



**Masterthesis**  
**APPENDIX**



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# A

## EXPERTS QUESTIONNAIRES

Oriënterend gesprek met kinder-fysiotherapeut Esther Hulspas 25-01-2018

**- Er zijn trends gaande dat kinderen tegenwoordig te veel achter de computer zitten en te weinig bewegen. Kunt u dit beamen?**

Over het algemeen zijn het vaak de kinderen vanuit de specifieke risico-doelgroepen waarbij ik het merk dat ze weinig bewegen. Ik kan niet bevestigen dat dit komt door het gamen, maar kan met zekerheid zeggen dat dit te maken heeft met het gebrek aan sociale interactie. Kinderen met autisme/PDDNOS hebben hier vaak last van.

Wat ik wel zie, is dat kinderen vaak niet het goede voorbeeld krijgen van de ouders. Zo worden ze vaak met de auto naar school gebracht, i.p.v. te gaan fietsen. Hierdoor worden ze niet gestimuleerd om te gaan bewegen.

**- Kun je wat zeggen over of bewegen daadwerkelijk goed is voor een kind? En hoe vaak in de week zouden kinderen moeten bewegen om te voldoen aan de dagelijkse fysieke inspanning?**

Wat bedoel je precies met bewegen. Is dat sporten of de dagelijkse beweging als lopen/fietsen etc.?

Wat betreft dagelijkse beweging, is deze heel de dag door natuurlijk. Als we over sporten praten, dan zou ik zeggen dat 1 of 2 keer per week voldoende is. Bij specifieke oefeningen zou ik denken aan 5 tot max 8 herhalingen.

Uiteraard lijkt het me logisch dat zware gewichten o.i.d. een NO-GO is.

**- Wat voor soort beweging zou goed moeten zijn voor de ontwikkeling van een kind?**

Ik denk dat het vooral belangrijk is dat een kind plezier heeft in het bewegen. Specifieke bewegingen noemen, vind ik lastig. Maar je kan denken aan de stimulering van de grove motoriek door het buitenspelen bijvoorbeeld. Ook een hele goede is altijd de hand/bal/oog coördinatie voor de ontwikkeling van een kind.

**- Welke doelgroep (of specifiek leeftijd) heeft hier het meest last van volgens u?**

De pubers. Verder ook de kinderen waarbij ouder-kind relatie niet optimaal is, waarbij je kan denken aan kinderen die snel achter de telefoon of tablet worden gezet om maar even rustig te zijn of op een andere wijze niet te 'belonen' zijn.

**- Wat zou, naast de digitalisering, nog meer de oorzaak kunnen zijn van het overgewicht bij kinderen?**

Het uit evenwicht zijn van de prijsklasse van gezond en ongezond voedsel. Ouders die het niet breed hebben merken dat vaker ongezond voedsel (fastfood uit de vriezer bijvoorbeeld) goedkoper is dan gezond voedsel (verse groenten).

**- Welke specifieke bewegingen (m.b.t. de dagelijkse motoriek) zijn goed voor de ontwikkeling van een kind?**

Elke vorm van bewegen voor een kind is goed voor de ontwikkeling. Van buitenspelen in het klimrek tot voetballen op het grasveld.

**- Kunt u een advies geven over de minimum en de maximum tijdsbesteding per dag aan beweging van een kind?**

De Nederlandse Norm Gezond Bewegen voor kinderen is dagelijks minstens 1 uur matig intensief lichamelijke activiteit waarbij de activiteiten minimaal 2 keer per week gericht zijn op verbeteren fitheid. De Fitnorm is tenminste 1 uur per week gedurende 20 minuten zwaar-intensieve activiteiten uitvoeren.

Zie hiervoor de beweeginterventie: overgewicht en obesitas bij kinderen

<https://nvfk.kngf.nl/binaries/content/assets/bi/nvfk/onbeveiligd/richtlijnen-en-es/kngf-standaard-beweeginterventie-overgewicht-en-obesitas-bij-kinderen.pdf>

Vragenlijst orienterend onderzoek bij experts:  
Linda Massar-van Haeringen (kinderfysiotherapeut)  
Nikki Vermeij (kinderfysiotherapeut)

maandag 19-03-2018

Linda recentelijk afgestudeerd als kinderfysiotherapeut en haar eindonderzoek ging over kinderen die wel en niet voldoen aan verschillende beweegnormen.

Nikkie is momenteel nog bezig met onderzoek doen. Zij houdt zich bezig met verschillende sprinttesten.

**- Welke doelgroep (of specifiek leeftijd) heeft hier het meest last van volgens u?**

Ik denk dat het (helaas) voorkomt bij bijna alle leeftijdscategorieën. Wij zien officieel kinderen van 0 tot 18 jaar in de praktijk, maar met name kinderen van 0 tot 16 jaar. Ik zie het met name rond de leeftijd van 10-16 jaar, maar ook bij de kinderen van 5-10 jaar zie je het zeker al gebeuren. Kinderen hebben steeds jonger al een telefoon en tablet en mogen anders die van de ouders gebruiken.

**- Wat zou, naast de digitalisering, nog meer de oorzaak kunnen zijn van het overgewicht bij kinderen?**

De kinderen die te weinig bewegen in Schiedam en Rotterdam doen dit om verschillende redenen denk ik (en is vaak een combinatie van deze factoren):

- ze komen vaak uit een gezin waarbij het niet vanzelfsprekend is om te bewegen/sporten. Ouders doen dit bijvoorbeeld ook niet

- voor een deel lijkt het ook samen te hangen met cultuurverschil. De populatie in Schiedam en Rotterdam is erg multicultureel. Daarbij is het niet altijd vanzelfsprekend om te sporten of de fiets te pakken naar een winkel toe.

- geld. De mensen in Schiedam en Rotterdam hebben over het algemeen minder te besteden en sporten is dan iets waar ze niet snel geld aan gaan uitgeven. Daardoor gaan ze niet naar een sportvereniging bijvoorbeeld en hebben niet alle kinderen een fiets. Hier is wel ondersteuning voor (jeugd sportfonds, maar ook scholen die voor een klein bedrag kinderen laten kennis maken met sporten, bv 5x een sportles voor 10 euro). Maar de praktijk wijst uit dat mensen hier niet van op de hoogte zijn, mensen toch net boven die inkomensgrens zitten om ervoor in aanmerking te komen of dat het een enorm gedoe is om dit aan te vragen. En aangezien lang niet iedereen (goed) Nederlands kan, gaat het hier ook mis.

- kennis. Ik denk dat er onvoldoende kennis is bij kinderen en bij ouders waarom bewegen belangrijk is en ook hoeveel ouders hierin bij kunnen dragen. Ouders komen vaak niet verder dan de kinderen naar buiten sturen om buiten te spelen, maar blijven zelf dan binnen op de laptop/telefoon/tablet enz. Ook denken veel ouders dat kinderen gelijk 3x per week moeten sporten en zien dan alleen problemen (geld, hoe kan ik mijn kind naar de sportvereniging brengen en halen terwijl ik ook moet werken en voor de andere kinderen moet zorgen). Terwijl het dagelijks bewegen, lekker naar het bos gaan om te wandelen, de fiets pakken naar de supermarkt enz, vaak vergeten wordt. Maar dit vraagt eigenlijk een leefstijlverandering van het hele gezin...

- tijd. Hangt samen met de dingen hierboven. Ouders werken hard en hebben moeite om hun kind naar een sportclub te brengen en te halen, omdat ze ook werken en nog andere kinderen hebben. Ook hebben ze hierdoor niet veel tijd om met hun kind na schooltijd op pad te gaan of hun kind lopend uit school te halen ipv met de auto. Het is toch altijd haasten van hot naar her.

**- Welke specifieke bewegingen (m.b.t. de dagelijkse motoriek) zijn goed voor de ontwikkeling van een kind?**

Ik weet niet of je echt zoekt naar specifieke bewegingen of meer activiteiten in het algemeen. Als je kijkt naar de (grof) motorische ontwikkeling is bewegingservaring opdoen het belangrijkste. Je kunt je voorstellen dat je niet goed leert klimmen als je nooit naar een speeltuin met een klimrek gaat. Ook leer je nooit goed een bal vangen als je nooit met een bal speelt.

Daarin denk ik dat het het belangrijkste is dat kinderen verschillende bewegingservaring opdoen. Dit bereik je met name door veel buiten te spelen met andere kinderen (en hoeft dus echt niet met een sport te zijn). Dan bedenken ze zelf vaak spellen wat ze kunnen doen en de ene keer gaan ze klimmen of schommelen en de andere keer gaan ze een balspel doen. Daar leer je motorisch het meeste van.

Maar ook ouders kunnen hierin veel betekenen. Door het kind eens mee te nemen naar een andere speeltuin, naar het bos om daar te wandelen/rennen/klimmen/hutten te bouwen en om met het kind te gaan fietsen. Want dat laatste is bijvoorbeeld echt een aangeleerde vaardigheid waar ze hulp bij nodig hebben, dat leren ze zelf niet zomaar.

