VIA

Your path to possibilities®

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STEPH WILLIAMS
Graphic Design

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Sustainability

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BEN TONG
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JON PAUL WHITE
Industrial Design

THE SPONSORS

THE CENTER FOR COGNITIVE UBIQUITOUS COMPUTING

The Center for Cognitive Ubiquitous Computing at Arizona State University is an inter-disciplinary research center focused on cutting-edge research targeting a variety of applications.

CASEY SMITHERAN

Casey has been an invaluable resource to our team in the research and development of our product-service system.

THE PROBLEM

BEYOND ACCESSIBILITY

Through research of the ergonomics of wheelchairs, the every-day life of the wheelchair user, and the comfort and aesthetics of wheelchairs, we aim to improve the overall quality of life for the wheelchair user.

Currently, the majority of power wheelchair controls are outdated and are limited in their connection with other technology. Additionally there is a lack of storage space on the power wheelchair, which often leads the user to storing objects in his or her lap, increasing the risk of objects falling and breaking. Lastly, current power wheelchair control designs require complex tooling and manufacturing, therefore consuming excess energy and material resources.

Via addresses each of these problems.

THE USER

USER PROFILE

Our user group includes male and female power wheelchair users from ages 10 to 35. In particular, those who enjoy and rely on their smart phones for daily socializing and communicating.

We are designing for tetraplegic power wheelchair users with damage to the brain or spinal cord at levels C4 to C7. These users have lost partial or total function of their arms and legs, and often have some level of finger dysfunction.

Causes of this damage can include trauma (e.g. a traffic collision, a fall, a sports injury), disease (e.g. amyotrophic lateral sclerosis (ALS), multiple sclerosis), or congenital disorders (e.g. cerebral palsy, muscular dystrophy).

THE PRODUCT-SERVICE SYSTEM

VIA

Via is a power wheelchair armrest adaptation combined with an easy-to-use mobile application that allows power wheelchair users to maneuver their chair and change seat positions and speeds, all through smartphone and Bluetooth technology. Via is designed for users with limited hand and finger movement.

Each purchase will come with slight modifications to the arm of the chair allowing users to dock their phone to ensure a constant charge and a safe place for the phone.

As apart of the Via vision, our desire is to raise awareness of power chair users by getting individuals to donate their previous smart phones to the cause. This option will reduce waste of technology while allowing power wheelchair users access to their on personal phone while operating the chair.

PRODUCT AESTHETIC BENCHMARKING

	DYNAMIC CONTROLS	PERMOBIL	QUANTUM	QUANTUM	BROADENED
FORM	Extruded oval	Knobby	Ripple	Asymmetric	Industrial
PERSONALITY	Practical	Practical	Tough	Sensible	Boorish
TEXTURES	Smooth	Machined	Cloth and rigid	Smooth and frictionless	Coarse
MATERIALS	Aluminum, plastic	Aluminum, plastic, rubber	Plastic, fabric, foam	Plastic, glass	Steel, aluminum, plastic
DETAILS	App, plug in, indicator lights	App, adjustable dock	Storage, zipper, rugged	Table	Steel, aluminum, plastic
COLOR					
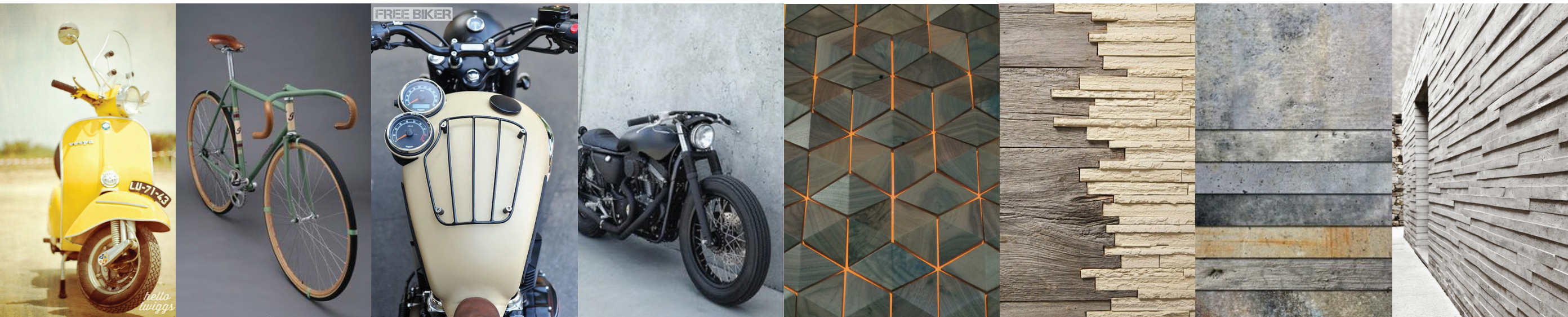
RETRO FUTURISM
Inspired by past transportation and details

Details from past bicycles, scooters, and motorcycles are used
to bring excitement and freedom into the wheelchair.

INDUSTRIAL MOVEMENT
Materials produce movement and life

Different materials and layers are employed, adding life into the wheelchair.
By layering materials correctly it can add a sense of movement as well.

FUNCTION TREE
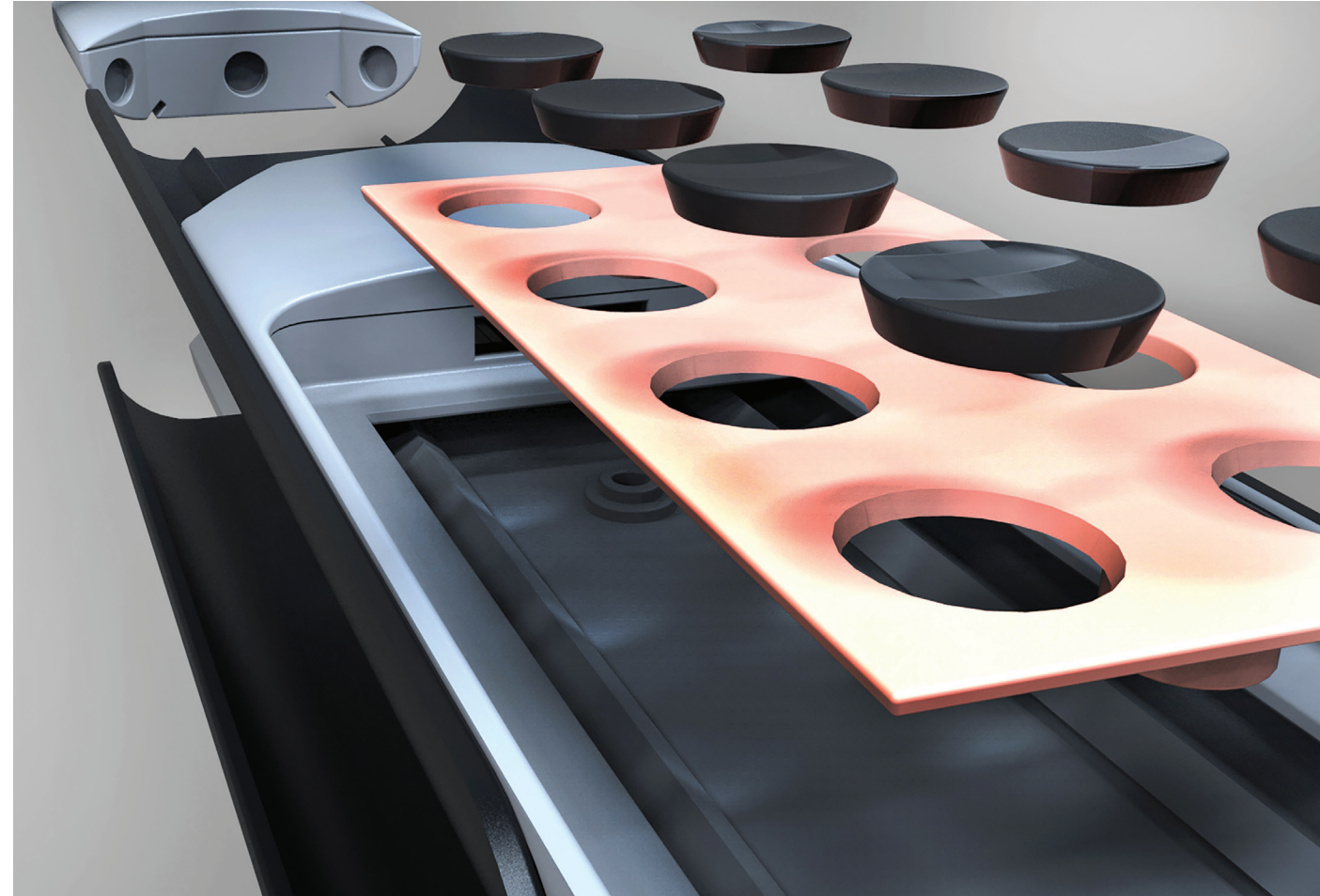
MAINTAINS PHONE FUNCTIONALITY

