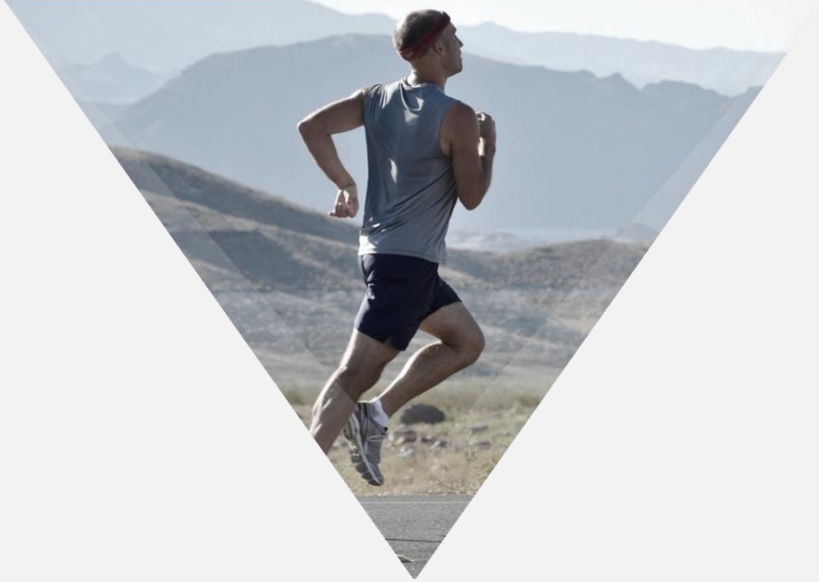

DEEPBREATH

Get more out of every breath.

Exotic

Exotic

OUR TEAM

TEAM 13

Chief Executive Officer

AUSTIN PHILLIPS

Hardware research and design

Chief Communications Officer

JIM PARK

User experience design and microcontroller communication

Chief Information Officer

SULAIMAN OMAR

Software design and integration

Chief Technology Officer

ALEX BOSWELL

Microcontroller Bluetooth integration and implementation

CONTENTS

1

INTRODUCTION

CONTENTS

BACKGROUND

Fitness Testing

Advanced measurements of fitness levels are expensive, and must be performed in special labs and settings.

Fitness enthusiasts who are looking to take their fitness journey to the next level are limited in their options.

[1]

OUR GOALS

MOTIVATION

PORTABLE, CONVENIENT, AND INEXPENSIVE

The goal of *DeepBreath* is to bring cutting-edge fitness technology to average consumers.

Our product could be the first of its kind to reach the general market.

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DEEPBREATH

Get more out of every breath.