**- Kunt u een advies geven over de minimum en de maximum tijdsbesteding per dag aan beweging van een kind?**

Daar zijn natuurlijk allerlei richtlijnen voor ontworpen. Er is in 2017 een nieuwe beweegerichtlijn ontwikkeld, waarbij advies wordt gegeven mbt matig intensief bewegen, sporten en zitten (sedentair gedrag), onder andere voor kinderen van 4 tot 18 jaar. Hierbij wordt aangegeven dat kinderen dagelijks minimaal 60 minuten matig intensief moeten bewegen (buiten spelen, wandelen, fietsen), 3x per week moeten sporten en zitten moeten beperken.

Er is geen tijd gegeven aan het zitten (wat is "veel" zitten...), maar als je kijkt naar richtlijnen uit andere landen en naar onderzoeken die zijn gedaan, dan wordt hierin als afkappunt 2 uur per dag (buiten schooltijd) aangehouden. Kinderen die meer dan 2 uur per dag zitten (denk aan spelen op een tablet of telefoon), zitten dus "te veel". Het is leuk dat je ook afvraagt of er een maximum tijdsbesteding is. We zien namelijk aan de andere kant ook problemen ontstaan bij kinderen die rond de groeispurt en pubertijd intensief sporten. Ik weet hierin niet wat echt veel is, maar we zien bij veel sporten dat ze 2x pw trainen en 1x pw wedstrijd hebben. Veel kinderen krijgen hierbij klachten aan knieën en hielen. Dit hoeft niet zo te zijn en kan tijdelijk zijn omdat ze op dat moment hard groeien en daardoor minder belastbaar zijn. Maar je kunt je voorstellen dat hoe meer je sport (rond die leeftijd), hoe groter de kans op lichamelijke klachten.

**- Welke doelgroep (of specifiek leeftijd) heeft hier het meest last van volgens u?**

Ik heb zelf het vermoeden dat de doelgroep die het meest inactief is geworden de laatste jaren de basisschool kinderen zijn en de eerste 2-3 klassen van de middelbare school. Al moet ik zeggen dat ook hogere klassen van de middelbare school steeds inactiever worden, bijvoorbeeld door de elektrische fietsen etc. Bij de basisschoolleeftijd zie je dat steeds minder kinderen op de fiets op lopend naar school komen, maar steeds meer met de auto worden gebracht en dat er na schooltijd niet meer zoveel buiten gespeeld wordt.

**- Wat zou, naast de digitalisering, nog meer de oorzaak kunnen zijn van het overgewicht bij kinderen?**

Naast de digitalisering is de snelheid van de maatschappij denk ik een oorzaak, ouders brengen kinderen niet meer lopend of op de fiets naar school, maar kinderen worden afgezet met de auto. Daarnaast zijn er steeds meer elektrische fietsen waar kinderen mee naar school gaan, kinderen hebben zo'n elektrisch ding waarop ze kunnen rijden (een waveboard niet, maar zoiets wat erop lijkt). Kinderen worden te weinig gestimuleerd om naar buiten te gaan, verliezen daardoor ook hun fantasie, kunnen zichzelf minder goed vermaken buiten. Daarnaast is natuurlijk voeding ook een belangrijke factor, hoeveel slecht eten is er nu wel niet op de markt en hoe vaak krijgen kinderen nu snel een koekje of een chipje oid.

**- Welke specifieke bewegingen (m.b.t. de dagelijkse motoriek) zijn goed voor de ontwikkeling van een kind?**

Een kind heeft uitdaging nodig en dat verschilt per kind wat het nodig heeft. Over het algemeen denk ik dat krachtsoefeningen (traplopen, ergens op klimmen en met dingen slepen etc) goed zijn voor de ontwikkeling, maar ook het evenwicht en balans. Denk aan ergens overheen lopen, balanceren, rolschaatsen of skeeleren, hinkelen, springen (ook kracht). Daarnaast complexere opdrachten (iets anders doen met je armen dan met je benen) zoals zwemmen is ook belangrijk.

**- Kunt u een advies geven over de minimum en de maximum tijdsbesteding per dag aan beweging van een kind?**

Ik denk dat het op de basisschool belangrijk is dat kinderen veel bewegen omdat daar de meeste groei en vermogen om te leren zit. Ik zou wel willen zeggen dat naast de pauzes op school en het naar school toe komen het belangrijk is om minimaal 1,5 uur in beweging te zijn. Een maximum zit er wat mij betreft niet aan als het maar niet gaat om maximale inspanning en het gaat om spelen (interval met rennen, klimmen, springen etc.). Aan explosieve kracht trainen zit natuurlijk altijd een maximaal die per kind verschillend is.

Vragenlijst orienterend onderzoek bij experts:  
Wanda Krispijn - Knijft (Kinder Fysiotherapeut)

dinsdag 20-03-2018

**- Welke doelgroep (of specifiek leeftijd) heeft hier het meest last van volgens u?**

Leeftijd 0-18 jaar, kinderen zitten vanaf jongs af aan al in de maxicosi tegenwoordig. Daarnaast zie ik hier in de regio (rotterdam zuid/achterstandswijk) veel allochtone kinderen met overgewicht. Waarbij cultuur maar ook het feit dat ouders niet bewegen een probleem is.

**- Wat zou, naast de digitalisering, nog meer de oorzaak kunnen zijn van het overgewicht bij kinderen?**

Zie dit filmpje!!! Denk ook dat dit voor kinderen kan gelden  
<https://www.youtube.com/watch?v=jGH7n2eC2F4>

**- Welke specifieke bewegingen (m.b.t. de dagelijkse motoriek) zijn goed voor de ontwikkeling van een kind?**

Mi wisselend duur en high intensetie afgewisseld

**- Kunt u een advies geven over de minimum en de maximum tijdsbesteding per dag aan beweging van een kind?**

minimaal - max de hele dag?

**- Welke doelgroep (of specifiek leeftijd) heeft hier het meest last van volgens u?**

Als de vraag alleen gericht is op het gebruik van hun mobiele telefoon zijn het de pubers (12-17 jaar). Helaas zien we eigenlijk al vanaf 2 jaar dat kinderen vaker achter tablet worden gezet of tv staat heel de dag aan bij ouders (dit zien we zelfs al bij baby's). De grootste groep die wij zien met overgewicht is tussen de 6 en 12 jaar. Jonger ook wel maar minder. Ouder ook maar zien vaak dat ze op jongere leeftijd ook al voor hun gewicht bij ons zijn geweest voor het K4F programma.

**- Wat zou, naast de digitalisering, nog meer de oorzaak kunnen zijn van het overgewicht bij kinderen?**

Cultuur speelt een grote rol. In veel buitenlandse culturen is eten een heel belangrijk aspect. Iedereen in de familie is aan de zware kant dus het is normaal. Daarnaast heeft de manier van opvoeden er mee te maken, sommige ouders kunnen geen grenzen stellen waardoor het kind elke keer zijn zin krijgt. Armoede, waardoor er veel eten met een nummer gekocht wordt en geen verse producten. En sociale aanzien, met traktaties op school moet mensen niet denken dat ouders geen geld hebben dus wordt er dus heel veel snoep getrakteerd want hoe groter de traktaties hoe groter de aanzien.

**- Welke specifieke bewegingen (m.b.t. de dagelijkse motoriek) zijn goed voor de ontwikkeling van een kind?**

Wandelen, rennen, klimmen, klauteren, fietsen. Ontwikkelen betekent eigenlijk ontdekken, en hoe meer een kind in beweging is hoe meer hij ontdekt hoe meer hij zijn motorische vaardigheden ontwikkelt.

**- Kunt u een advies geven over de minimum en de maximum tijdsbesteding per dag aan beweging van een kind?**

Min 30 min max 2 a 3 uur (achter elkaar)

Recentelijk Master kinderfysiotherapie behaald. Doet op dit moment onderzoek naar de inzetbaarheid van de XBOX Kinect en top 5 meest verkochte spellen. Interesse in mogelijkheden om kinderen meer te laten bewegen.

**- Welke doelgroep (of specifiek leeftijd) heeft hier het meest last van volgens u?**

Kinderen die motorisch gezien onhandig zijn hebben hier het meest last van. Buitenspelen en schoolgym is moeilijk voor ze, vaak zijn ze ook niet heel populair bij dit soort activiteiten, dit maakt het voor deze kinderen minder aantrekkelijk om actief te zijn. Waar die motorische onhandigheid door komt maakt dan eigenlijk niet uit, dit kan letterlijk komen door te weinig oefenen, waardoor het kind niet voldoende trainingstijd heeft om een activiteit eigen te maken, kan komen door gedragsproblematiek, lichamelijke klachten, motorische retardatie. Of een combinatie van factoren.

