areas requiring practice.

1 Soldering

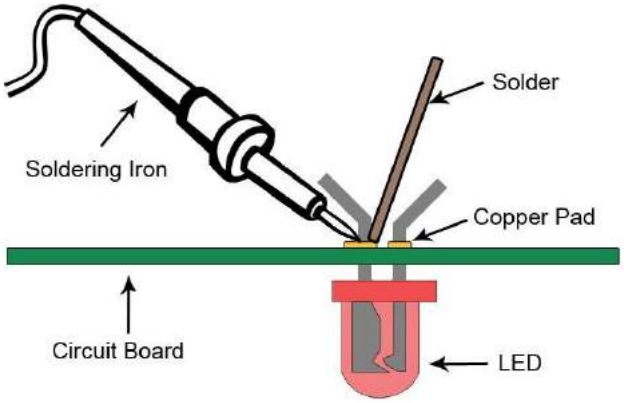
Aim - To identify current skill level in soldering and areas to improve.

Method - Soldering

- Ensure water and wet cloth is nearby for safety and also wear safety gloves and glasses.
- Turn on soldering-iron and hold it with dominant hand
- Hold piece of solder in other hand
- Heat terminal/wire then place solder and ion together and separate when desired joint is made

Results - My work in wire joints was good although at times I was using to much solder

Conclusions - With practice efficient soldering can be achieved and majority of joints were very secure which is very promising.



2 De-Soldering

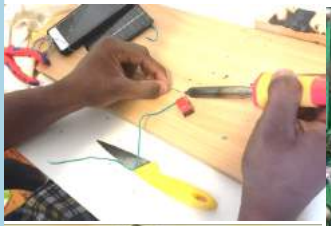
Aim - To identify current skill level in de-soldering and areas to improve.

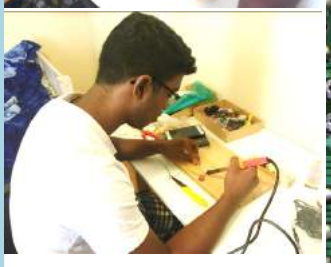
Method - De-soldering

- Ensure water and wet cloth is nearby for safety and also wear safety gloves and glasses where necessary.
- Turn on soldering-iron and hold it with dominant hand
- Heat terminal/wire then gently pull wire and/or component form connection joint

Results - Some components were very sensitive and heating terminals too much would damage them but otherwise it was very well done.

Conclusions - This was a very efficient process with minimal issues





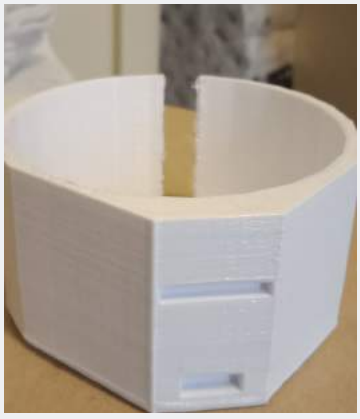
Evaluation for Experimentation and Testing - Tests and investigations conducted have given very useful insight into issues that were ignored/undervalued during idea stage. A more realistic outlook on the design and functionality of the Smart fitness bottle can now be considered for a final design with the results and conclusions gathered.

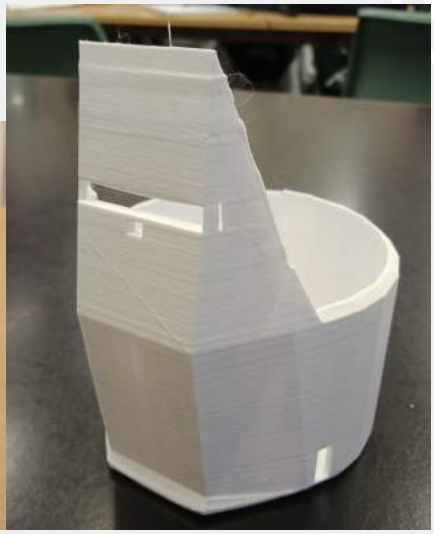
EVIDENCE OF

Testing design solutions

CAD drawings made previously, were printed to act as prototypes for the final casing of the electronics. Also the CAD design was made to satisfy AS1100 standards.This was to determine few factors which include:

- ***Scaling of size***
- ***Aesthetic ability***
- ***Function (does it serve its purpose and does it fit all components)***
- *Structural integrity (difficult for bottle to stand and to hold)*
- *Print quality*
- *Time taken to print*
- *Surface texture (can it be sanded and painted on)*





- ***Results and conclusions -***
- ***Small scaling error of approximately 1.2% (fixed with consideration error percentage)***
- ***Aesthetically pleasing although could be modified further by reducing pointing out effect in the front by reducing its width***
- ***Function is not compromised and will fit all components easily***
- ***Stands sturdy and base texture provides additional grip and other surfaces are very smooth already***
- ***Print quality can be controlled and this effect time to print (the prototype was printed with medium and took 2 hours to print)***

APPLICATION

OF CONCLUSIONS

With reference to my project, evidence of these modification can be seen in the change in design of...

Aesthetics- Bottle surface

Material test 1 - The bottle surface has been partly polished and painted therefore heating caused burning of paint and discoloration. ***New paint coat and polish should be feasible once functionality*** of bottle is deemed successful based on set criteria

Ergonomics- Bottle structure

Material test 3- The bottle has vacuum layer for insulation and cutting this would damage the bottle hence ***no structural changes will be made to bottle***

Aesthetics- Electronics casing

Material test 4 -The bottle cap can be removed hence a ***modular casing for electronics is feasible***

Function/production- Electronics

Technique Test 1 & 2 - Additional appliances such as soldering guns or workstations re necessary as results were satisfactory to the requirement so the criteria of success. ***A soldering pencil should be adequate and greater care must be taken with sensitive terminals***

Function - Electronics

Process test 1- All components function properly as long as coding has been done correctly,**built-in guides on the software pack will be used. Due to range of difficulty, changes to the time plan and criteria for success such as labeling function first priority over efficiency will be made**

Function - Electronics

Process test 2 -This test was useful in identifying and solving several issues such as updating support files, and also **these issues have been noted as conclusions for later usage as trouble-shooting information**

EVALUATION

The following conclusions and modifications have been taken as a direct result of the experimentation and testing of ideas,materials and tools with regular updation to the criteria of success where necessary. I found this process useful as it provided valuable information on aspects that were not considered in depth in initial research and justification of ideas.