2

BUSINESS CASE

CONTENTS

Market Analysis
Demographics
Competition
Cost Analysis
Pricing Considerations

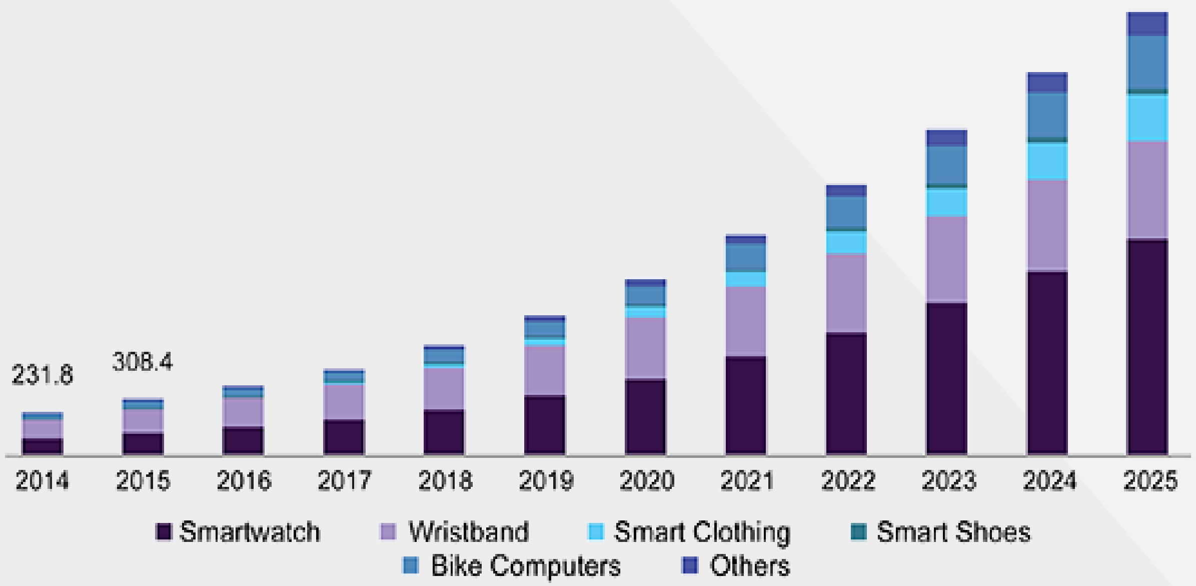
MARKET ANALYSIS

The graphs below show a marked growth in the fitness technology and wearables industry.

Global forecast of sports, fitness & activity monitor market revenue from 2013 to 2019 (in billion U.S. dollars) [2]

Source: Statista *Global forecast of sports, fitness & activity monitor market revenue from 2013 to 2019 (in billion U.S. dollars)**

China smart fitness market by product, 2014-2025 (USD Million) [3]



Source: Grand View Research *Smart Fitness Market Analysis By Product (Smartwatch, Wristband, Smart Clothing, Smart Shoes, Bike Computers, Others), By Type (Head-wear, Torso-wear, Hand-wear, Leg-wear, Bike mount), By Region, And Segment Forecasts, 2018 - 2025*

DEMOGRAPHICS

Our target demographic is the every-day fitness enthusiasts and amateur athletes.

- Every-day fitness enthusiast that don't mind spending money on health and fitness related activities
- Amateur athletes. Most of the time amateurs will never get access lab grade equipment. If they do its only once or twice in their career.

COMPETITION

Only other similar product on the market available for personal use is VO2 Master [4]

VO2 MASTER

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DEEPBREATH

Specific Target Market

MSRP: $4,999

No Social Media Presence

Broader Target Market

Cheaper

Social Media Emphasis

COST ANALYSIS

Type	Part Number	Quantity	Unit Price	Total Price
Sensor	LOX-02	1	$90	$90
Sensor	SprintIR-WF-100	1	$115	$115
Sensor	AWM730B5	1	$250	$250
MicroController	ESP-32	1	$25	$25
Power Supply	Anker Astro E1	1	$22	$22
Mask Material	Training Mask	1	$20	$20
			TOTAL	**$522 CAD**

PRICING CONSIDERATIONS

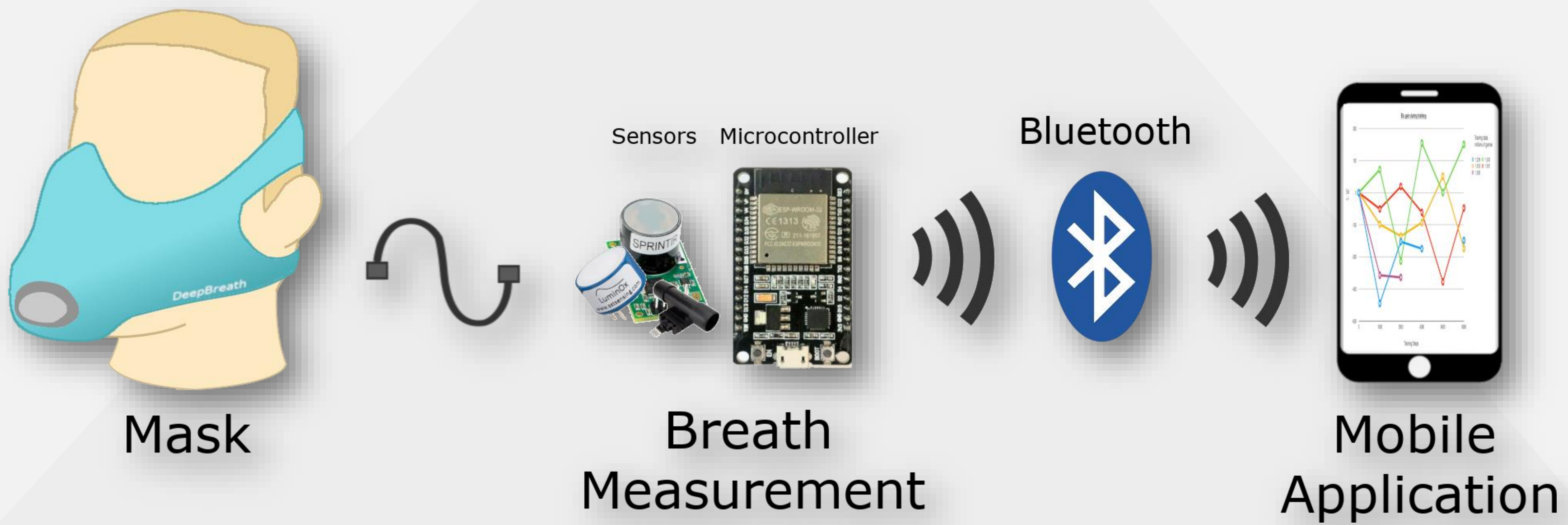
- Areas where we can reduce price
  - Look into cheaper flow sensors, currently most costly
  - O_2 and CO_2 prices will get reduced significantly at scale
  - Ex: At 10,000 units CO_2 and O_2 sensors:
    - $115 -> $25 and $90 -> $15 (estimates)
- Areas where we can't estimate right now
  - R&D
  - Creating our own mask from the ground up
- Estimated final cost at scale
  - $150-200 per unit