**- Wat zou, naast de digitalisering, nog meer de oorzaak kunnen zijn van het overgewicht bij kinderen?**

Kennis bij ouders over gezonde voeding, tijdgebrek bij ouders om te kunnen koken. Ik werk in een achterstandswijk in Rotterdam en veel ouders vinden het niet veilig om hun kind alleen buiten te laten spelen, dit kan ook een factor zijn. En er is ook veel cultureel bepaald, in bepaalde culturen hoort het dat je kind "lekker mollig" is want dit geeft aan dat het goed gaat met de familie. Veel families vinden dit erg belangrijk, als je dan uitlegt dat het veel gezondheidsrisico's met zich mee brengt wordt hier vaak niets mee gedaan.

**- Welke specifieke bewegingen (m.b.t. de dagelijkse motoriek) zijn goed voor de ontwikkeling van een kind?**

Bedoel je hier de grove of fijne motoriek

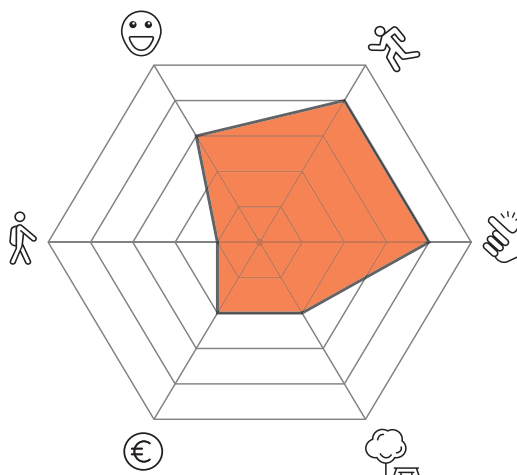
**- Kunt u een advies geven over de minimum en de maximum tijdsbesteding per dag aan beweging van een kind?**

Ik zou de nederlandse norm gezond bewegen aan houden..

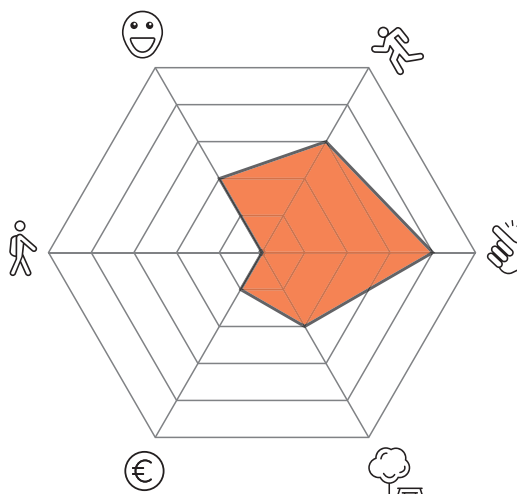
# B RATING GUIDE

## PHYSICAL ENVIRONMENT PRODUCTS

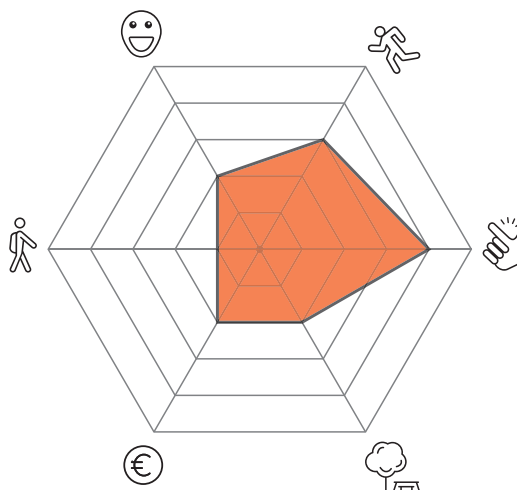
### Nexersys



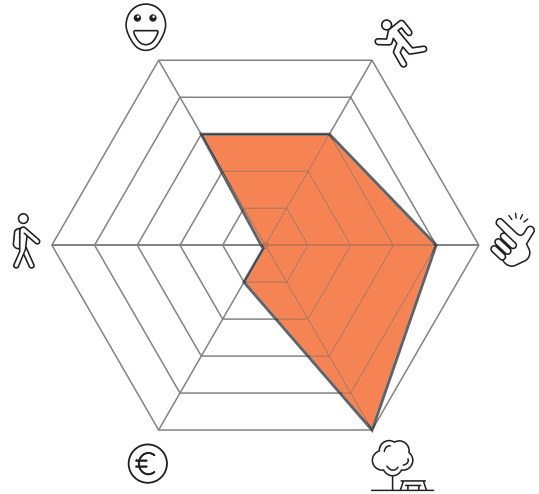
### Trailblazer



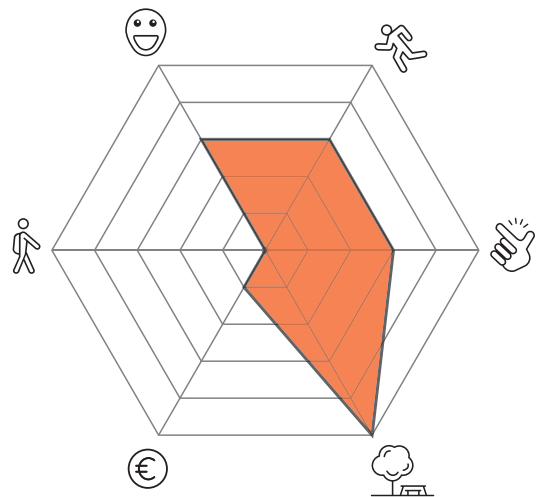
### Kidzpace



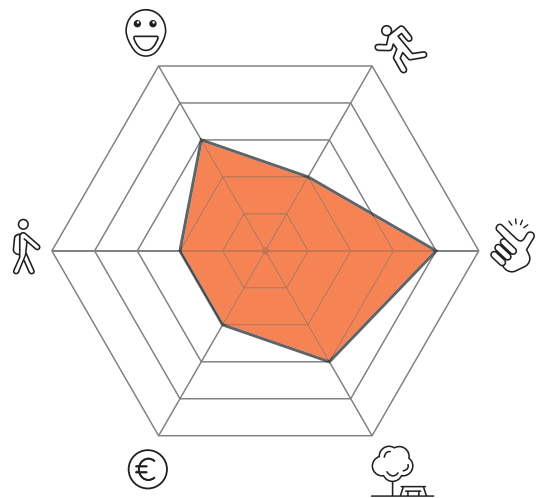
## Sutu



## Sona

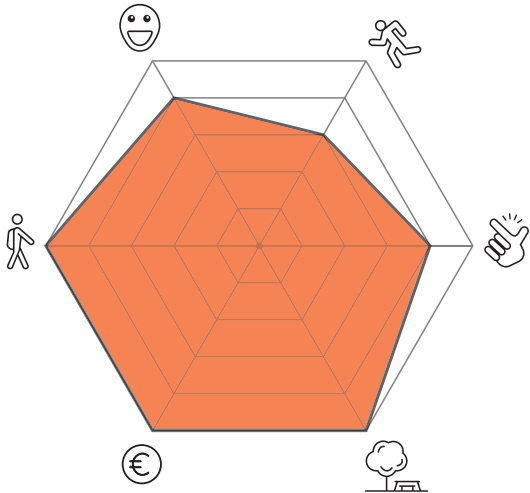


## IMO-Learn

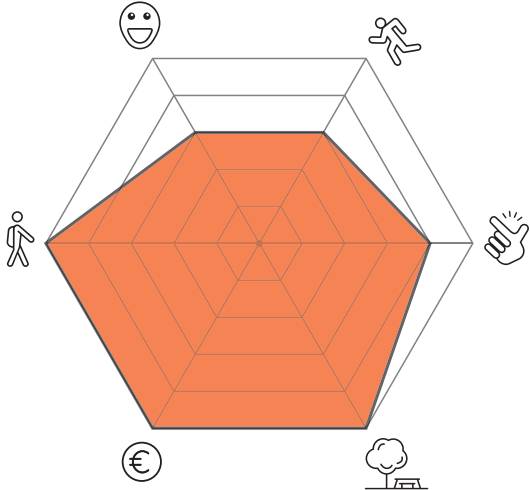
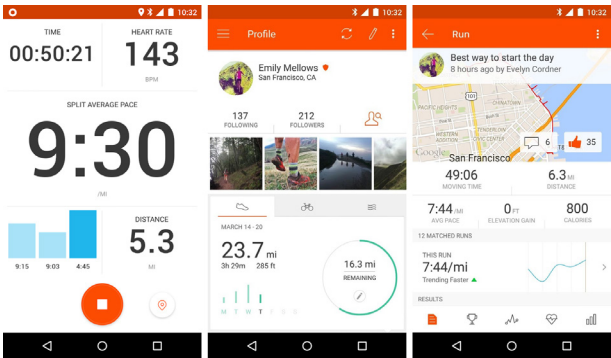