Selection and Justification of Ideas and Resources

	Idea	Chosen	Justification
1	Have heart rate monitoring system that will record readings or display live on LCD screen and phone.	Display live	I would display it live because I would need to do additional programming to make app record readings and I am not sure if it is within my skill area. Also, the other way would drain battery and cause discomfort for user.
2	Have electronics of the project embedded in the bottle or create a modular system that will be permanently fixed	Create a modular system	This method is not only easier but also logical as embedding the electronics in the bottle would mean that I would need to cut the aluminium bottle which already has vacuum sealed walls for insulation and this would be compromised. Also reattaching the base after cutting seems unfeasible. Also, a modular method gives greater flexibility in terms of design and size.
3	Custom design circuitry or use development board and design a suitable circuit which will involve programming from scratch	Use development board	Using the development board would make it much efficient process as the custom designing of circuitry is very expensive especially for a one off. This seems impractical and the chosen method gives greater flexibility in what I can do with the ease on expense.
4	3D print entire bottle to fit electronics or 3D print only casing for electronics	3D print casing	By only 3d printing the case I reducing the work load as well as solving the main issue this idea was aimed at. This was to somehow implement the electronics into the bottle.
5	Need some visual representation of circuit design	Use circuit diagram software	This was method I used quite often in my previous projects and it gave me a solid guide to follow when confused and keep in on track.
6	Have a user-friendly interface for heart rate	Have a cut-out in CAD design for pressure to be placed with finger	This way allows user to apply pressure on the cut-out with sensor and it also adds to the aesthetic aspect of the MDP
7	Either use cells as energy source or rechargeable custom battery.	rechargeable custom battery	The cell batteries are minimal in their capacity even though they don't take much space but, in this case, the custom battery is more suited to eh needs of the MDP

Selection and Justification of Ideas and Resources

	Resource	Type	What idea does it serve?	Justification	Tools required	Techniques involved and source	Availability/ Location
	Aluminium bottle	Component material	2/4	Aluminium offers durability and great strength to weight ratio. Also, easy to work with	Hammer and Chisel	Using hammer and chisel without denting the bottle (skill acquired by D&T teacher and practice)	Kmart
	Plastic casing	Casing material	2/4	Great flexibility in terms of design and sizing.	3D printer	Using CAD software and efficient with scaling. (practice and tutorial videos)	School 3D printing room
	Solder	Gluing material	To attach wire connections	Vital for joining wire connections to PCBs	Soldering-iron and stand	Ability to solder efficiently with minimal usage of solder with clean joints (practice and prior expertise)	Jaycar Electronics
	Wire (aluminium)	Extension material	To carry current across circuit	Aluminium is very reliable and common with its capabilities	Wire stripper	Easy to cut wire but need to practice making neat wire joints with minimal wastage. (practice)	Ebay
	Silicon lining	Gripping material	For ergonomics of the MDP	Provides grip for holding and securing base	Scissors	Careful trimming according to shape desired may practice on test piece.	Lincraft, Ebay
	Chrome paint	Coating material	Aesthetic purposes	Will coat and provide seamless finish to the modular design	Paint brush/ spray bottle	Practice on test material and make flush finish with minimal wastage.	Bunnings

EVALUATION

This final justification of ideas and resources provided assurance for the construction processes ahead and also aids in identifying late modifications but in this case majority stayed the same. Since ideas and resources were tested and evaluated positive results were considered when choosing them

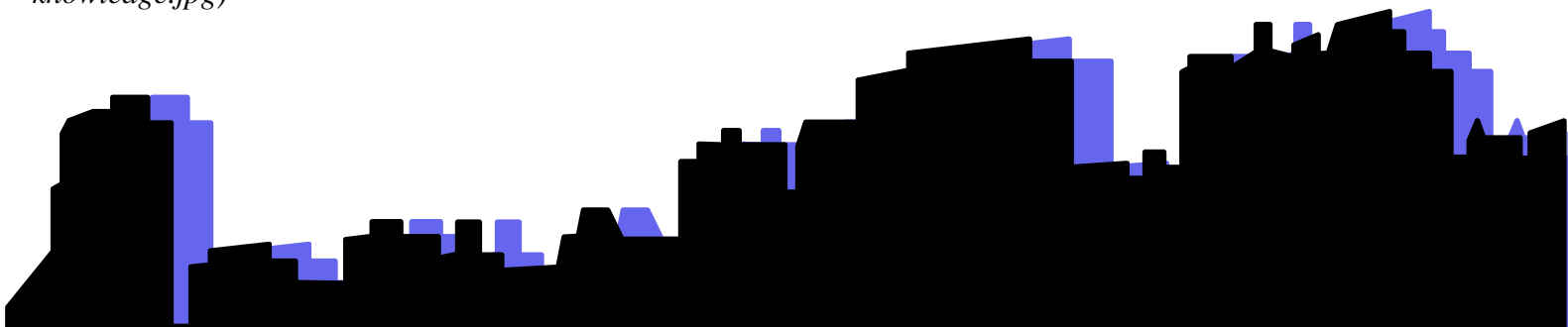
Thinking **BIG**...

Design Solution on Industrial Scale

What is the difference between a bath tub and a swimming pool? Of course, the amount of water but also the external aspects such as the containment factor, size, function and overall capacity to serve and offer more users. This analogy closely links to conversion between electronic products as to their manufacture as a one-off in comparison to the methods used by industries. below is the generalised flow of production for PCB manufacture.