- Communicate between phone and chair
- Connect to headset via Bluetooth
- Charge phone efficiently

CUSTOMIZED BASED ON USER PREFERENCE

- Record user feedback
- Allow user multiple control options

COSTS LESS TO THE USER

- Consist of few parts
- Utilize removable components
- Contain few materials

CONTROLS THE WHEELCHAIR

- Adjust seating
- Accept commands
- Control speed
- Display information

STAYS CURRENT WITH NEW TECHNOLOGY

- Allow firmware updates
- Maintain software compatibility
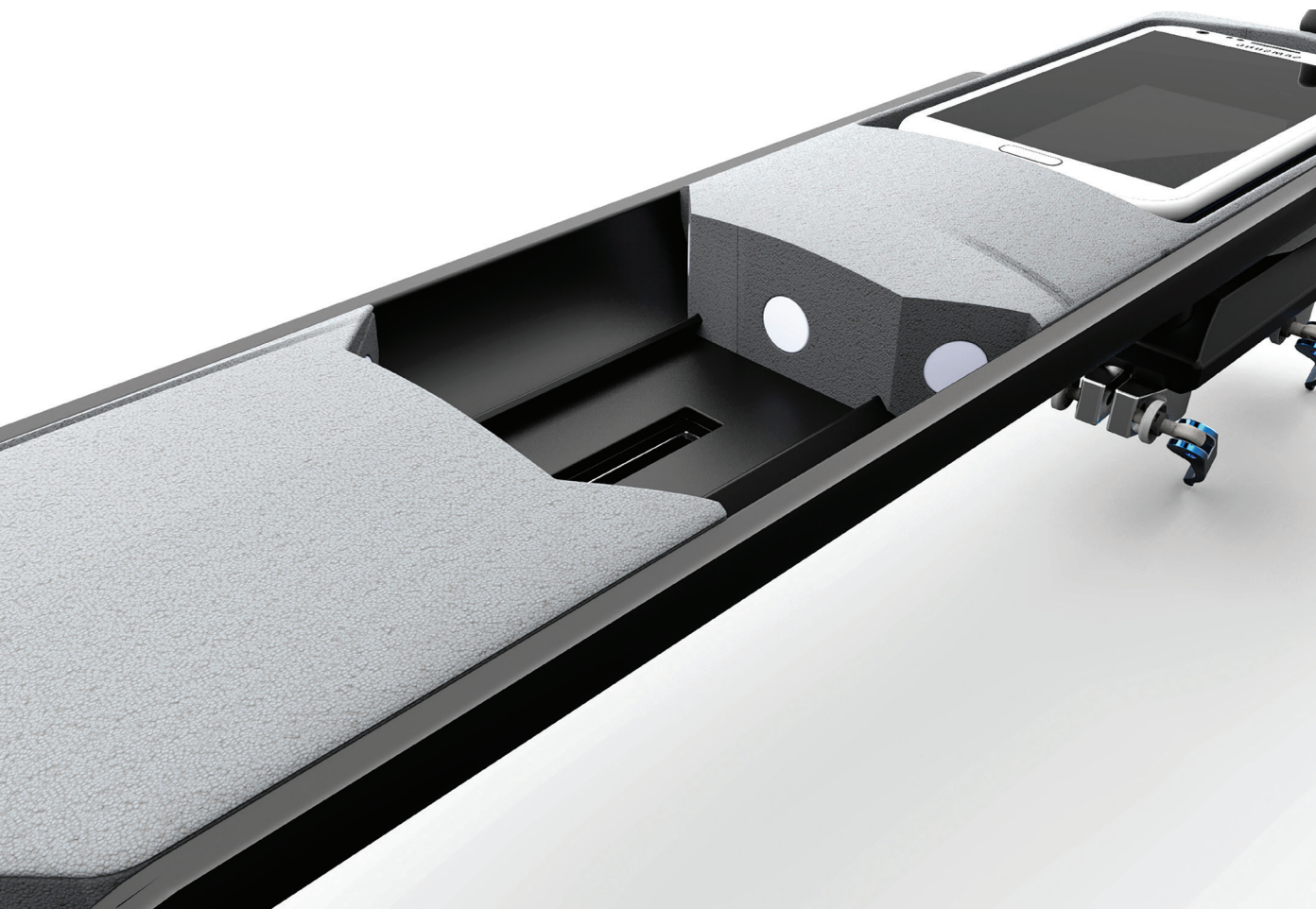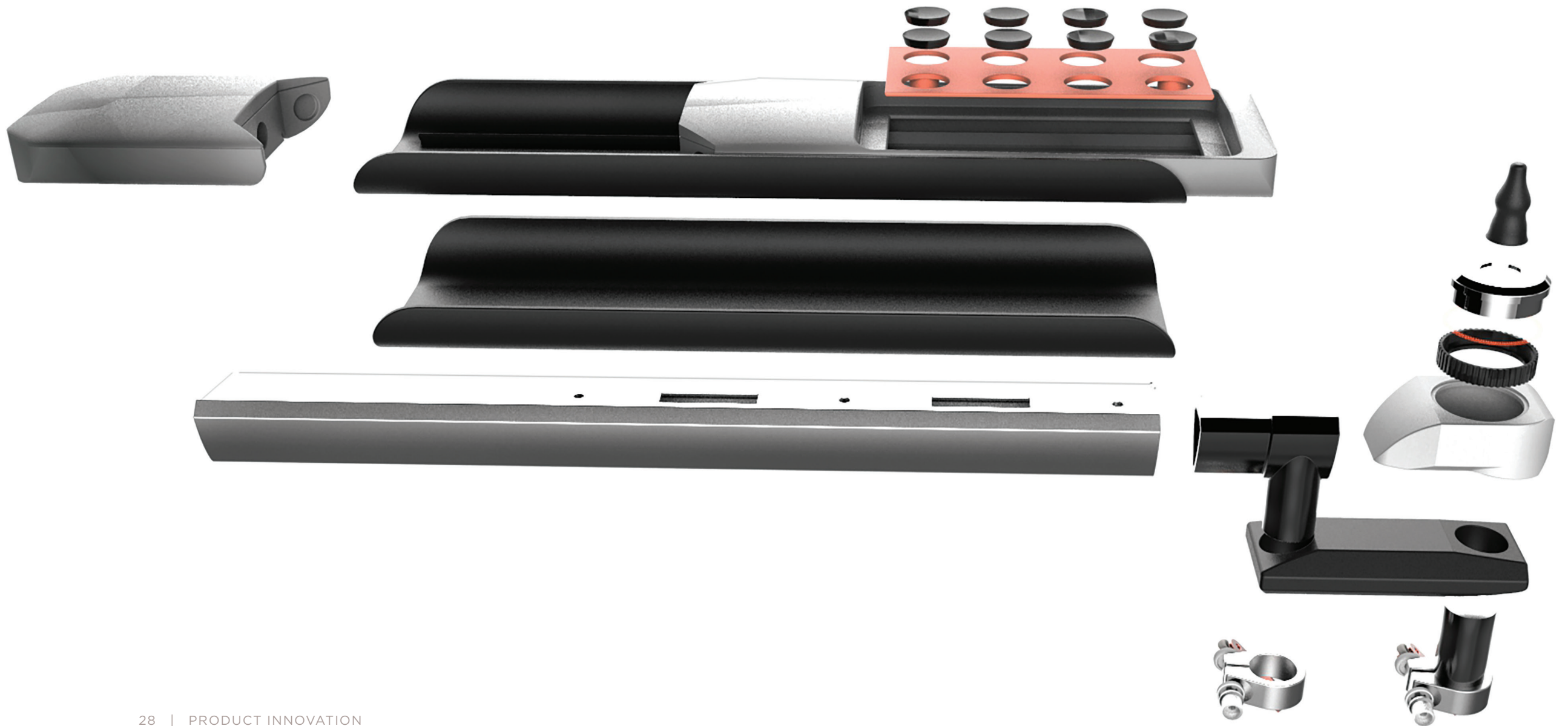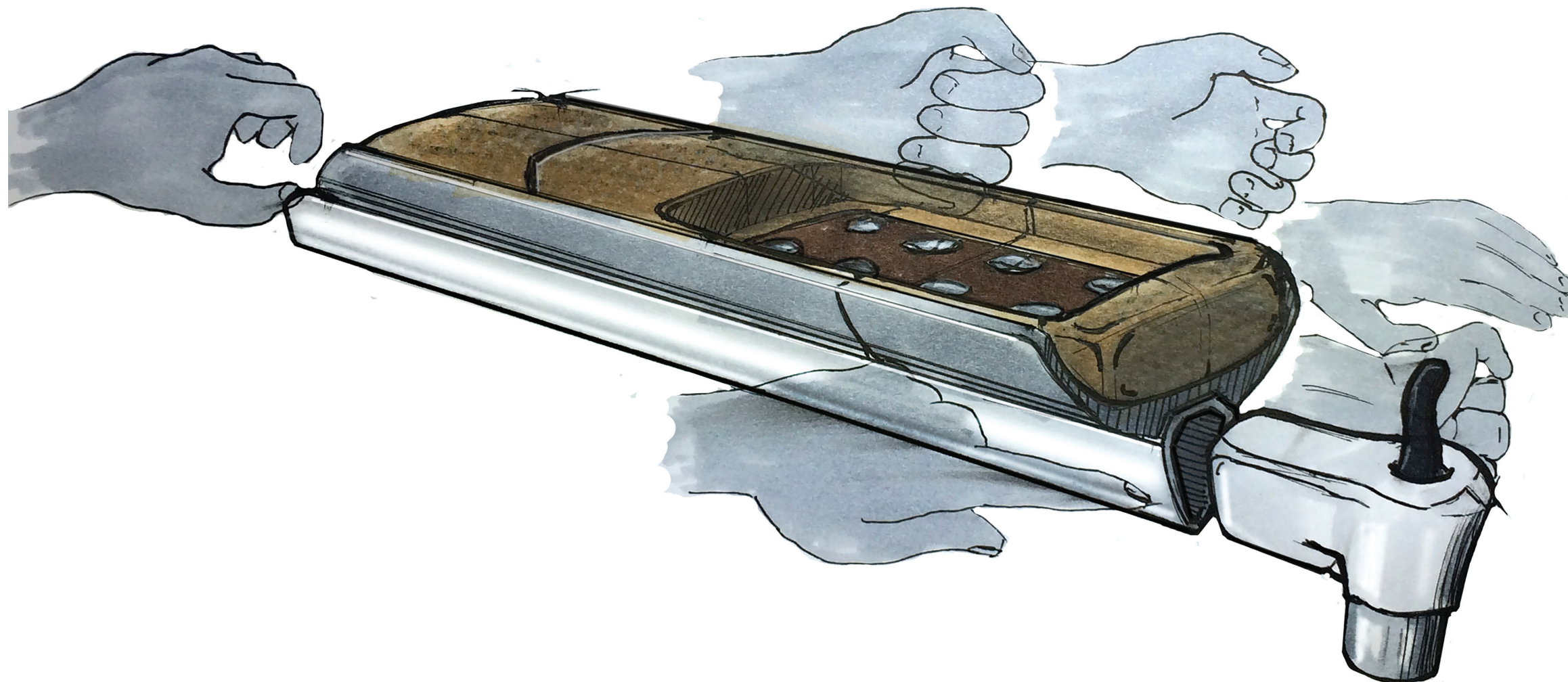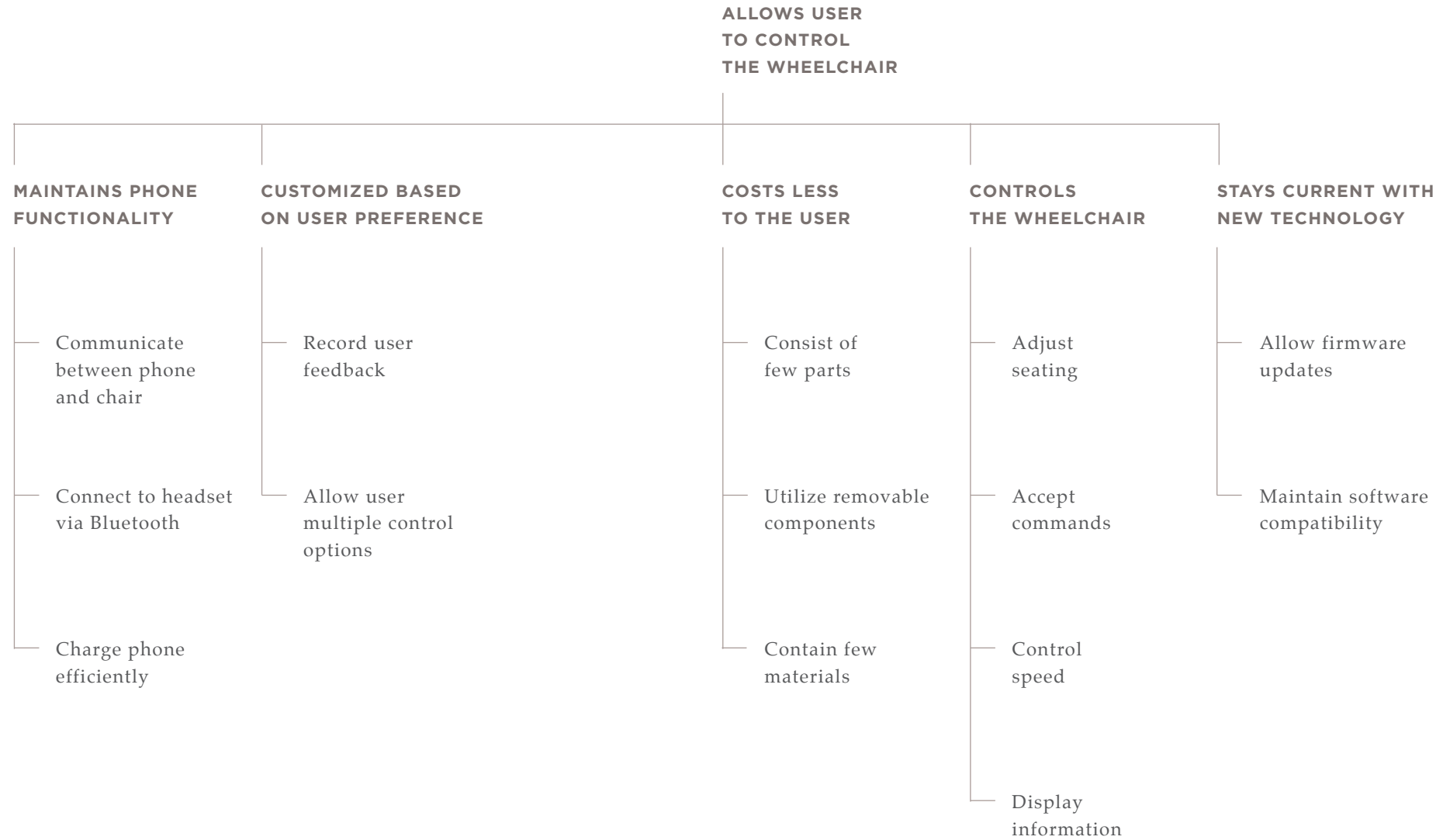
SUB-FUNCTION	SOLUTIONS
Communicate between phone and chair	
Charge phone efficiently	
Protect phone from physical damage	
Consist of few parts	
Utilize removable components	
Contain few materials	
Allow firmware updates	

SUB-FUNCTION	SOLUTIONS
Adjust seating	
Accept commands	
Control speed	
Display information	
Record user feedback	
Allow user multiple control options	
Maintain software compatibility	
Connect to headset via Bluetooth	

FINITE-STATE MACHINE

This diagram describes the user interaction with the Via mobile application.