# DIGITAL ENVIRONMENT PRODUCTS

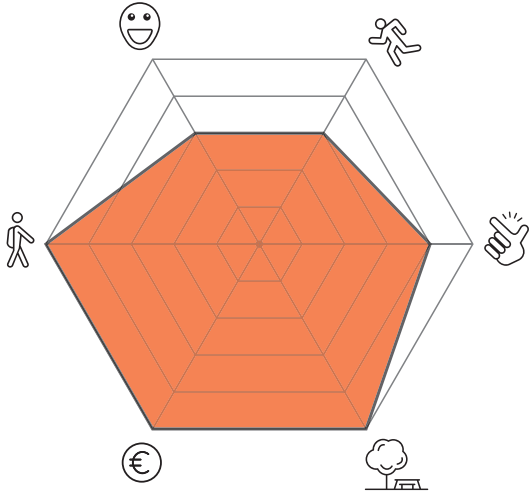
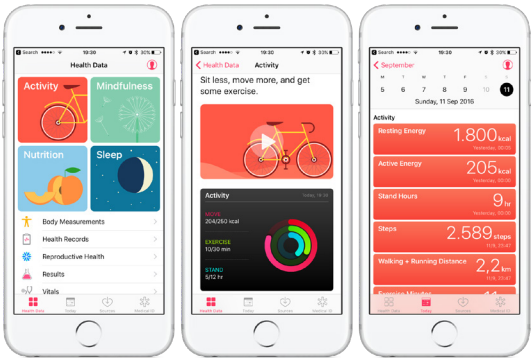
## Pokemon GO



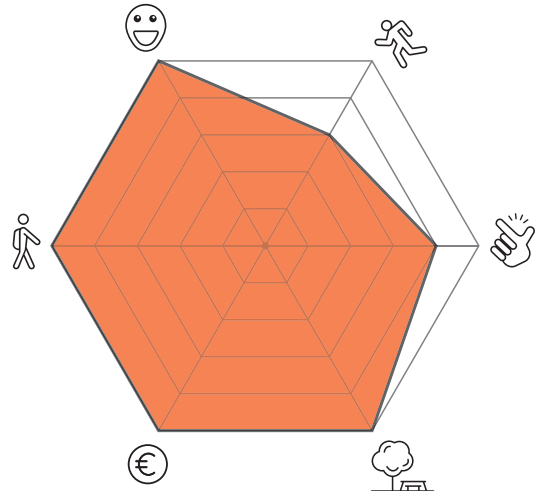
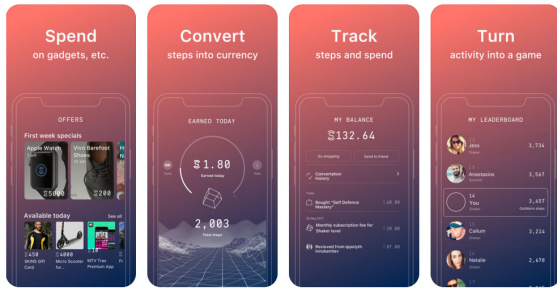
## Strava



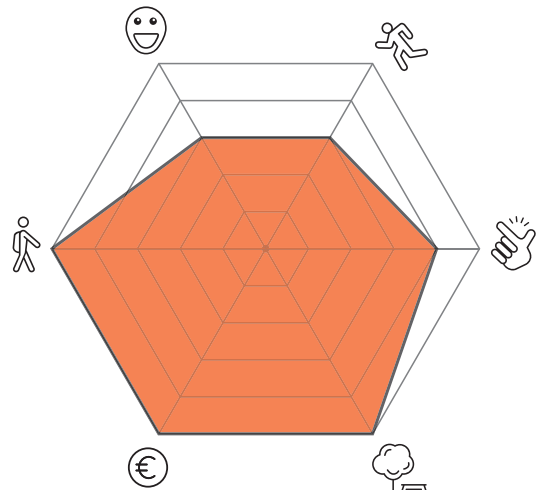
## Iphone health app



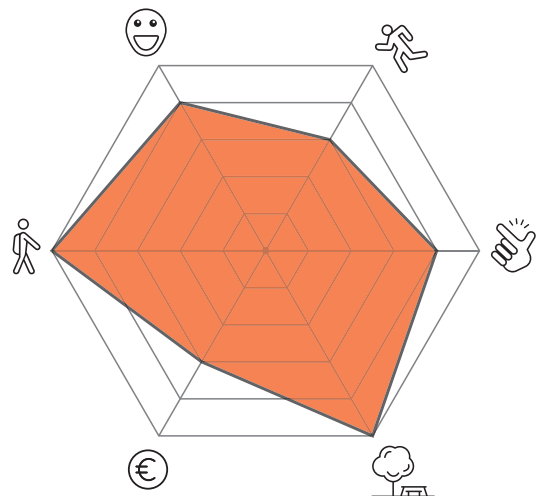
## Sweatcoin



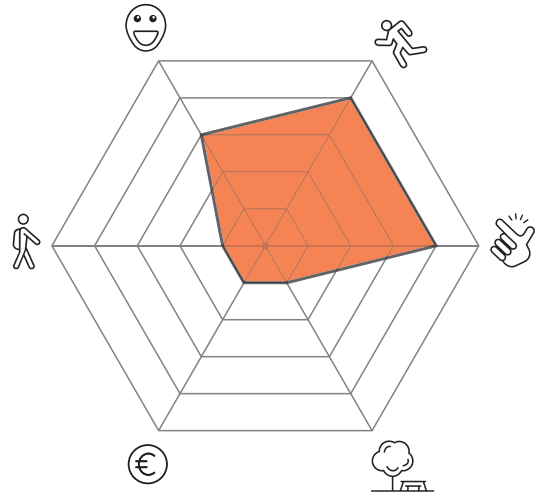
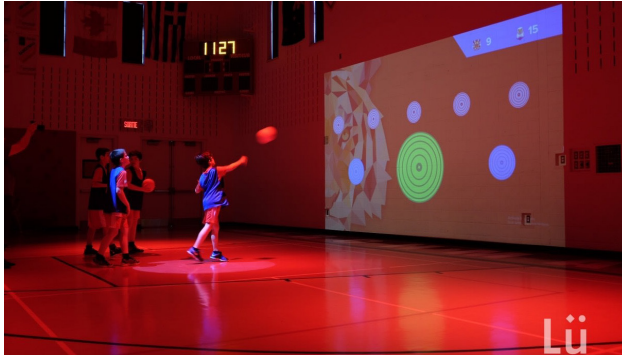
## Super Stretch Yoga



## Sworkit



# LU

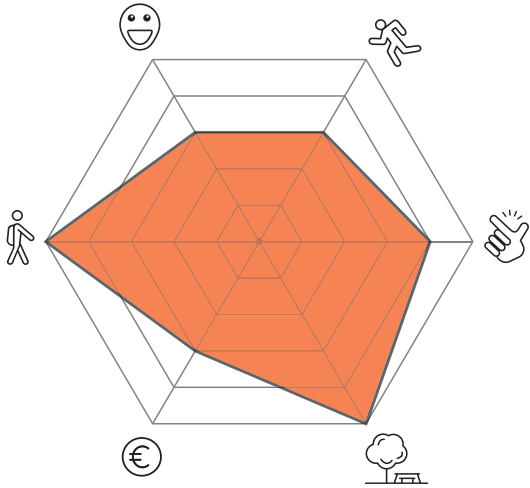


# PLATFORM PRODUCTS

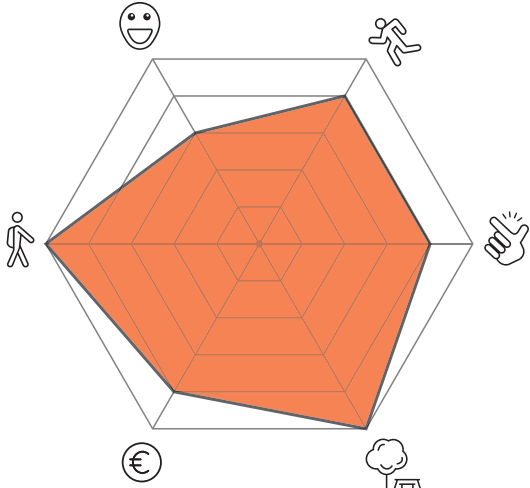
## Fitbit



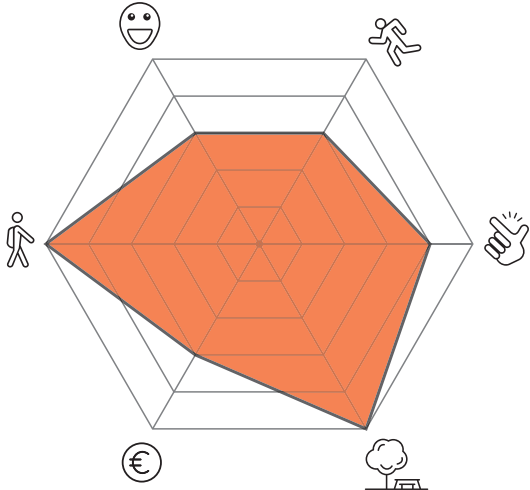
Discover a whole new world of fitness.