3

TECHNICAL CASE

CONTENTS

SYSTEM OVERVIEW



Technical Background

Fitness Metrics

Two metrics we focused on are VO_2 max and RER (respiratory exchange ratio). We hope to include more metrics as product develops, but these two are a strong start.

VO_2 Max

VO_2 max is a measure of the amount of oxygen the body can process over a defined period of intense exercise.

RER

The respiratory exchange ratio (RER) discerns whether the body is burning carbohydrates or fat for energy.

Technical Background

Chemical Analysis

Detailed chemical equations for calculating fitness metrics are shown here.

VO_2 Max

The VO_2 max is calculated using summation of breaths over period of time:

$$VO_2\ Max = \frac{Total\ volume \cdot (V_{O_2\_in} - V_{O_2\_out})}{Weight\ of\ person}$$

RER

The RER can also be calculated using summation of breaths over time:

$$RER = \frac{V_{CO_2}}{V_{O_2}}$$

$$V_{CO_2} = \frac{Total\ volume\ of\ air\ exhaled}{\%CO_2\ in\ exhale\ breath}$$

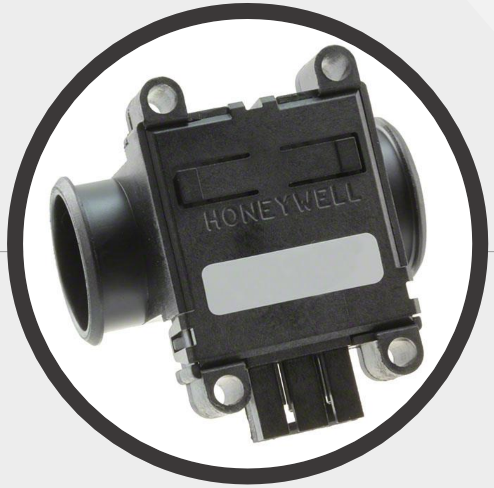
$$V_{O_2} = \frac{Total\ volume\ of\ air\ inhaled}{\%O_2\ in\ inhale\ breath - \%O_2\ in\ exhale\ breath}$$

COMPONENTS AND MATERIALS

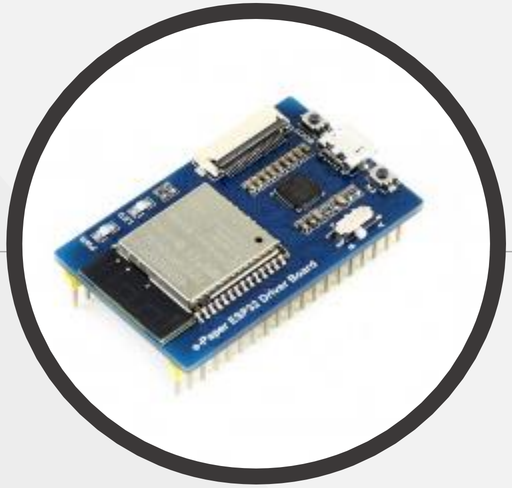
Electronic components used as part of the *DeepBreath* system.

LOX-02 Sensor
Used to measure the percentage oxygen content of the user's breaths

SprintIR Sensor
Used to measure the percentage carbon dioxide content of the user's breaths



Honeywell AWM730B5
Mass airflow sensor used to measure the amount of air that the user inhales and exhales.