While majority of the processes are conducted on-site; manufactured components are usually shipped to company site for assembly with other components such as the plastic casing of the bottle and the bottle itself. Major advantages of large scale manufacturing is *ability to outsource from cheapest vendor, import in bulk, sponsors and much larger budget and advertising capabilities.*

Image source - (https://i.pinimg.com/474x/3f/d8/74/3fd8741a27a3b2ce0265a1466cf313f3--printed-circuit-board-knowledge.jpg)



Thinking **BIG**...

Design Solution on Industrial Scale

Process Safety

"Safety Is First Priority"

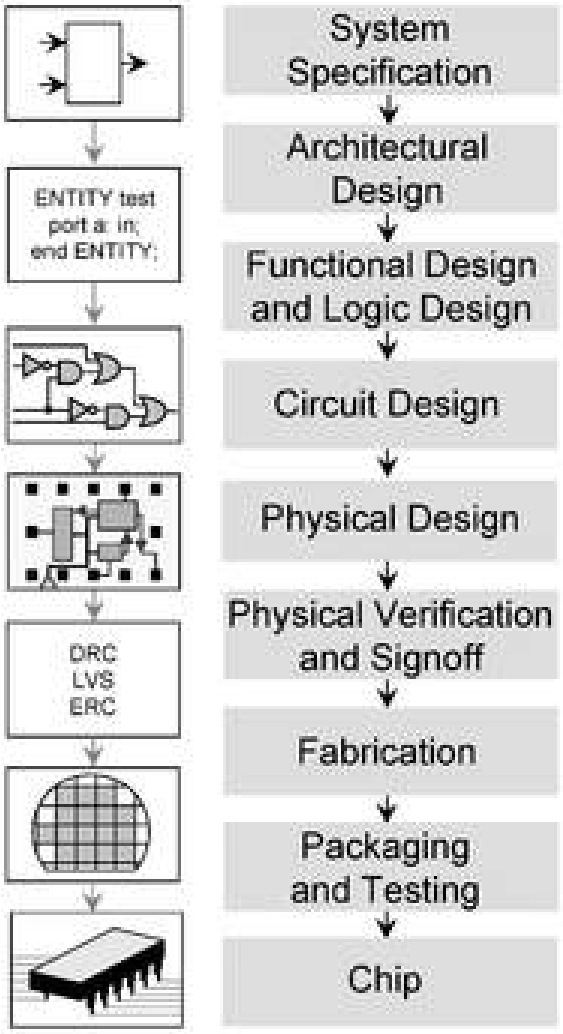
Safety is underlying factor of a successful company and its products sale. organisations such as, Safe Work Australia an Australian government statutory body established in 2008 to develop and regulate national policy relating to Work Health and Safety and workers' compensation. (safeworkaustralia, March 2019). Authorities regulate and monitor industry processes to ensure safe and fair practices. The preliminary risk/incident prevention process is as follows:

Anticipation
Risk analysis procedures

Inquiry
Reliable advice from unbiased sources (safety engineer) and diagnostic analysis

Execution
Set procedures for mitigation followed

Resilience
Issue noted and prevention method evaluated for future encounters



Brief structure of Chip/ Micro-controller manufacture. *Image source - (https://i.pinimg.com/474x/3f/d8/74/3fd8741a27a3b2ce0265a1466cf313f3--printed-circuit-board-knowledge.jpg)*

"Safety...

doesn't happen by accident"

Safety considerations with OHS applications

- **Eye strain**
- **RSI (Repeated strain injury)**
- **Ergonomics of seating**
- **Adjustable seating availability**
- **Lighting and ventilation**
- **Power sockets and electronics device away from food and drink**
- **Foot rest**

Anticipation
Risk assessment and mitigation methods in place

Regulate
Consider issues at all stages of construction and use of tools.

Execution
Proceed with safety procedures for mitigation once issue identified

Resilience
Issue noted and prevention method evaluated for future encounters

The safety procedure undertaken is a adaptation to that of Industry's. Here, the diagram is more inclined to the MDP and its related procedures.

TOOLS & RISK LEVEL

Prevention and Precaution methods

Soldering ion -

- Never touch the element or tip of the soldering iron. They are very hot (about 400°C) and will burn.
- Hold wires to be heated with tweezers or clamps.
- Keep the cleaning sponge wet during use.
- Always return the soldering iron to its stand when not in use.
- Turn ion off or unplug it when not in use.

Safety blade -

- Cut away from your body. Make sure no body parts are in the cutting path, or in the path the blade might take if it slips.

Solder smoke -

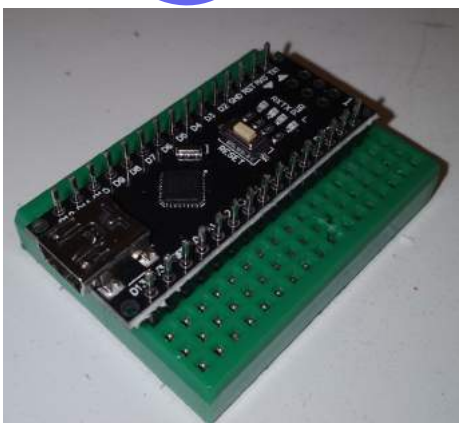
- Harmless to small exposure although might pose threat for asthmatic users in such case use gas mask

Solder Smoke

Nose Plier -

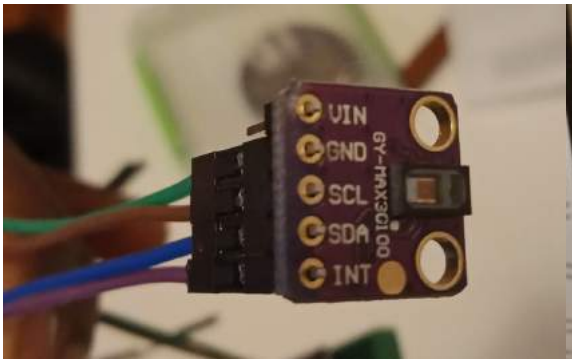
- Only use required force and assess consequences of action at all stages in usage
- Wear safety gloves ad take care with fingers