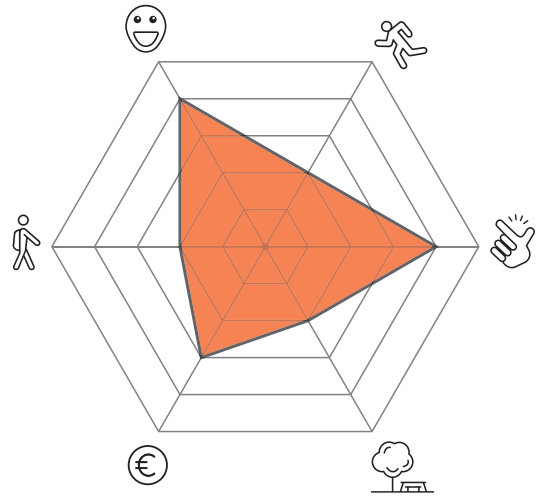
## Moov



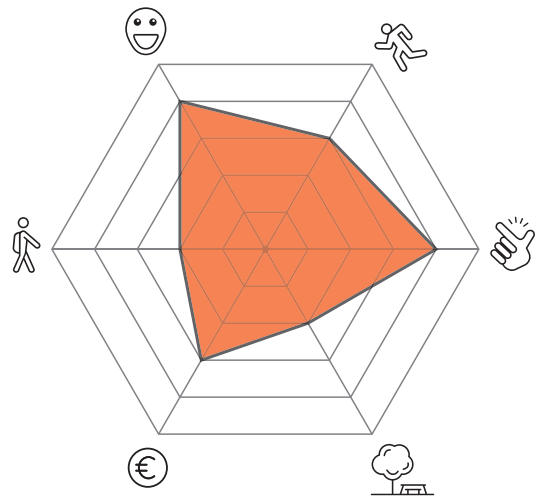
## Cosinuss



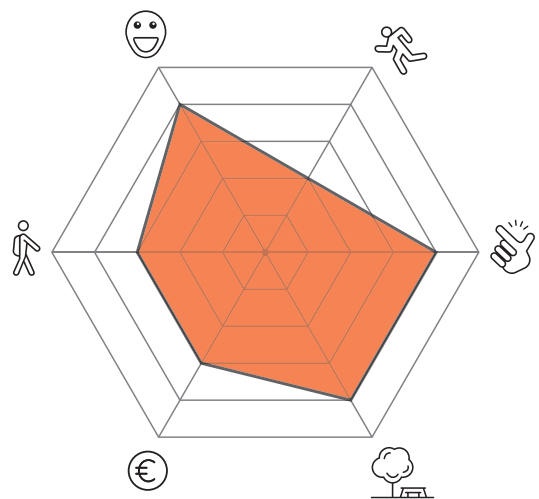
## Nintendo Wii



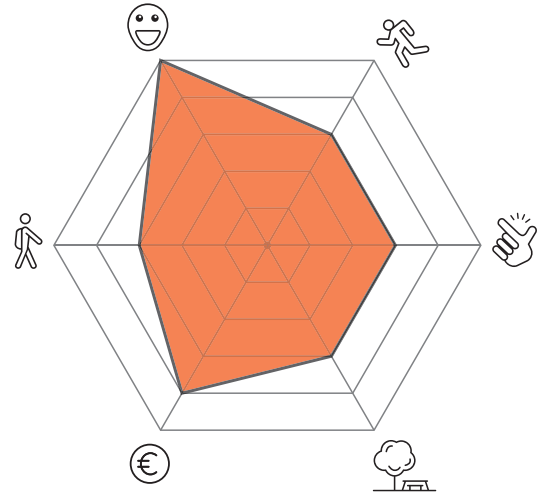
## Nintendo Wii Balance



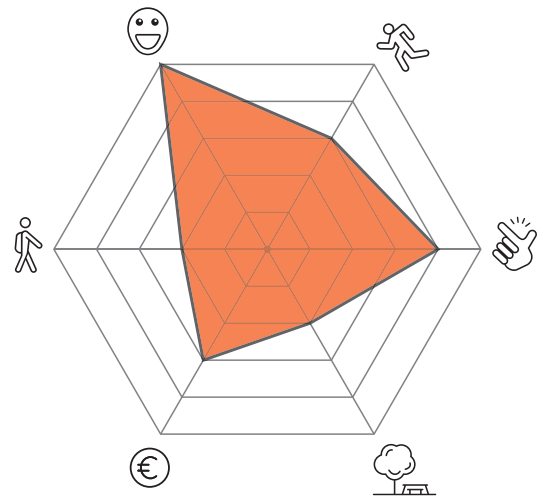
## Nintendo Switch



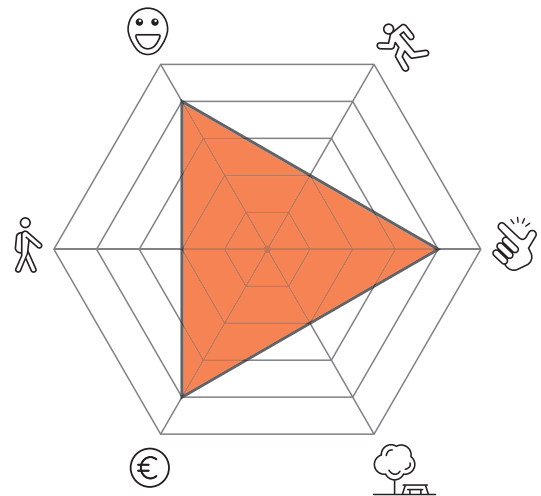
## Nintendo Labo



## Xbox Kinect



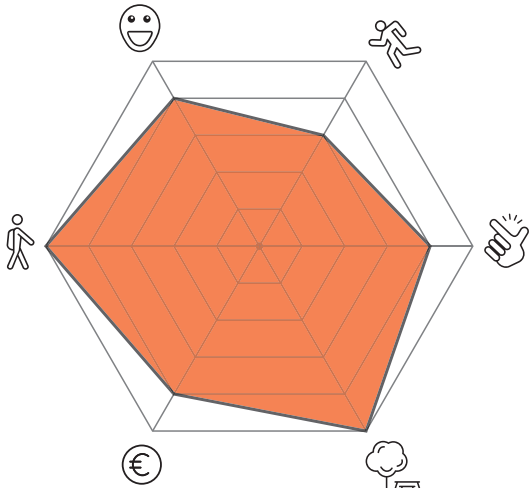
## Playstation Move



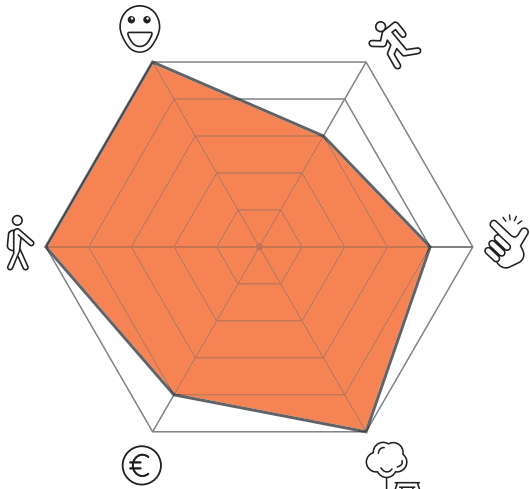
# Playstation VR



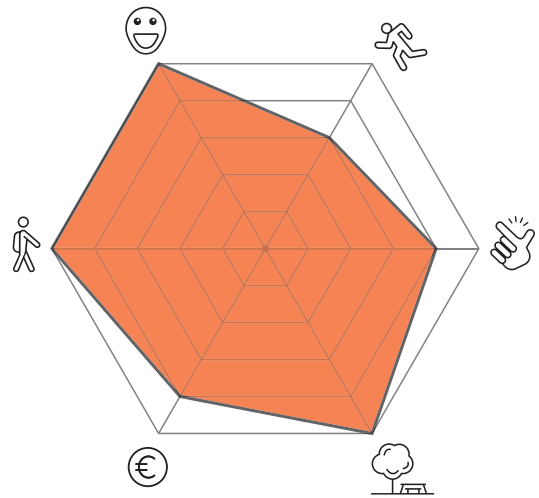
# Zamzee



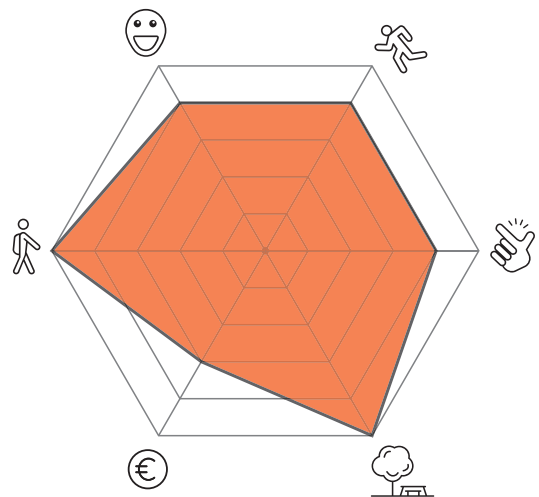
# Geopalz Ibitz



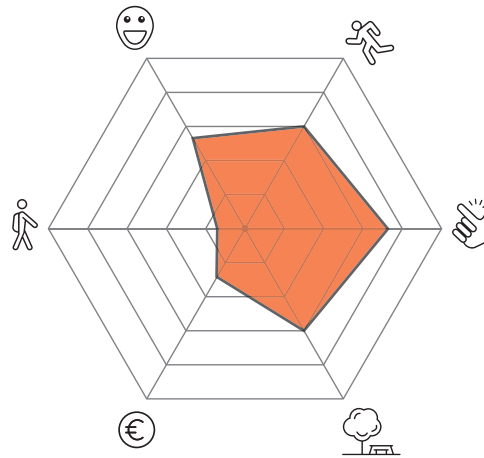
## Kids Power Bands



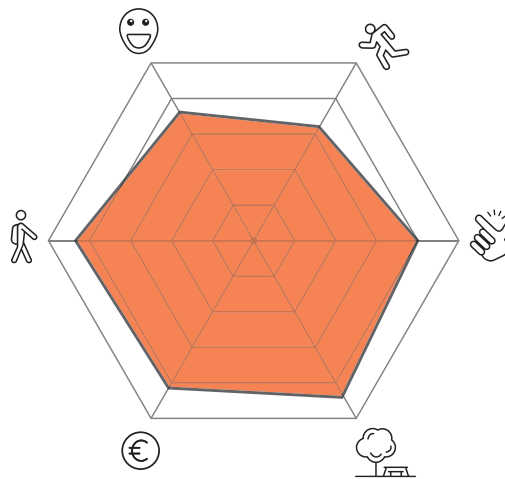
## Super Suit



## Overall score physical environment products



## Overall score digital environment products



## Overall score platform products

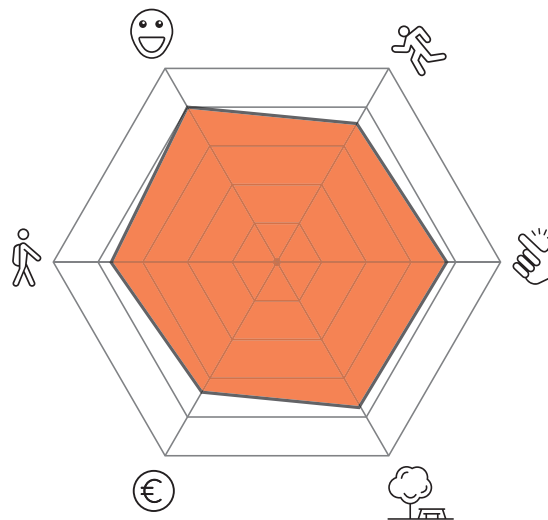




Figure:1 AR google glass.jpg

# C REALITY TECHNOLOGIES

To gain some new insights for the to-be-designed product, a deep dive into some technology focussing on real time products has been done.

## C.1 AR/VR/MR PRODUCTS

Augmented, Virtual and Mixed reality technologies can be seen as one of the technological trends of the past few years. (X) Due to this highly trending topic, many companies tried to merge AR/VR/MR technology in their products to stimulate the physical activity. Most of these companies designed this products especially to be used for gaming applications.

### C.1.1 AR

Augmented reality can be seen as the integration of digital information(overlays) with the user's environment in real time (Techtarget, 2018). This digital information is commonly shown to the user via a smartphone or tablet.

Some examples of this relatively familiar technology are the *Google glass* and the recently introduced *IKEA Place*, where the consumer literally can see their potential pieces of furniture at home before pulling out the credit card.

### C.1.2 VR

Virtual reality can be seen as an artificial environment that is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment (Techtarget, 2018). The exact difference between AR and VR can be found in the absence/presence of a fully artificial environment.

Some examples of VR product are the *Oculus Rift* and the *Samsung Gear VR*, where the Samsung Gear VR let you use your own smartphone to create the artificial environment.