ESP32
The microcontroller used to control the overall breath measuring system

TIMELINE

The different phases for the development of *DeepBreath*

PROOF-OF-CONCEPT

- Circuitry and sensors implementation
- Mobile app Bluetooth functionality

ENGINEERING PROTOTYPE

- Mathematical analysis of raw sensor values in mobile app
- Improved circuit design

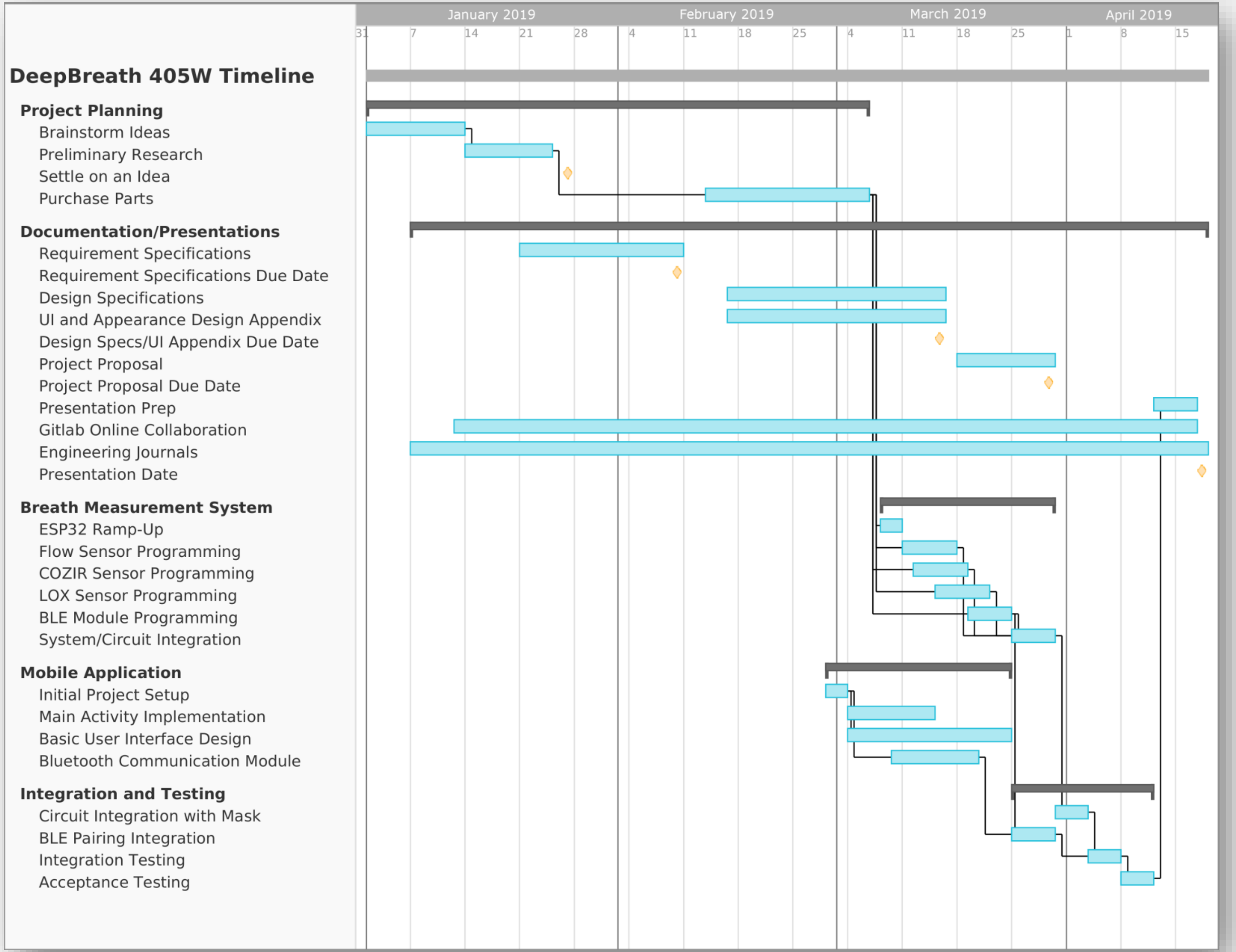
PRODUCTION

- Proprietary microcontroller fabrication
- Bulk ordering of parts
- Design our own mask