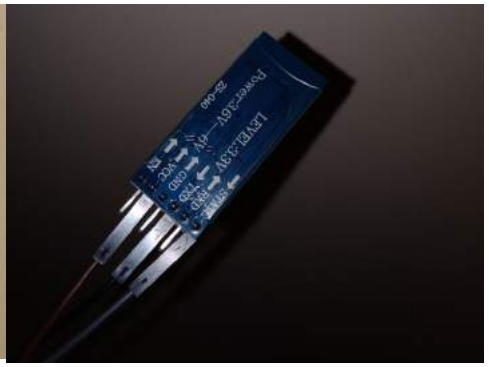
Evidence And Application of Practical Skills



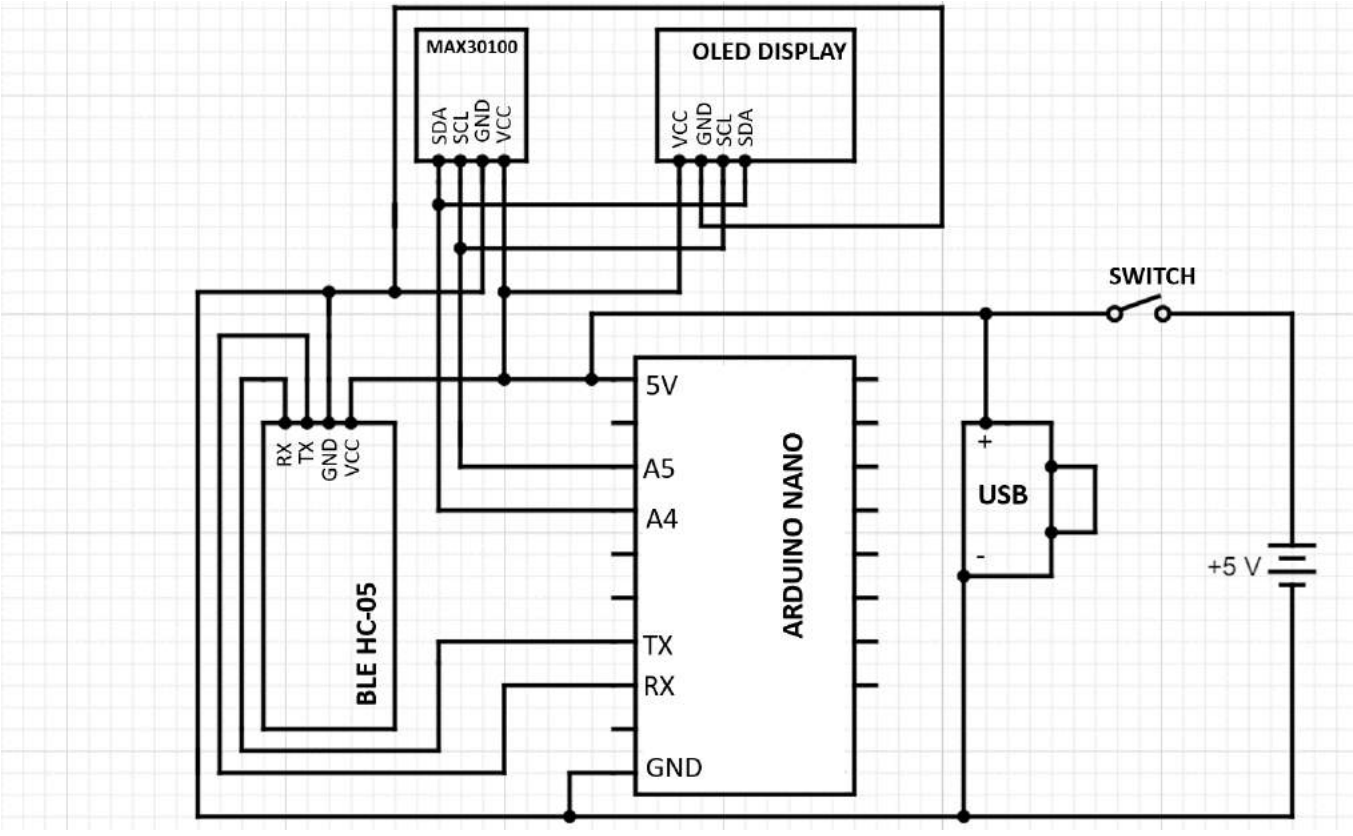
In the initial stages of assembly the components terminals were snipped to size using a cutting plier and then soldered on to the appropriate terminal pins

Evaluation -Some of the terminals in breadboard were loose and this caused issues. I fixed this issue by using thicker wire and electrical tape





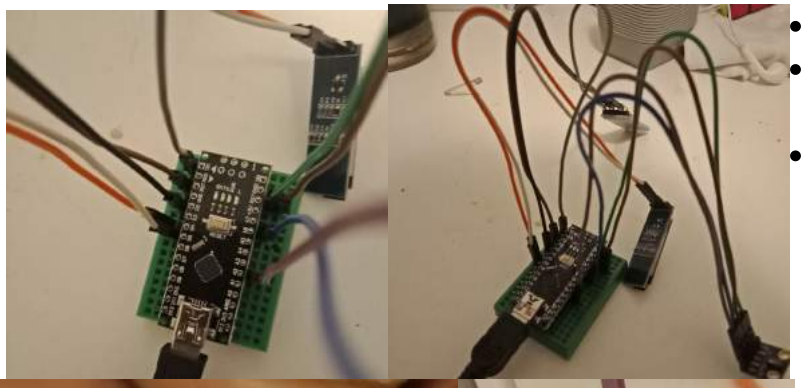
Next each component is connected according to the circuit diagram below, that was custom designed to suit the design/functional requirements. The circuit has parallel connection to the battery (power supply), USB ports and Sensor circuitry. Circuit created using drawing tool (www.circuit-diagram.org)