■ Interaction with top half of screen

■ Interaction with bottom half of screen

CHANGE PART
Sets a different part to be highlighted on the home screen

ADJUST CHAIR
Changes display to an interactive up and down arrow

INCREASE SPEED
Increases speed mode of wheelchair movement

HOME SCREEN
Displays current speed and highlights the part to be moved

RESUME POSITION
Returns chair to the configuration it was in before preset was selected

PRESET SELECT
Changes display to a list of previously defined user presets

DECREASE SPEED
Decreases speed mode of wheelchair movement

SET TIMER
Changes display to a countdown timer retrieved from preset

ADJUST CHAIR
Changes display to an interactive up and down arrow

tap screen

swipe right

swipe left or timeout

swipe right

swipe left

swipe up

swipe down

swipe right or timer ends

swipe left

select preset

BILL OF MATERIALS

COMPONENT	QTY	COST ($)	PART #	SOURCE	MATERIAL	FINISH	PROCESS
32-bit microcontroller	1	1.00	1-01	Microchip	Int. circuit, logic	n/a	n/a
Printed circuit board	1	18.00	1-02	OSH Park	Circuit board, RoHS	n/a	n/a
6' 3.5mm-RS-232 cord	1	10.00	1-03	VasterCable	Copper, secondary	Rubber	n/a
15mm button	8	0.42	1-04	SparkFun	LDPE, secondary	n/a	n/a
Joystick module	1	50.00	2-01	Diestco	PP, secondary	n/a	n/a
18" Schedule 40 Extruded pipe	1	9.00	3-01	Online Metals	Aluminum, secondary	Paint	Extrusion
Molded slider	1	1.00	3-02	Torgus	PP, secondary	n/a	Injection molding
Cushion	1	7.00	4-01	Wondergel	Silicone	Fabric	n/a
Molded phone holder	1	1.00	5-01	Torgus	PP, secondary	Paint	Injection molding

OKALA IMPACT FACTOR ASSESSMENT

FIRST DESIGN

COMPONENT	WEIGHT (lbs)	MATERIAL	OKALA FACTOR POINTS	TOTAL IMPACT
32-bit microcontroller	0.004	Int. circuit, logic	2600	10.4
Printed circuit board	0.11	Circuit board, pop.	320	35.2
6' 3.5mm-RS-232 cord	0.35	Copper, primary	140	49
15mm button	0.064	ABS, primary	2.4	0.1536
Joystick module	1	ABS, primary	2.4	2.4
18" schedule 40 extruded pipe	1.17	Aluminum, primary	13	15.21
Process: Extrude	1.17	-	0.64	0.7488
Molded slider	0.7	ABS, primary	2.4	1.68
Process: Injection mold	0.7	-	0.72	0.504
Cushion	0.67	Silicone	1.7	1.139
Molded phone holder	1.11	ABS, primary	2.4	2.664
Process: Injection mold	1.11	-	0.72	0.7992

Total/1000 hrs

MATERIALS	**8.158**	**-**	**-**	**119.8986**	**4.134434483**
TRANSPORT	**12.24**	**Air freight, cont.**	**3**	**36.72**	**1.266206897**
END-OF-LIFE	**8.158**	**Polystyrene landfill**	**0.35**	**2.8553**	**0.098458621**
LIFE CYCLE (1000s of hrs)	**-**	**-**	**-**	**29**	**5.4991**

Legend: End-of-Life, Transport, Materials

Okala Factor / 1000 hours — bar chart: First Design, Final Design
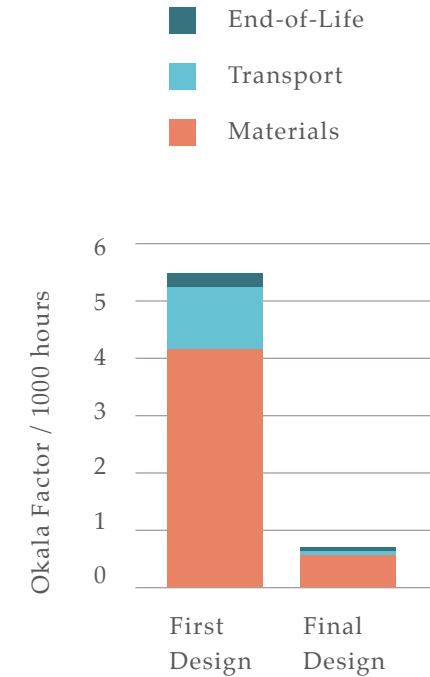
OKALA IMPACT FACTOR ASSESSMENT

FINAL DESIGN

COMPONENT	WEIGHT (lbs)	MATERIAL	OKALA FACTOR POINTS	TOTAL IMPACT	
32-bit microcontroller	0.004	Int. circuit, logic	2600	10.4	
Printed circuit board	0.11	Circuit board, RoHS	85	9.35	
6' 3.5mm-RS-232 cord	0.35	Copper, secondary	0.04	0.014	
15mm button	0.064	LDPE, secondary	0.91	0.05824	
Joystick module	1	PP, secondary	1.3	1.3	
18" schedule 40 extruded pipe	1.17	Aluminum, secondary	0.55	0.6435	
Process: Extrude	1.17	-	0.64	0.7488	
Molded slider	0.7	PP, secondary	1.3	0.91	
Process: Injection mold	0.7	-	0.72	0.504	
Cushion	0.67	Silicone	1.7	1.139	
Molded phone holder	1.11	PP, secondary	1.3	1.443	
Process: Injection mold	1.11	-	0.72	0.7992	**Total/1000 hrs**
MATERIALS	**8.158**	**-**	**-**	**27.30974**	**0.6827435**
TRANSPORT	**12.24**	**Train, freight**	**0.14**	**1.7136**	**0.04284**
END-OF-LIFE	**8.158**	**Recycled**	**0**	**0**	**0**
LIFE CYCLE (1000s of hrs)	**-**	**-**	**-**	**29**	**0.7255835**
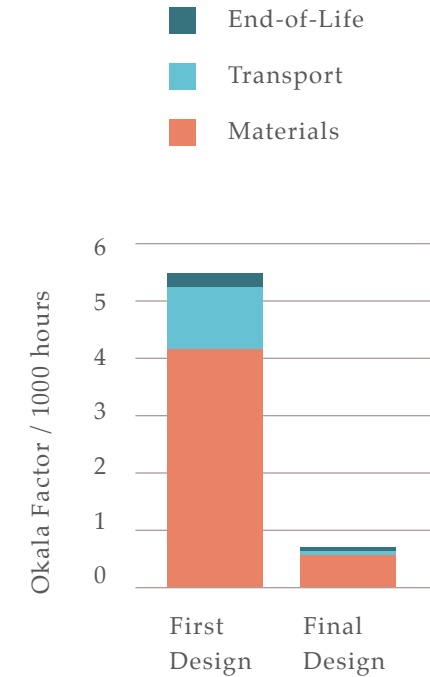
Legend:
- End-of-Life
- Transport
- Materials