DEVELOPMENT SCHEDULE

Proof-of-Concept

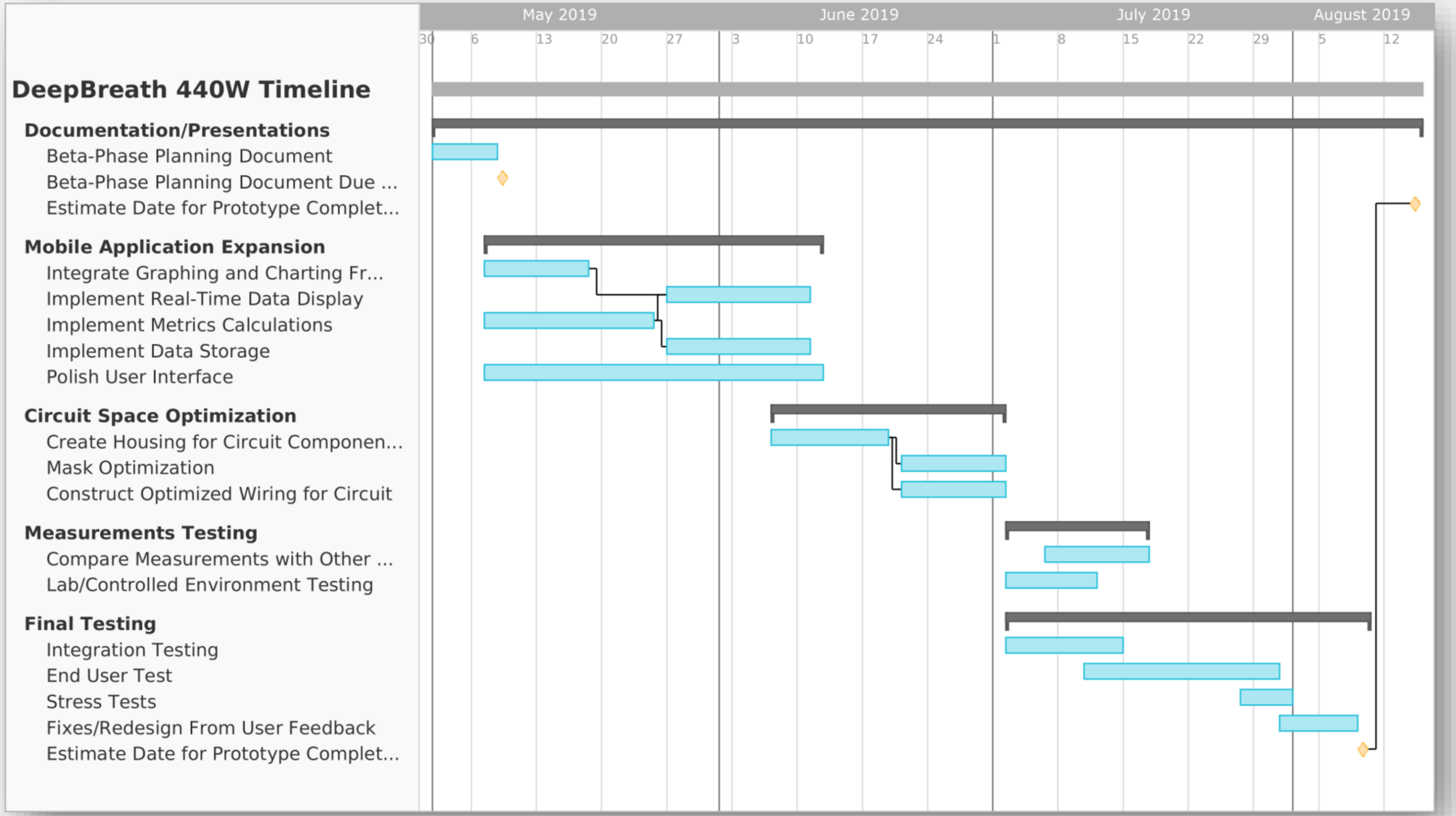
Gantt chart showing the schedule for the proof-of-concept development in 405W



DEVELOPMENT SCHEDULE

Engineering Prototype

Gantt chart showing the estimated schedule for the engineering prototype development in 440W