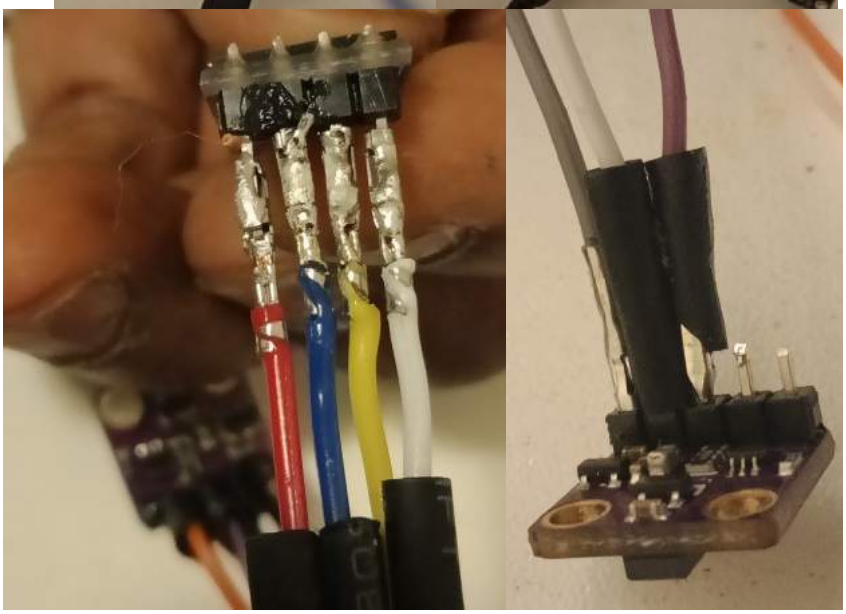


Evidence And Application of Practical Skills

Attaching the Bluetooth module in the Arduino.

- Connect the bluetooth module at the back of the board and also connect the wire in the Arduino as follows:
- RX from Bluetooth to the TX1 pin in the Arduino.
- TX from Bluetooth to the RX0 pin in the Arduino.
- GND from Bluetooth to the GND (pin besides the RX0 pin) in the Arduino.
- Vcc from Bluetooth to the 5V pin in the Arduino.





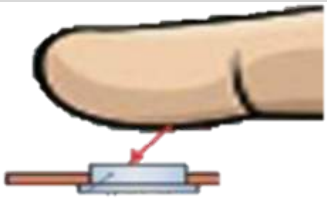
Attaching the MAX30100 sensor and OLED display in the Arduino.

- VIN from MAX30100 to the 5V pin in the Arduino (same as we have in the Bluetooth step).
- SCL pin from MAX30100 to the A5 pin in the Arduino.
- SDA pin from MAX30100 to the A4 pin in the Arduino.
- GND pin from MAX30100 to the GND pin in the Arduino (pin between VIN and RST).

Ensuring Safety

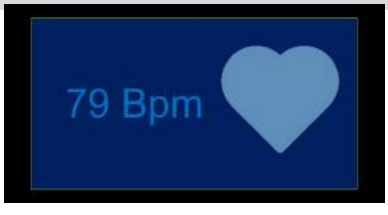
- Connect insulating sleeves to wire connections to prevent short circuiting of bare wire and to strengthen wire connections.
- Use solder flux so that solder stick to the terminals well.

Levels of Code



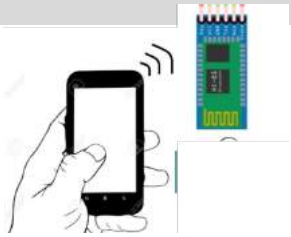
STAGE 1

Initiates code once finger is placed MAX30100 heart sensor.Reads and calculated using a algorithm the number of heart rate through analyzing light refracted off flowing blood across a time period



STAGE 2

This result is displayed on the display module. Once the finger is removed for a certain amount of time. The arduino will initiate the code again.The sensor is ready to use once again.



STAGE 3

If a bluetooth capable device is connected to the Bluetooth HC-05 component (in slave mode) the results will also be transmitted real-time to the device though the use of a third party application

Evidence And Application of Practical Skills

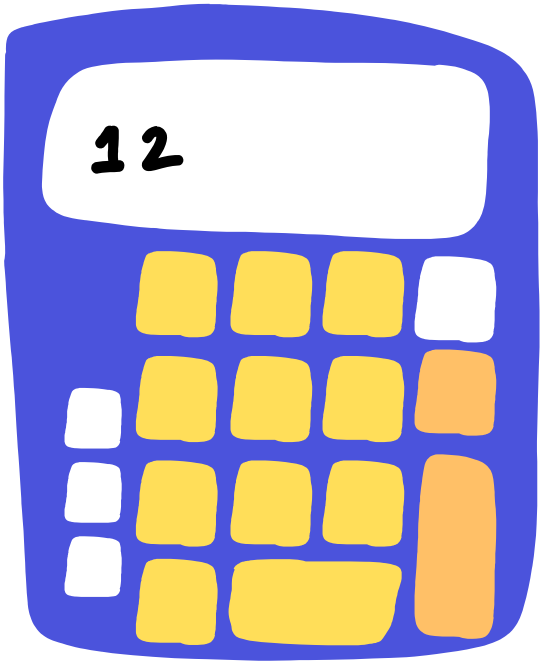
```
long delta = millis() - lastBeat;
lastBeat = millis();

beatsPerMinute = 60 / (delta / 1000.0);

if (beatsPerMinute < 255 && beatsPerMinute > 20)
{
  rates[rateSpot++] = (byte)beatsPerMinute; //Store this reading in the array
  rateSpot %= RATE_SIZE; //Wrap variable

  //Take average of readings
  beatAvg = 0;
  for (byte x = 0 ; x < RATE_SIZE ; x++)
    beatAvg += rates[x];
  beatAvg /= RATE_SIZE;
}
```