Okala Factor / 1000 hours

6
5
4
3
2
1
0

First Design   Final Design

BRAND INNOVATION

	DYNAMIC CONTROLS	PERMOBIL		INVACARE	OTTOBOCK	SUNRISE MEDICAL
FORM	Ovals	Circles, partial circles		Ellipses, curves	Circles, rectangular images	Spheres, ellipses
PERSONALITY	Practical	Modern, dynamic		Empowering	Sensible, friendly, modern	Healthy, optimistic
TEXTURES / MATERIALS	Gradient, glow	Grainy, scratched metal		Gradient, glow	Flat, grayscale photography	Gradient, reflection
TYPE TREATMENT	Sans serif; colors for emphasis	Condensed; caps; boxes		Caps; sans serif; light weights	Color type and blocks for emphasis	Serif and sans serif; caps; color system
COLOR						

HERITAGE

Stakeholder challenges
Outdated control
Innovation
Here to help
Human-focused
Research
Passionate
Ambitious
Team work
Design for end user
Being more than we are
One finger use
Youthful
Creative
Implement technology
to improve experience

PERSONALITY

Advanced
Friendly
Adventurous
Dependable
Energetic
Multi-faceted
Accessible
Capable
Optimistic
Connected
Knowledgeable
Futuristic
Helpful
Personal / personable

SENSORY ASSETS

VISUAL
Black & White
Silver
Blue (trusting)
Monochromatic
Brilliant
Clean
Attractive
Feedback
Chair settings

FEEL
Smooth
Comfortable
Glass

HEAR
Feedback
Comfort

SMELL
Fresh
New Car
New Plastic

EMOTIONAL BENEFITS

Safe
Admiration
Amusing
Freedom
High-tech
Happy
Pride
I have something most
people don't have
Connected
Comfort / calm
Security
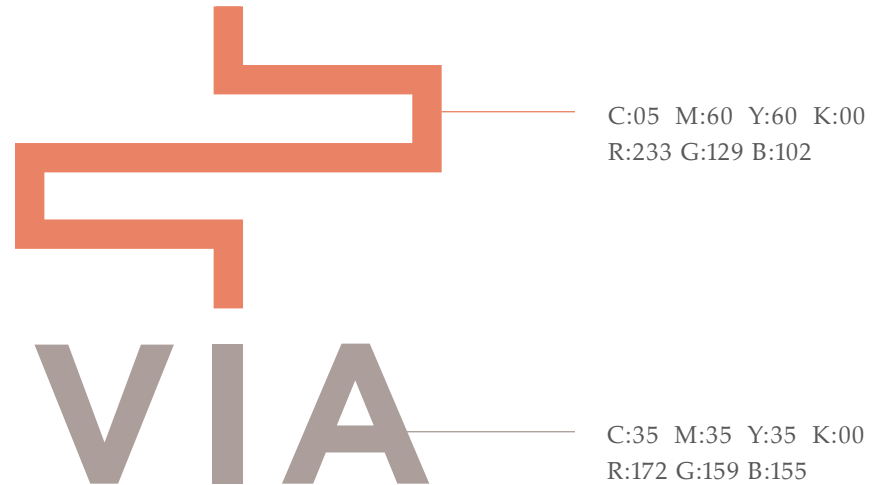Confident
Creative
Cutting-edge
Equal in society

FUNCTIONAL BENEFITS

Eco-friendly
Comfort
Ease of Use
Accessibility
Improved quality of life
Adjust position
Voice command
Hands-free
Hold objects
Protects phone
Connectivity
Customizable
Future development
Visual display
Pleasing experience

SELF-EXPRESSIVE BENEFITS

I'm confident.
I'm on the cutting edge.
I can depend on this
product.
I am amusing.
I'm productive.
I can multi-task.
I am active.
I am independent.
I'm tech-savvy.
I can work freely.
I've got the world at
my fingertips.
I'm outgoing.
I'm environmentally
conscious.
I am safe.

C:05 M:60 Y:60 K:00
R:233 G:129 B:102

VIA

Your path to possibilities©

C:35 M:35 Y:35 K:00
R:172 G:159 B:155

THE LOGO

Our logo is a bold combination of logotype and symbol.
The orange symbol is representative of the "path to
possibilities" that Via provides to its users. The geometric
form of the symbol also references the technological
integration within the product.

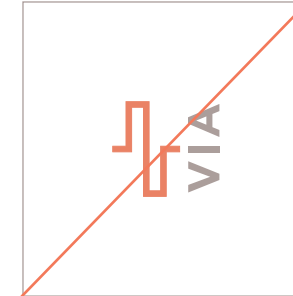**THE TAGLINE**

Our tagline is empowering and makes reference to the
possibilities that open up when a smartphone becomes the
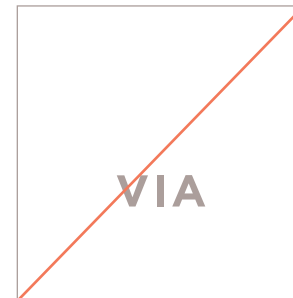control module for a power wheelchair.

LOGO USAGE

Allow for adequate space
around the logo.

Black on white
for one-color printing.

Reverse when logo appears
on dark background.
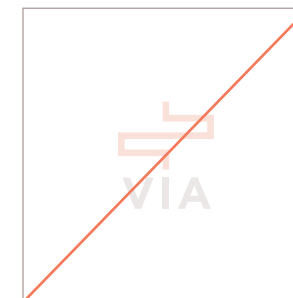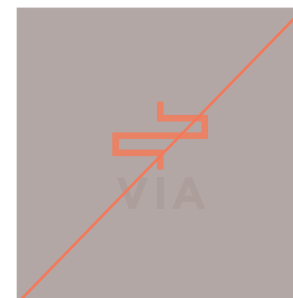
BRAND GUIDELINES

PRIMARY COLORS

C:05 M:60 Y:60 K:00
R:233 G:129 B:102

C:35 M:35 Y:35 K:00
R:172 G:159 B:155

C:00 M:00 Y:00 K:80
R:88 G:89 B:91

SECONDARY COLORS

C:55 M:05
Y:15 K:50
R:59 G:115 B:127

C:55 M:05
Y:15 K:00
R:107 G:193 B:211

C:35 M:47
Y:00 K:03
R:162 G:136 B:187

C:05 M:85
Y:60 K:00
R:229 G:78 B:89

TYPEFACES

HEADING 1
GOTHAM BOLD

HEADING 2
GOTHAM BOOK

Body Copy
Palatino Regular

IMPLEMENTATION TIMELINE

research

development / design

financial

other

marketing

launch

| DEC | JAN 2015 | | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN 2016 | MAR | APR | MAY |

Early Product
Development

Seek Investment / Funding
(Edson Proposal)

Develop Second
Prototype

Social Media Sharing /
Print Ad (Disability
Empowerment Center
newsletter)

Tradeshow Launch

Add to App
(e.g. Bluetooth)

Consumer and
Market Research

Develop First
Prototype

Website
Development

Seek
Additional
Funding

Teaser / Viral
Campaign

Test Product Launch,
LA

Mobile App
Development

Usability Testing

Test Product Launch,
Tempe

Seek Partnership with
Local Companies

VALUE PROPOSITIONS

The goal of Via is to give power wheelchair users a more desirable daily experience through smartphone integration. These improvements come in a few different forms. With Via, the user will be able to control the way the chair functions, such as speed and seat adjustments, all from their smart device. Since the chair now has smart phone it will be able to communicate through Bluetooth technology.

Another feature is added storage into the armrest. Not only will your phone fit into the new armrest, users will now have the ability to store items like keys or a wallet in the storage system in the arm of the chair. This will allow the user to operate their smartphone while it charges throughout the day and keep personal items safe. The current UI of power chairs are outdated. Incorporating the smartphone to the process will make it easier for the user to make needed adjustments throughout the day. More value is created for customers because it utilizes a technology that 1.75 billion individuals already own and use on a daily basis.

CUSTOMER SEGMENTS

The customers who will benefit from Via will be in the niche market of power wheelchair users. Our target customers are male and female power wheelchair users from ages 10 to 35. One of the major characteristics of our target market is that they enjoy and rely on their smart phones for daily socializing and communicating. Via will be priced in a way that is competitive to competitors' products. Users' education level will not be a consistent factor to take into account for our product. Via will be targeted for users in the Arizona for the first year of business with the goal of expanding to parts of the south west region.