4

PRODUCT DEMONSTRATION

CONTENTS

Proof-of-concept Demo

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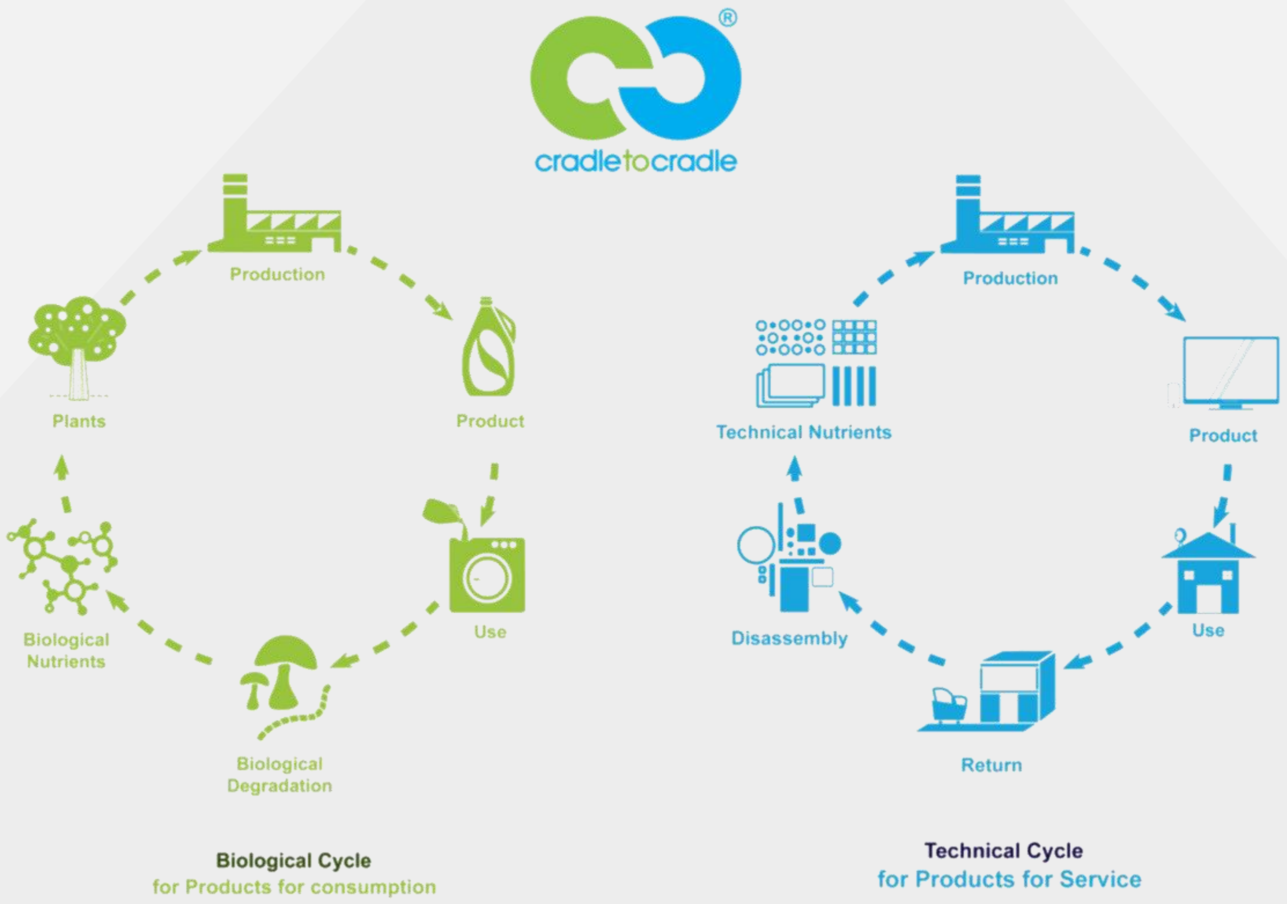
DESIGN STANDARDS

CONTENTS

CRADLE-TO-CRADLE DESIGN



[4]

ENGINEERING STANDARDS

IEC 62133:2012

Standard for the safe operation of portable sealed secondary cells and batteries. [5]

C22.2 NO. 0.23-15

General Requirements for Battery-Powered Appliances [6]

ISO 9241-161:2016

Ergonomics of Human-System Interaction [7]

IEEE 1621-2004

User Interface Elements in Power Control of Electronic Devices [8]

ISO 14040:2006

Standard for environmental management, Life Cycle Inventory Analysis and Life Cycle Impact Assessment [9]

RoHS Compliancy

Restriction of Hazardous Substances (RoHS) Compliancy [10]

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RISK MANAGEMENT

CONTENTS

PRODUCT RISKS

Identified risks for the *DeepBreath* product itself

Reliability

Our cost-effective components allow affordable solution, but lack slightly in precision or accuracy compared to high-cost alternatives.