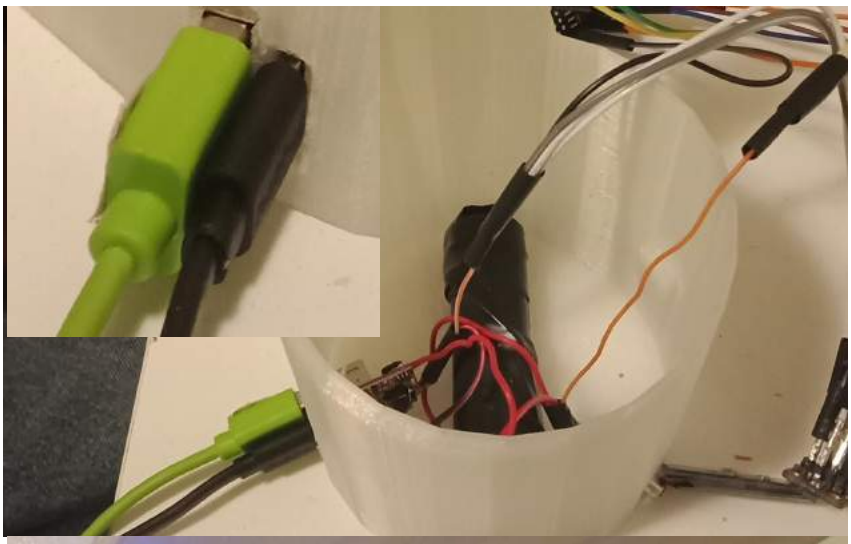
Calculating Bpm and Temperature

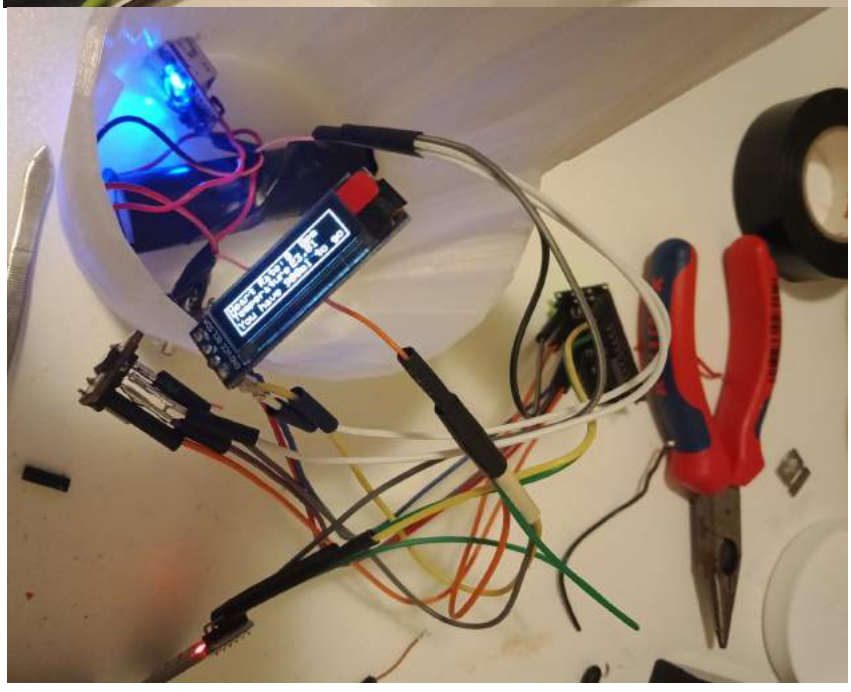
How the code works (Calculations)

Through readings from IR transmitter and Photodiode, the reflected light from blood volume in tissue is measured across a 60 second time period which then calculates an average beats per second. Therefore the longer and stable the finger is placed the more accurate the reading.

The temperature of liquid in bottle is determined by using bottle surface temperature and using the specific heat capacity formula $c = Q / (m * \Delta T)$ to determine liquid temperature







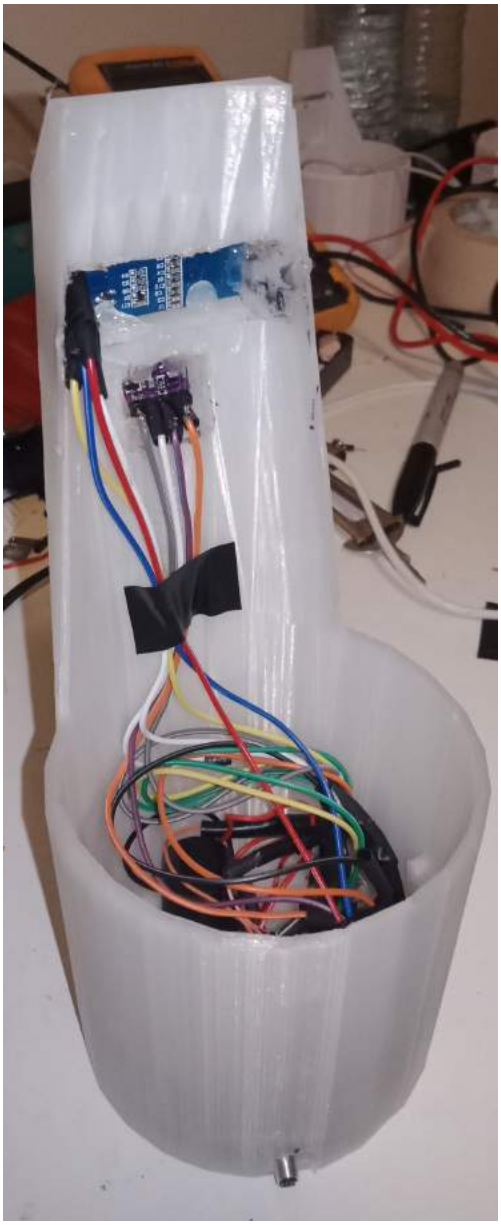
Component Assembly

- After all parts have been soldered, insulated with electrical tape and checked for no bare wiring or weak connections; grooves were made on to the casing body.
- By first making a rough sketch of the exterior outline of the ports and switch face, the hole was drilled and then carefully filed to shape.
- All wires were neatly taped and routed so that positive wires (colourful) and negative wire (black,grey and white) can easily be identifed.