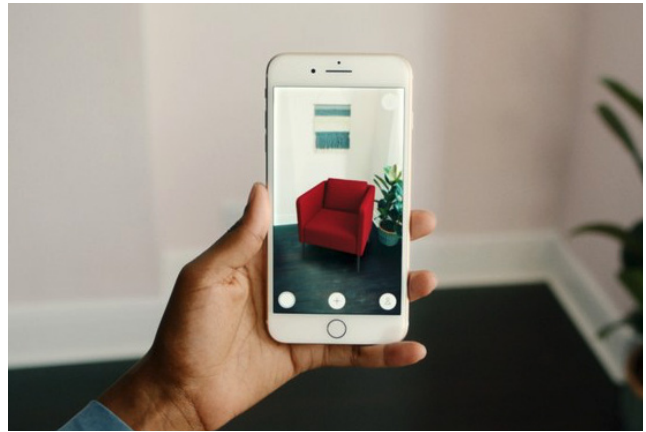


Figure:2 AR IKEA.png



Figure:3 VR Oculus Rift.jpg



Figure:4 VR samsung gear.jpg



Figure:5 VR view2.jpg

### C.1.3 MR

Mixed reality is the most recent development in reality technologies and can be seen as a hybrid system that involves both physical and virtual elements (Techopedia, 2018).

Basically the difference between AR and MR can be found in the quality and level of interaction of the added digital environment. In MR, the digital environment involves virtual objects in which interaction is possible, where in AR no interaction is possible with the digital content.

These days, many products can be found within this technology category. Some examples are the *Microsoft HoloLens* and the *Asus Mixed reality*.

Some of the AR/VR/MR products are also mentioned in the topic Game devices.



Figure:6 MR HoloLens.jpg



Figure:7 MR Windows mixed reality.jpg

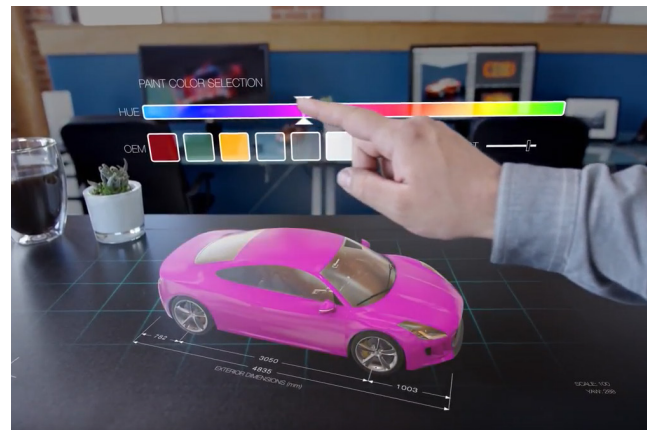


Figure:8 MR holoLens view2.png



Figure:9 MR HoloLens view.jpg

## C.2 ACCESSORIES FOR VR/MR

Beside the products mentioned earlier, the market has also brought some new accessories to go with the VR/MR products. Due to these accessories, the physical activity can be stimulated even more. Where the VR/MR headsets mostly focus on the sense of seeing, and hearing in some cases, accessories are used to add a certain level of feeling and feedback to the digital world.

One of the accessories is the *Haptx feedback gloves* (Haptx, 2018). This glove can be used in VR and creates an haptic experience of the digital world. Pneumatic actuators assisted by miniature valves control the pressure on each actuator for haptic feedback.

The *Icaros exercise device* (Icaros, 2018) let the user experience (and workout) while playing in VR. Accelerometers within the Icaros connect with VR glasses to follow each move of the user.

The *Cyberith entertainment system* (Cyberith, 2018) is a bit similar to the Icaros, only this device lets the user walk/run instead of flying.

There are also some companies who provide a full gaming suit like *Araig* (Araig, 2018). This sensory force feedback suit allows the user to experience a full gaming experience with the use of accelerometers, pressure-sensors, motion sensors and an integrated soundsystem.