BUSINESS MODEL

CHANNELS

One of the best ways to communicate the value propositions of Via to customers is through partnering with a power chair company. This will give the user an opportunity to see how the product works and add it to their chair. Customers will be able to order the product online or at select showrooms and retailers. The showrooms will give the customer the opportunity to test Via and understand what it is able to do for them. Users will also be able to view the product and order it online. Once purchased they will be able to schedule a time with a technician that will install Via to their existing chair. After installation users will be given instruction on how to use Via and its features.

CUSTOMER RELATIONSHIPS

The customers will be our first priority. They are the reason we exist as a company. Keeping a open communication with them will allow us to keep them satisfied and learn from advice they have on how the product could potentially be improved in future models. The service we provide will be based on a one-on-one personal assistance. This will increase costs in comparison to a self-service system or automated system, but the benefits of having a customer who feels appreciated and well-served is necessary for customer retention. Another way we will create a better relationship with our customers is by creating a social network amongst all Via users. This will give us a good venue to understand what users want and ways to keep them happy with the product through software improvements, etc.

REVENUE STREAMS

Revenue streams will be through a one-time purchase through show room or online order. Once purchased, a technician will come to the user's home per their scheduling and will have their chair outfitted with Via. Most potential customers will be working with insurance companies to gain at least partial funding for the product. The product itself could potentially save the user money if they decide to use their own smart phone for the actual user interface. Although app sales could be a part of revenue, we decided to have the application fee to be incorporated into the cost of Via.

COST STRUCTURE

The major cost of Via will be the software development and integration of the smartphone to the power chair. The assumption is that this design will actually save users money mitigating the need for the UI currently being used. Some other costs of Via would be gaining awareness of the need for donated phones for the design. Therefore, use of guerrilla marketing to make users aware will be a cost that should be taken into account. Fixed cost could potentially be labor and rent for a space if growth allows it. Variable costs would be raw materials along with costs of manufacturing and distribution.

BUSINESS MODEL

KEY RESOURCES

Some key resources for Via would be the actual engineering of the software and the ability to manufacture the docking portion of the arm of the powered chair. Therefore, engineers will be a huge resource to the development of Via and its success. It is our current assumption that this product is not already patented and would be a step taken in the future if it would benefit the company. We also assume that Via will be a capital-intensive product because the costs of developing the software that interacts with the chair in an easy and efficient way for the user, as well as being approved for use by the FAA, etc.

KEY PARTNERSHIPS

Partnerships that would be helpful for the success of Via include companies like Cell Phones for Soldiers that has outfitted more than 11 million lightly used cell phones that otherwise would have be in landfills. Cell Phones For Soldiers would help Via create an awareness for wheelchair users and could also help recovering veterans if they are in need of power chair assistance. Other key partnerships would be with a local power chair company, LifeProof phone cases and Plastinova (discussed in the Biomimicry section). These partnerships will help both parties, as we offer a better technology options for their customers as well opening us up to the existing customer base.

KEY COMPETITORS

Currently, the largest competitors we have within the power chair industry include Invacare, Permobil, Sunrise Medical, Ottobock, Hoveround, and Dynamic Controls. These companies currently hold a large share of the market and have existing UI that they sell to customers. Although we are a smaller company, Via still sits within the same market and aims to compete with the current UI they are producing.

KEY PARTNERS

Local manufacturers

Power chair companies

Tech companies

Cell Phones for Soldiers

Showrooms

KEY ACTIVITIES

Research and development

Connect with target market

Reach out to local manufacturers /
power chair companies

Explore subscription type
revenue streams

KEY RESOURCES

Research and development

HR (Engineers / designers)

Manufacturing capabilities

Working capital / funding

Technology

VALUE PROPOSITIONS

Freedom

High-tech

Ease of use

Bluetooth connectivity

Carefree

Lower cost

Voice commands

Storage

CUSTOMER SEGMENTS

Male / female

Ages 15–35

Power chair users

Techies

Arizona

CHANNELS

Personal technician

Showrooms

Partnerships

Word of mouth

Social media presence

COST STRUCTURE

Licencing

Capital intensive

Research and development

Customer acquisition

Fixed costs (rent, etc.)

Variable (COGS, labor)

REVENUE STREAMS

Showrooms

One-time order

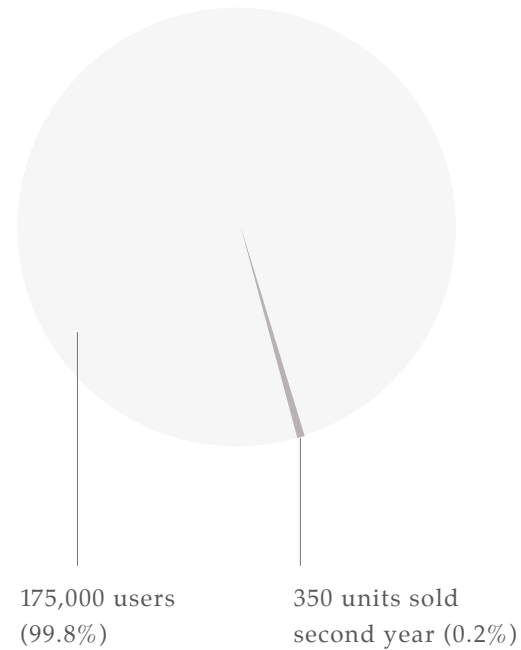Private purchase

Technician installation

CUSTOMER RELATIONSHIPS

Personal assistance

Social media

Focus on customer retention

FINANCIALS

Break-even Point

POWER WHEELCHAIR MARKET

QUARTER	2016				2017
	1	2	3	4	1
UNITS SOLD	50	75	100	125	200
GROSS PROFIT ($)	100,000.00	150,000.00	250,000.00	250,000.00	400,000.00
EXPENSES ($)	103,965.75	161,065.75	171,721.75	182,577.75	237,203.75
NET PROFIT ($)	(3,965.75)	(11,065.75)	28,278.25	67,422.25	162,796.25

175,000 users
(99.8%)

350 units sold
second year (0.2%)

Via will reach 0.2% of
market in the second year.

Via will break-even at the third quarter of the second year.
We plan to raise funding for first year through Edson Proposal (up to $20K).

FINANCIALS

Operating Budget

QUARTER	**2016** 1	2	3	4	**2017** 1	2	3
UNITS SOLD	50	75	100	125	200	250	300
DIRECT MATERIALS COST ($)	12,500.00	18.750.00	25,000.00	31,250.00	50,000.00	62,500.00	75,000.00
DIRECT LABOR COST ($)	3,500.00	3,500.00	4,000.00	4,500.00	5,000.00	5,250.00	5,500.00
INDIRECT OVERHEAD COST ($)	700.00	700.00	800.00	900.00	1,000.00	1,050.00	1,100.00
UTILITIES COST ($)	75.00	75.00	75.00	75.00	75.00	75.00	75.00
RENT COST ($)	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00	1,200.00
LABOR COST ($)	-	-	-	-	37,500.00	37,500.00	37,500.00
SUBTOTAL ($)	17,975.00	24,225.00	31,075.00	37,925.00	94,775.00	107,575.00	120,375.00

Operating budget increases in
second year after launch of product
following the trade.