Evidence And Application of Practical Skills

Interior Layout

The following shows the layout of the wiring before all wires were routed and sealed with electrical tape to protect circuitry from internal short circuiting and moisture protection.



Component Assembly (Evaluation)

The assembly was tricky as the varying sizes of the components required a lot of care with intricate calculations, use of glue and filing in order to make neat fittings.

Evidence And Application of Practical Skills

After the interior part of the assembly was complete outer edges and corners were smoothed using a file and sand paper. Plastic threads from melting and 3d printing were removed by sanding.

Production Stage Evaluation

After experiencing issues regarding sizing of the components, working with very small spaces and intricate fittings. I was forced to adapt and critically solve problems with the most effective solution, for example, as components such a display did not fit snugly, I had to manually melt the width side by heating a metal blade and placing it with applied pressure on the side to be increased. This rewarding experience enabled the production stage to be complete and final finishes such as stickers for ports, brand name and silicone seal was made.

Modifications

Improvements made during production stage that vary with initial design.

- Drilling new holes for the switch and micro-usb port
- Increasing size of spacing for display and heart rate sensor by melting sides with heated blade
- Using a 4000mah rechargeable battery instead of 1500mah in order for it to cope with the design requirement of charging a 5V device as well as powering sensor circuitry.


The Evaluation

EVALUATION

PRODUCT SUCCESS ANALYSIS - FUNCTIONAL

The Smart fitness water bottle will monitor the heart rate of it user as he/she puts his finger on the sensor

The heart rate sensor functioned as expected when experimented against Fitbit watch and Blood pressure monitor although their was a slight calibration issue which was immediately fixed.

Device	Average Bpm
Smart Fitness Bottle (Aquate)	72
Samsung S7	69
Xiaomi Mi Band 3	71
Blood Pressure Monitor	75

The temperature of liquid will be displayed

This aspect also was initially inaccurate as the temperature of the sensor itself was not considered in the algorithm/code. This was fixed by subtracting percentage of error from each initial reading

Through the mode changing on switch, the phone device can be charged and the internal battery can be recharged through USB port

This aspect worked as expected as various power outlets and USB cables were tested for compatibility and all were capable of charging phones devices such as Iphone 6s, Samsung S7, OPPO A73 and Iphone 8.

Once pressure is released the sensor will automatically reset and ready to measure again

The sensor was successful in sensing the infrared readings to determine intensity and return a heart rate of zero when it is below san IR value of 5000

The readings will be received via Bluetooth to the users device through a Bluetooth Terminal app

Once a device has been paired with the Bluetooth module; through the app the phone is connected for data transmission. After initial trials the layout of readings was modified.

The readings will also be displayed via an OLED display

The spacing, size and font of he displayed text was deemed acceptable based on personal judgment and display brightness was ideally dependent on lighting of environment to save battery.

The app will prompt user for regular water intake and notifications/reminders.

Although the written code was functioning in order to receive and display live notifications the third party app was not designed to interpret the code. Although a simulation of this function was still included sucessfully

EVALUATION

PRODUCT SUCCESS ANALYSIS - AESTHETICS

A good prototype is effectively able to simulate the final system as well as be able to be critically analysed for success and failures in both functional aesthetic areas

The bottle and its casing will have polished surface finish	The casing and bottle after polishing and sanding a smooth finish was produced.
Rubber lining for water sealing	Using industrial silicone paste te sealing of the gaps between casing and bottle ensured that water could not enter into the electronics
Silicone skin around casing for holding grip and rubber or magnet on the base for sturdiness/attachability.	This was partially successful considering that function was to prioritise, time was not allocated for this part
MDP will follow a dark - colour scheme with colours ranging between dark grey to matte black.	The finished result was appealing and aesthetically pleasing with the use of avaailable colours and budget
Components will be placed so they adhere to user and his grasp of the bottle.	This was done during the design of the CAD and successfully achieved

The above screenshot is the testing of the function/ aesthetic appeal of the measurements and how they are displayed. The font,colour and size was plausible and pairing of devices was very intuitive and effiecient. As it follows a similar method to most bluetooth enabled devices.

EVALUATION

PRODUCT SUCCESS ANALYSIS - SOCIETY

Social/cultural values and beliefs shape the needs and function of emerging technologies. As a result, their ethically just influence on the user is a criterion that defines the probability of success and its reception in the global-market. Based on an article by Deborah Lupton (Centenary Research Professor, University of Canberra), the influence on the user of Fitness technology and its function can be separated into areas of consideration these include:

- Taking control over health and
- wellbeing
- Providing motivation to
- achieve personal bests
- Spurring healthy competition
- Giving real-time feedback
- Learning healthy behaviours
- Social Conscience

In terms of this MDP, several of these factors have been considered closely as they encourage the maintenance and monitoring of health and daily activity, while providing additional ease. Hence, the influence on the user is mainly concerned over their well being than any other.

In terms of political and social trends, government organisations have already exposed their interest in developing the idea of smart connectivity in our lives. This has been evident in our transport through OPAL cards, Credit card (Pay Wave), Artificial and Machine learning technology in our mobile devices. The development of IoT technology will only continue to enhance our day to day activities and the large data that is produced as result of this will attract data analytic purposed-based organisations such as Australian Government Department of Health. Their involvement will therefore enable social awareness of such technology. A motion for the changing nature of work would allow users to become aware and intrigued of technology that receives both political encouragement and social reputation.