Wear Over Time

As *DeepBreath* is still in early phases of design, we haven't yet been able to test how it will hold up to extended wear and tear.

Product Safety

Various aspects of user safety must be concerned, especially concerning the wearable mask.

BUSINESS RISKS

Identified risks for the *DeepBreath* business prospects

Consumer Acceptance

Our product is the first of its kind, therefore demand may be slow at first.

Competition

As a new player in the field, we must compete with existing competitors in the fitness wearable industry.

RISKS MITIGATION

Risk analysis and mitigation

Reliability

Trend is particularly important, more so than measurement precision

Wear Over Time

Future plans for thorough stress testing

Product Safety

Design process accounts for various aspects of user safety

Consumer Acceptance

Strong and effective marketing required

Competition

Advertise capabilities of our product that set us apart from competitors e.g. social media presence

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CONCLUSION

CONTENTS

PLANS FOR 440

Our team's plans for ENSC440

- Fabricate our own PCB for the peripheral circuit (power supply and sensors)
- Optimize circuit: use boost in power supply circuitry
- Integrate circuitry and battery pack with the mask in a clean and sleek way
- Upgrade software on app to include VO2 max and RER testing
- More robust codebase
- Thorough testing; benchmarks and stress

SELF-REFLECTION

Looking back on this semester, and lessons learned

Time Management
Learning to manage tasks and schedules is critical in any project.

Planning For Contingencies
You must be prepared for the fact that anything can happen during the course of development.

Thorough Prior Research
Make wise, informed choices before you make irreversible decisions.

CONCLUSION

Advanced fitness metric testing is difficult.
But it **doesn't** have to be.

We want to bring this technology to average fitness enthusiasts, lower-level athletes, and anyone else without the ability to spend thousands of dollars on workout equipment.

References

- [1] *VO2 Max Test - What to Expect*. 2013.
- [2] "Global sports, fitness & activity monitor market revenue 2013-2019 | Statistic", *Statista*, 2019. [Online]. Available: https://www.statista.com/statistics/302572/fitness-sports-and-activity-monitor-market-revenue-worldwide/. [Accessed: 17- Apr- 2019].
- [3] "Smart Fitness Market Size & Share | Global Industry Report, 2014-2025", *Grandviewresearch.com*, 2019. [Online]. Available: https://www.grandviewresearch.com/industry-analysis/smart-fitness-devices-market. [Accessed: 17- Apr- 2019].
- [4] "Cradle to Cradle | Auburn University Office of Sustainability", Wp.auburn.edu, 2019. [Online]. Available: http://wp.auburn.edu/sustainability/tag/cradle-to-cradle/. [Accessed: 5- Feb- 2019].
- [5] f. Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, "IEC 62133:2012 | IEC Webstore | rural electrification, energy storage, battery, energy efficiency, smart city, power bank, powerbank", Webstore.iec.ch, 2019. [Online]. Available: https://webstore.iec.ch/publication/6515. [Accessed: 17- Apr- 2019].[6] "CSA C22.2 No. 0.23-15 | Standards Council of Canada – Conseil canadien des normes", Scc.ca, 2019. [Online]. Available: https://www.scc.ca/en/standardsdb/standards/28121. [Accessed: 13- Mar- 2019].
- [7] I. 9241-161:2016, "ISO 9241-161:2016", ISO, 2019. [Online]. Available: https://www.iso.org/standard/60476.html. [Accessed: 13- Mar- 2019].
- [8] "IEEE 1621-2004 - IEEE Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments", Standards.ieee.org, 2019. [Online]. Available: https://standards.ieee.org/standard/1621-2004.html. [Accessed: 13-Mar- 2019].
- [9] I. 14040:2006, "ISO 14040:2006", *ISO*, 2019. [Online]. Available: https://www.iso.org/standard/37456.html. [Accessed: 17- Apr- 2019].
- [10] "2019 RoHS Compliance Guide: Regulations, 10 Substances, Exemptions, WEEE", Rohsguide.com, 2019. [Online]. Available: https://www.rohsguide.com/. [Accessed: 2- Feb- 2019].
- [11] Lapak, 2018.

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Get more out of every breath.

Ask us anything!