FINANCIALS

Start-up Budget

PRODUCT / PROTOTYPE MATERIALS COST ($)	50
BUSINESS DEVELOPMENT COST ($)	12,500.00
INITIAL PRODUCT RUN COST (50 UNITS) ($)	3,500.00
GRAND TOTAL ($)	**700.00**

PRODUCT-RELATED SERVICES

In-home services (e.g. installation)

Via installation is included with the price of the product

Training to use the product on day of installation or another day if scheduled

Mobile application support services

Monthly app updates (e.g. fixing bugs, performance)

Post-sale service through application

End of life buy back program (percentage off next Via purchase)

SOCIAL & ENVIRONMENTAL CLAIMS

CLAIM	YES	COULD BE IMPROVED	NO	UNKNOWN CURRENTLY
Enhances the health of not just individuals but families or communities	■			
Aids in better communication between family or community members	■			
Assists in saving lives with reasonable (not exorbitant) costs		■		
Benefits of this product are available not only to the affluent but to lower income groups as well			■	
Manufactured under fair labor practices thereby making sure that there is not exploitation of workers	■			
Manufactured in a facility that has appropriate and enforced plant safety rules	■			
Manufactured by people who are paid above the average wage for people in their region	■			
Provides benefit to under-served populations such as elders living with meager incomes, poor populations, malnourished children, etc.		■		

SOCIAL & ENVIRONMENTAL CLAIMS

| CLAIM	YES	COULD BE IMPROVED	NO	UNKNOWN CURRENTLY
Assists in the process of redistribution of opportunity, thereby providing more opportunity to those who have less access	■			
Assists in the alleviation of poverty by providing jobs and other means to low-income groups	■			
Manufacturer uses third-party certifiers to verify the absence of slave and child labor			■	
Manufacturer allows organized labor				■
Manufactured with low impact materials	■			
Uses organic and low or non-toxic materials		■		
Materials used in this product available locally	■			
Raw materials needed for the manufacture of this product do not cause damage to fragile ecosystems				■
Supply chain for this product minimizes the amount of transportation required between stages of its lifecycle	■			

SOCIAL & ENVIRONMENTAL CLAIMS

CLAIM	YES	COULD BE IMPROVED	NO	UNKNOWN CURRENTLY
Shipped through the least polluting means		■		
Weight of product / packaging have been minimized to minimize the impacts needed to move heavier items		■		
Helps in shifting from product to service	■			
Assists in reducing carbon dioxide production (global warming)		■		
Minimizes waste	■			
Reduces power consumption		■		
Is durable	■			
Requires infrequent maintenance / has parts that can be repaired rather than replaced	■			
Needs power / minimizes or eliminates the use of single-use batteries	■			
Gets its power from renewable energy systems			■	

| CLAIM	YES	COULD BE IMPROVED	NO	UNKNOWN CURRENTLY
Components manufactured in factories that employ renewable energy resources			■	
Disposed of appropriately at the end of its life (taken back by the corporation, recycled, reused as something else, or safely composted)	■			
Minimizes the need for packaging	■			
Packaging will be reused or recycled	■			
Documents (collateral such as brochures, pop materials, manuals, etc.) are printed on recycled paper; are printed with non-toxic ink; will be taken back, recycled or reused	■			
Designed so that toxic or valuable components can be quickly removed by manual disassembly	■			
Largest components of the product made of recyclable materials (metals or majority thermoplastics [PS, PS-ABS mix, HDPE or PP])	■			
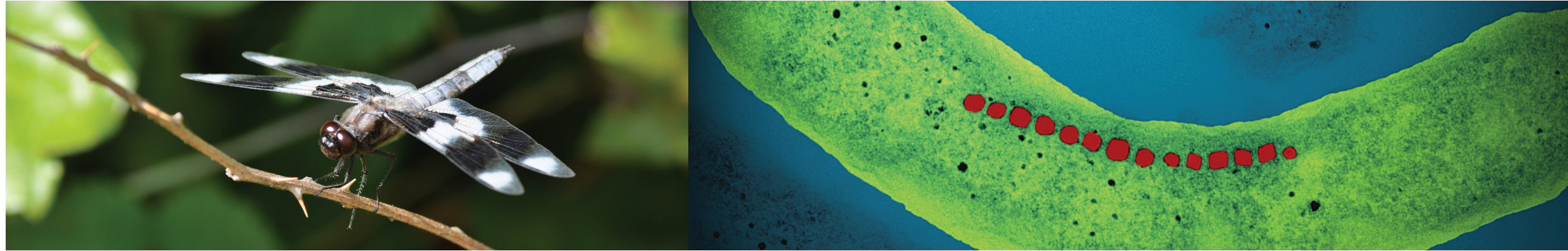
DRAGONFLY NEURAL NETWORK INSPIRED CIRCUITRY

Dragonflies are very interesting insects, particularly the Libellula lydia. They have the ability to quickly change flight patterns to adapt To their prey's flight pattern which allows them to catch 95% of its intended prey and can also compensate for broken wings. The most amazing part is it does all this through the use of only 16 neurons. It does so by using a neural system that's incredibly power conservative and with very little volume. This is exactly the kind of behavior we want out of our product, a compact and power conscious device. We can achieve this through the use of analog signals modeled after those of the dragonfly's neural structure. These signals can carry more data than a digital signal as well as conserving battery power.

PROPRIOCEPTION IN MAGNETIC OCEAN DWELLING BACTERIA

Aquaspirillum magnetotacticum is a type of ocean dwelling bacteria. Their most interesting trait is the presence of biological magnetite in their cells. These magnetic particles, sometimes called magnetosomes, are made of the same material that guides a compass. The Aquaspirillum magnetotacticum use these magnetosomes to align themselves to be parallel to the magnetic field and give them a sense of direction. It would be ideal for our product to also have a sense of up and down and to attain that, we can use the phone's gyroscope which has a similar functionality to the magnetosomes, except instead of utilizing a magnetic field, it utilizes a gravitational field. This could allow us to adjust the chair automatically depending on its current angle.

BIOMIMICRY
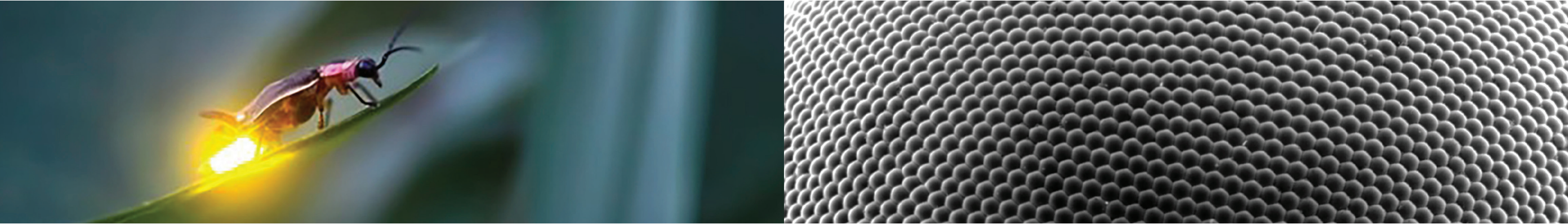
FIREFLY INSPIRED LIGHTING

The firefly has a unique way of distributing its light as well as being efficient in energy. Nanostructures on the cuticle of the firefly's abdomen help transmit bioluminescent light efficiently because they perfectly match the wavelength of light being emitted. A material like this substantially increases the efficiency of high-power lighting in LED packages. By reducing the amount of light reflected internally (i.e., the light reflected inside the lens), more light is available for transmission.

MOTH EYE BIOLOGY FOR ANTI-GLARE QUALITIES

By mimicking the nanostructures found on eyes of nocturnal moths this can help with the development of anti-reflective and anti-glare films. Films with this capability can be used on displays for items like computers, cell phones, and PDAs. Having the users phone out exposed and at an angle the anti-glare film can help in protection as well as helping the user see the screen more clearly.

EMPLOY MULTIPLE FEEDBACK LOOPS

One way we can incorporate this deep pattern in our product is to allow the user to provide feedback through their experience with the product. We will include surveys and/or ratings of different features of the mobile app that will appear as the app is being used. This will allow users to voice positive and negative feedback, and will allow us to improve the product based on that feedback. We will also make this available on our website and/or social media so that manufacturers and stakeholders other than the user will also be able to contribute to the improvement of the product.