Figure:10 Araig gaming suit.png



Figure:12 Icaros.jpg



Figure:11 Haptx.jpg

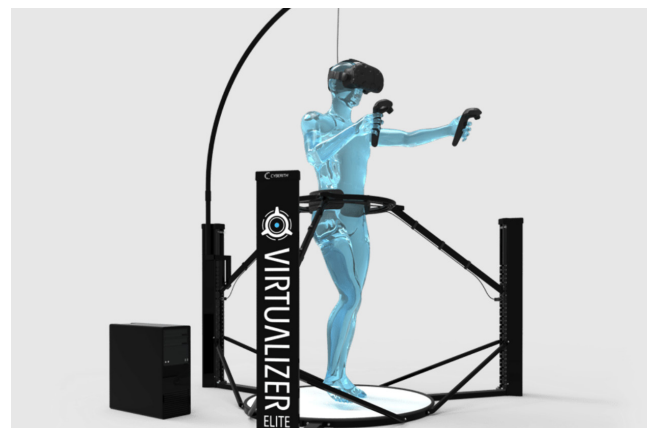
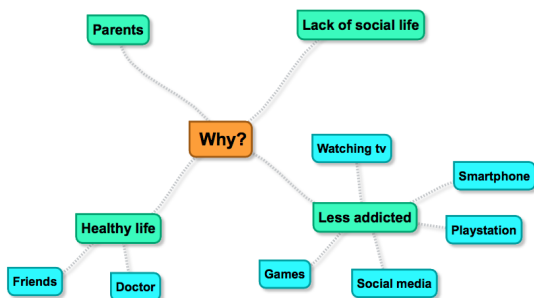
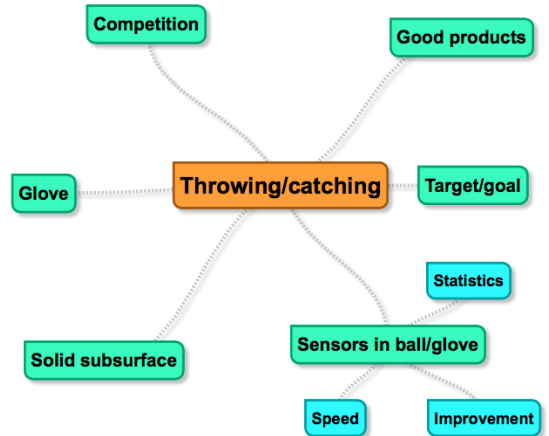
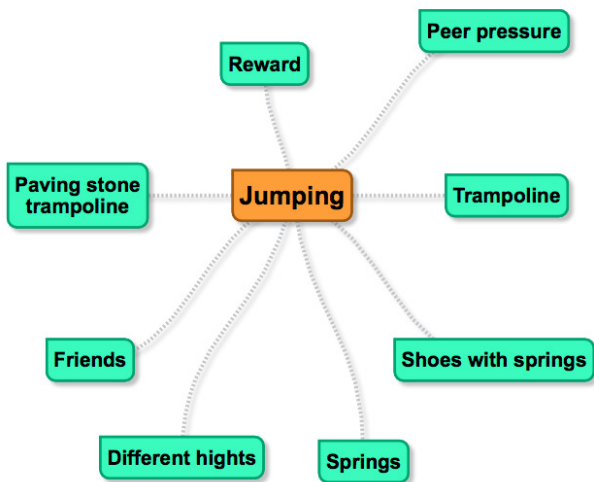
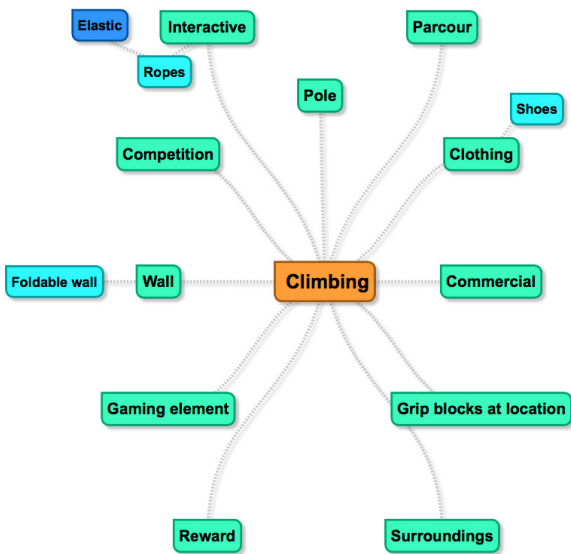
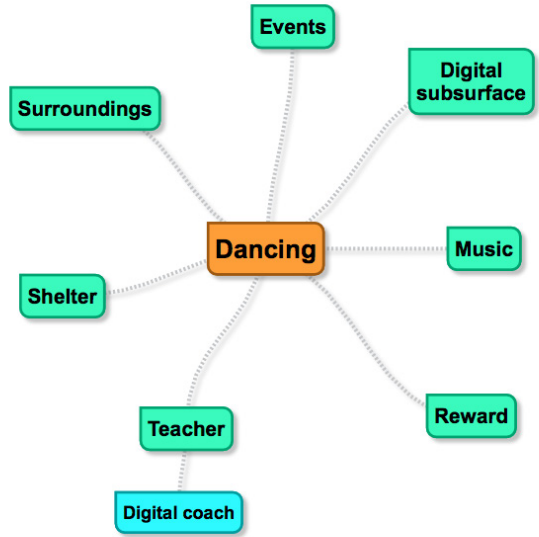
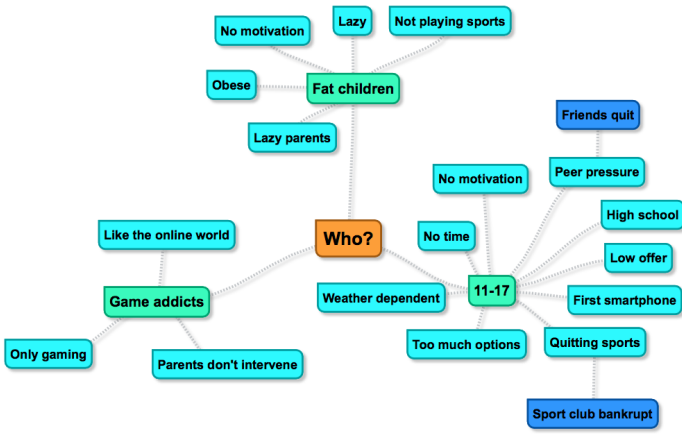


Figure:13 Cyberith.png

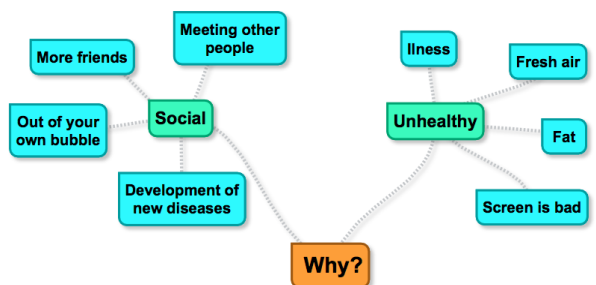
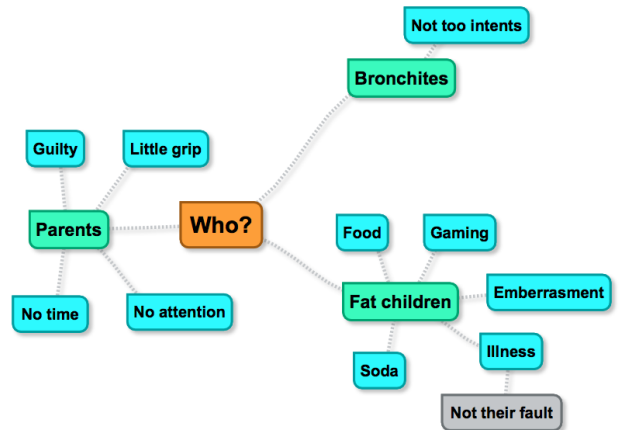
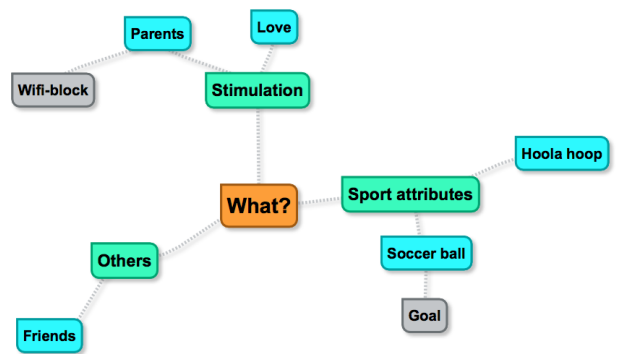
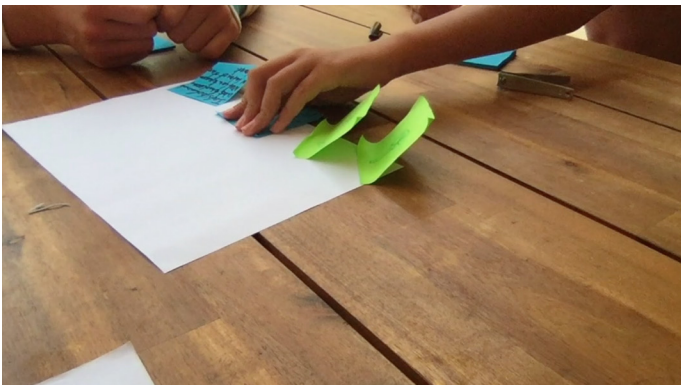
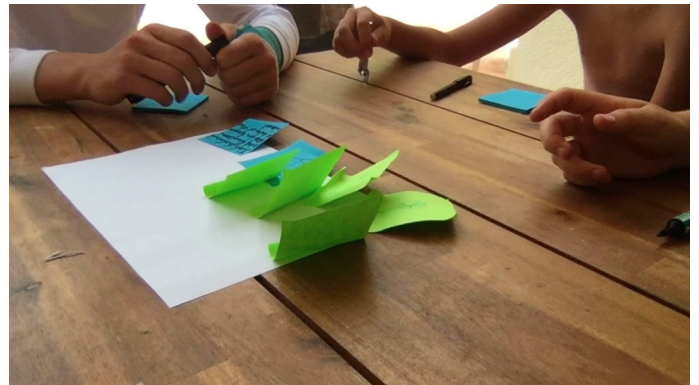
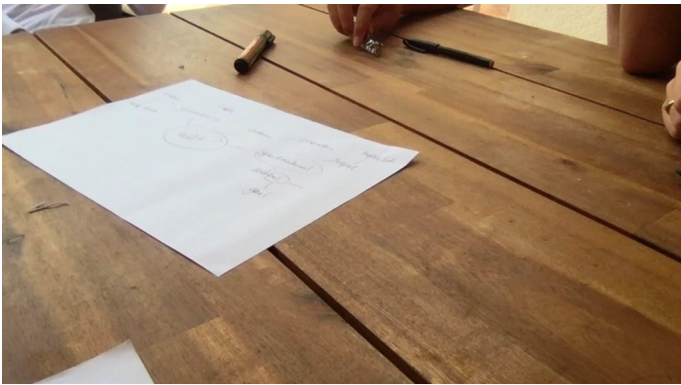
# D CREATIVE SESSIONS