The security of data on the other hand is highly dependant on the application package of the product. In terms of the Smart Fitness Bottle appropriate use of data has already been considered for ethical reasons, data from the sensor readings cannot be altered or manipulated and serve the sole purpose of sending readings. Although in future developments of the MDP, a more user inclusive application may allow users to create profiles and set multiple daily goals and compete with other users of the Smart fitness bottle in completing daily goals. In such cases integrity of data and privacy need to be maintained through appropriate encryption methods such as passwords and authentication keys (fingerprint, face recognition, pattern)

EVALUATION

PRODUCT SUCCESS ANALYSIS - ENVIRONMENT

The Smart Fitness Bottle requires a wide range of materials and equipment. The environmental impact these may impose are needed to be kept at low. When discussing the impacts these projects have to offer on the individual and environment; it is important
to consider two key areas:
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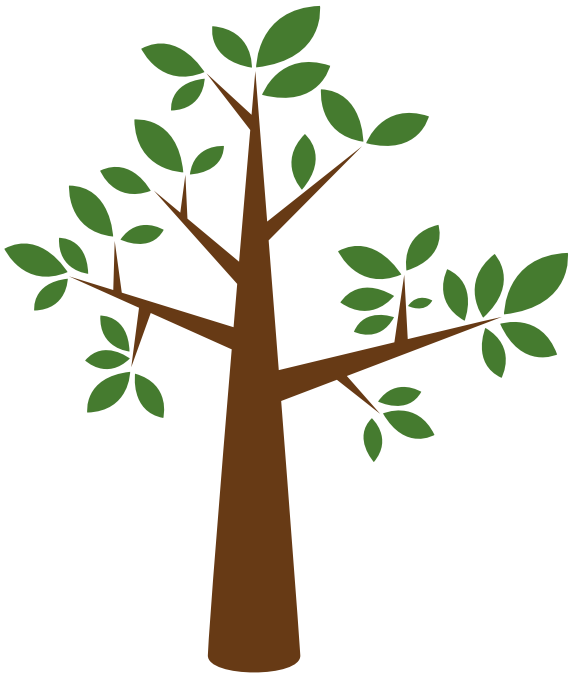
- Primary impacts (retrieving and manufacturing
- materials)
- Secondary (Disposing or recycling)



Materials in

- Electronic components (aluminum, lead, silicone, plastic and other materials used in electrical components)
- Glue (Ethylene-vinyl acetate (EVA)
- copolymer material)

These materials are all known to impact on the environment in the two stages (primary and secondary).
In the primary area, Aluminium and silicone are mined materials which require the deformation of land and destruction of an area in hectares. This activity negatively affects the life that existed on the land. The pollution produced during the process of retrieving and then converting the raw material to a usable form are also side effects of such materials. Plastic is a human made material that also produces pollution during its manufacturing stage where toxic gases are released when it is melted and
formed.

In the secondary stage, Electronic components and other plastic based objects are hard to dispose of as they produce toxic gases when burnt and when disposed of in landfills; they can drastically affect the
health of animal life that may swallow it for food. Major industries around the world have seen the overproduction of e-waste (electronic-waste) as a silent but dominant threat to consider. Even though plans and actions have been made to recycle certain aspects of computers and other electronics the issue is still present. The hope for 100% recyclable electronics and plastic production is the only solution for the growing issue. The field of technology provides the opportunity to design and produce projects that can betterment on the issues that face society every day. These projects could be anything from making a everyday activity like making coffee by hand transformed to a machine that makes it for you with a push of a button or as big as helping create prosthetic limbs. Projects in the past have proven that they can help many other fields such as medical, technology and agriculture to improve their knowledge and simplify their work with help of revolutionary projects made in the hope of a better alternative.

EVALUATION

FINAL ASSESSMENT OF MDP AND FUTURE PROSPECTS

The Smart fitness water bottle was a successful stride into the field that I find most interesting. The ability to interact with coded electronics and emerging/ developing technologies such as development micro-controllers and 3D printing technology was an insightful experience. Looking at the positives I was able to produce a reliable monitoring system that can provide accurate reading s to regulate healthy hydration habits and fitness motives. The design brief was successfully met and initial criterions were completed to a satisfactory level. Looking at the final product I would say that I would have hoped for a smaller version of the product, although it was not part of the initial goals. In search for future prospects of its improvement I believe that a custom printed circuitry and industrial standard plastic manufacture (injection moulding) would allow for improvement on the design. Unfortunately, the current budget and time allocated is unfeasible for this.

Personally, I found this experience a challenging yet invigorating, one that allowed the development of new skills and refining of the existing. Initially, having no prior experience with Arduino and its coding language, having to use 3D modelling for scale designs and using module electronics. These components have enriched my personal knowledge and motivation to pursue the field of technology as it enables the betterment for society and its needs. This idea for the MDP had begun from the hope to design and produce something that is not only new and unique but actually contributes to the betterment of the user's health. At this stage I believe I have achieved what I had set out for initially and hopeful for its future implementation as a marketable product

The Future...

Projects such as these are generally rolled out for manufacture after significant R&D and large quantities of prototypes testing and evaluation. Not to mention the larger economic and time support. Comparing the idealistic gap between my MDP at this stage and it being marketable in the near future; I believe several improvements could be made. The conducted testing and evaluation only suggests that the ergonomic and size aspects of the design would prepare it to be a successful product in the market. Although, these aspects are not essential to the set criteria of success due to the time, economic feasibility and availability of tools. With appropriate financial and expert support the product can be improved even further. Comparing positives and negatives of this MDP in initial justification and evaluation on functional and aesthetic aspects provided the reality; there is always room for improvement.

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Major Design Project 2019

Aquate

The smart fitness water bottle