FOSTERING COOPERATIVE RELATIONSHIPS

The idea behind fostering a cooperative relationship is for both groups to benefit from the partnership equally. Once establishing ourselves in the power wheelchair market we aim to partner with a power wheelchair company that will open us up to their existing customer base as well as giving them access to the technology we've created. Waiting to approach the power chair companies until we are established will give us more leverage when negotiating business partnership plans.
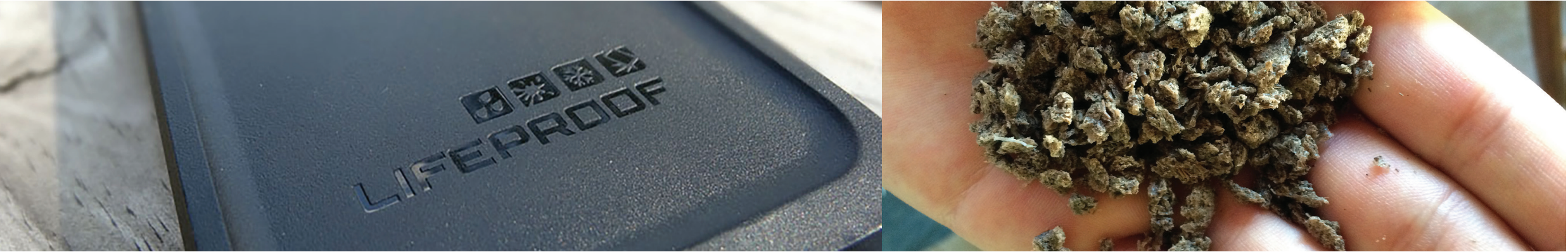
FOSTERING COOPERATIVE RELATIONSHIPS

By partnering with protective case manufacturers, such as LifeProof, our group intends to employ their company to manufacture the phone housing component of our product. The case, or housing component, would then be shipped from their manufacturing facility to our warehouse for final assembly and distribution. Our design will allow the case to be easily incorporated into the arm rest that our group has developed. The case manufacturer will benefit by being provided with a new market to profit from, and our company will be able to reduce the amount of capital needed to produce our product by outsourcing part of the work to manufacturing companies. This not only eliminates the need to build or re-open another factory, but also eliminates the emissions associated with operating a separate factory.

USING WASTE AS A RESOURCE

A company called Plastinova has developed a process that allows them to take agave bagasse, the tissue of agave that is left over from producing tequila, and combine it with recycled plastics to produce more resistant types of plastic. Our group intends to utilize this technology to produce the plastic parts of our product. We plan on using agave bagasse or sorghum bagasse because these plants are grown in North America and they provide a sufficient amount of waste. The main benefit from using plant waste plastics is that the amount of petroleum-based plastics that are produced each year can be reduced significantly. External benefits include a reduction in the amount of plastics reaching the landfill, a reduction in emissions related to having to transport the plastics to the landfill, and a reduction in emissions directly related to producing petroleum-based plastics.

SYSTEMS MAP

■ positive result

■ negative result

EXTRACTION

■ Raw materials

■ Emissions

PROCESSING

■ Materials for production

■ Emissions

PRODUCTION

■ Product goods

■ Solid waste, emissions

REPURPOSE / RECYCLE

■ Raw materials

■ Eliminating waste

■ Emissions

DISPOSAL

■ Solid waste, emissions

USAGE

DISTRIBUTION

■ Transporting goods

■ Emissions

PACKAGING

■ Protecting goods

■ Solid waste, emissions

SUSTAINABILITY REPORT

MISSION

Our mission is to improve the overall quality of life for wheelchair users through research of the ergonomics of wheelchairs and observation of the activities performed in the users every-day lives.

As a company we have determined sustainability to be "providing goods or services using processes and systems that are; non-polluting, energy conserving, and requires minimal resources, while still being economically feasible to produce."

RESPONSIBILITIES

Our responsibility to people is to develop a reputable company that will be able to provide a product that improves the life of power wheelchair users, while also benefiting everyone interacting with that user in one way or another.

Our responsibility to the planet is to minimize any effects our product might have on the environment through the use of sustainable materials that will be manufactured and assembled regionally.

Our responsibility to profit is to produce a product that is both desirable and affordable for consumers, but has a large enough profit margin that it is economically feasible for our company to maintain production.

THE ROLE OF SUSTAINABILITY

Our main goal is to replace internationally produced products with locally produced products whenever feasible. As well as provide high quality products that are durable, easy to recycle, and consist of materials that have little to no impact on the environment when they are used. By doing so we will be able to significantly reduce the emissions associated with transporting the products, which improves the quality of life for everyone by reducing their exposure to hazardous materials. Another benefit associated with producing our product locally as opposed to outsourcing over-seas is that we stimulate the local economy which also improves quality of life.

POTENTIAL ENVIRONMENTAL IMPACTS

In terms of raw materials we will try to minimize our environmental impact by utilizing recycled materials such as plastic and aluminum thereby reducing the amount of mining that would need to be done, which disturbs natural ecosystems and destroys the environment, and also reduces the fossil fuel emissions associated with any type of mining.

In order to reduce our impact in the manufacturing process we will try to partner with companies who already have manufacturing capabilities, such as LifeProof. By partnering with them we will be able to reduce the amount of capital needed to physically produce our product because they already have a majority of the machinery needed.

Transportation is another major issue associated with environmental impact. Our plan for reducing emissions related to transportation is to use as many local resources as possible while producing our product in order to reduce the overall distance the materials will have to travel. Another way is to keep the design of our product as light as possible in order to reduce the amount of fuel it takes to ship our products once they are finished. In addition, we will be using locomotives to ship our products instead of airplanes or tractor trailers. Locomotives are much more efficient in terms of energy use and are also less susceptible to delays because freight trains have priority over passenger trains.

The design of our product consists of materials that can be completely recycled and they are assembled in a way that allows for easy disassembly. By making the product out of recycled materials and also making it easy to disassemble our environmental impact can be virtually eliminated in terms of the products end of life.

SOCIAL OBSTACLES

The major issue our company faces is a limited market of customers. Currently, our product focuses on incorporating the smart phone into the control module of the power wheelchair. This limits our customer base to power wheelchair users. If we can find a way to expand our product into other industries we would have a much more diversified business plan and also a lot more opportunities to grow as a business.
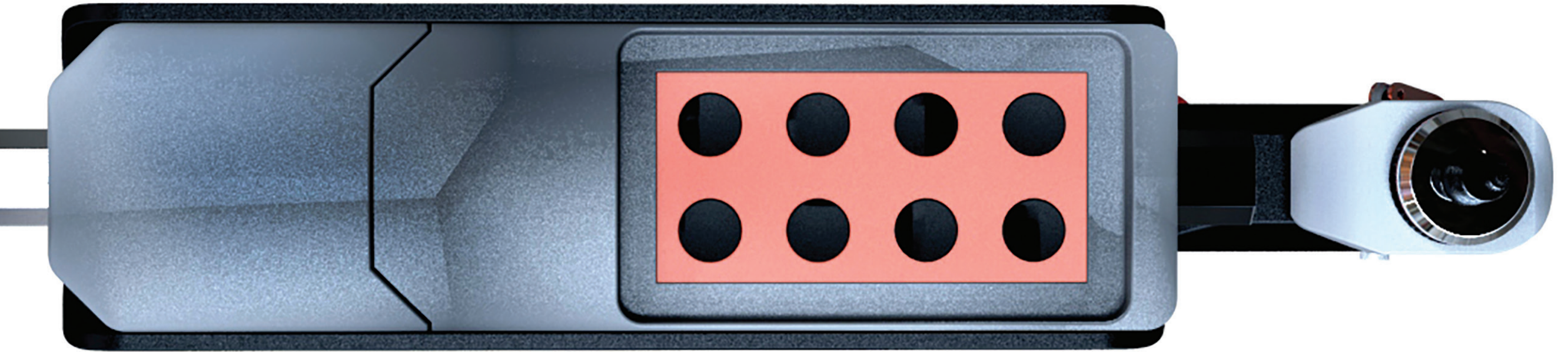
Upon examining the problem from five very unique perspectives, we have found a unique, cost effective, futuristic solution that allows the user a degree of flexibility not seen in previous power chair controllers. It is our vision that this development will inspire further growth in the community. We hope to foster an environment in which users can design their own apps to work hand in hand with their chair, allowing a level of control that did not exist until now.

T!V!T

Innovation Space
2014 – 2015
Arizona State University