## CREATIVE SESSION 1





# CREATIVE SESSION 2



# E

## TREND ANALYSIS

Within this topic several potential opportunities will be suggested. These opportunities, according to trends in the near future, are specifically selected for the general goal to stimulate physical activity among children. These trends will guide as a source of inspiration for the next step in this project, the ideation phase.

The trends can be categorized into:

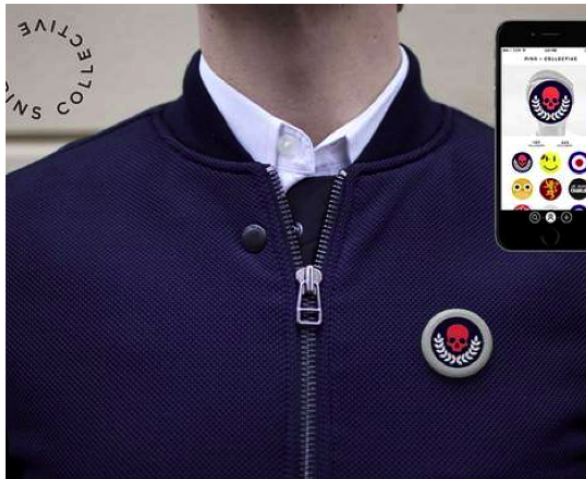
- Popculture trends
- Business trends
- Fashion trends
- Life stage trends
- Life style trends
- Marketing trends
- Technological trends

# POP CULTURE TRENDS

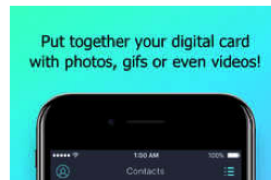
## GIF powered platforms

Consumers engage with GIF-powered platforms for both business and pleasure

Implications - Stretching beyond the use as cultural shorthand online, the GIF format is being wielded by consumers and brands alike to communicate various type of information with the help of personalization platforms. Given this new functionality in both personal and professional spaces, this shift highlights the ways in which consumers are open to the re-contextualization of imagery for other purposes.



**Animated GIF Pins**  
These Digital Pins from Pins Collective Display Customized GIFs



**Digital Business Card Apps**  
'100AM' Helps People Exchange Contact Details Paperlessly



**Airport GIF Stations**  
Easyjet and Stansted Airport Set Up a Real-Time Departure Board at a Subway



**Governmental GIF Archives**  
The National Archives and Records Administration is Collecting GIFs



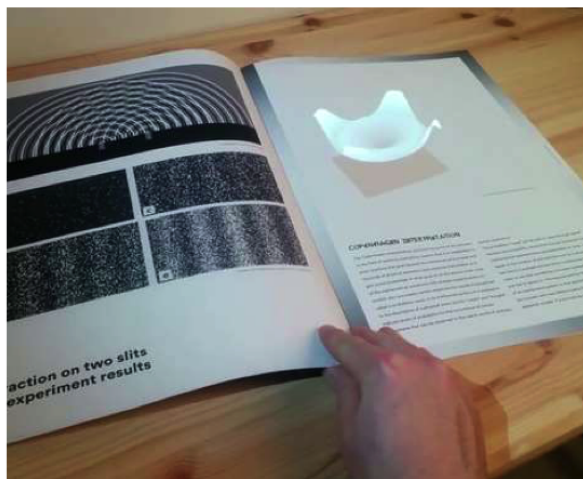
**Video Meme GIF Converters**  
'GIPHY Loves Vine' Creates and Saves Vine GIFs

# BUSINESS TRENDS

## AR Packaging

AR features entice consumers to engage with products in-store

Implications - Incorporating augmented reality features into product packaging and displays is quickly becoming the new way for brands to create a memorable experience for consumers. These interactive moments enhance the shopping experience through engagement that is inspiring and visually enchanting. In addition to enticing consumers on location, AR interactions also generate social media content, spreading word of mouth marketing on a wider scale and showcasing the importance of engaging the constantly connected consumer via digital mediums even in-store.



**DIY Augmented Reality Books**  
This Augmented Reality Book Requires No Apps or Special Glasses to Use



**AR Egg Cartons**  
Vital Farms' Newly Redone Egg Carton Design Comes to Life with Augmented Reality



**AR Code Candy Packaging**  
This PEZ Packaging Features Scannable Codes that Unlock Mobile Games



**Augmented Sausage Packaging**  
Bemis' Transforms Branding with Interactive Package Systems



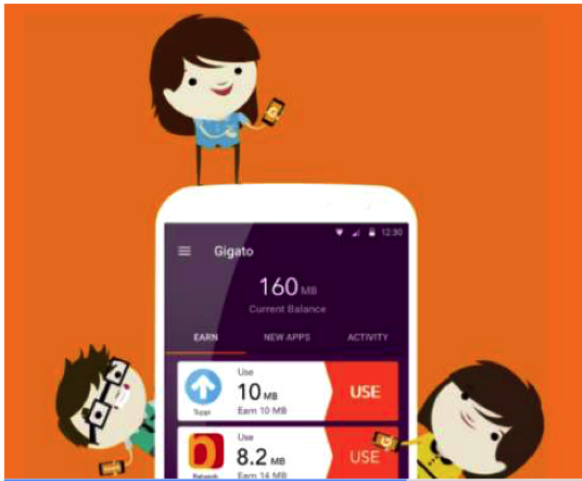
**Augmented Reality Sneakers**  
The Monte Z High-Tech Sneakers Have a Design That Comes to Life in AR

## Payout apps



Payout apps entice consumers to earn data and cash through engagement

Implications - Apps offering free data or money in exchange for usage are enticing young audiences to monetize their leisure time. Leveraging data as currency, these companies are finding creative ways to circumvent the growing culture of "walking ad blockers" and engage mobile users. In the spirit of the growing demand for net neutrality, apps that offer free data access will not only allow cost-conscious consumers to stay connected longer, they will also provide opportunity for getting people in developing countries online.

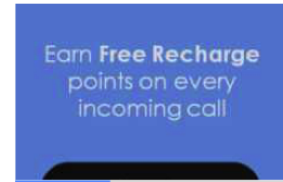


### Free Data-Earning Apps

Gigato is an App That Provides Free, Unrestricted Internet Data For Users



**Ad-Watching Coupon Apps**  
The MyAds App Allows Users to Receive Money When Watching Advertisements



**Ringtone-Replacing App Payouts**  
The PayTunes App Replaces Ringtones With Advertisements



**Pay-For-Use Data Apps**  
Earn Talktime Provides Pays Users Through a Variety of Different Functions

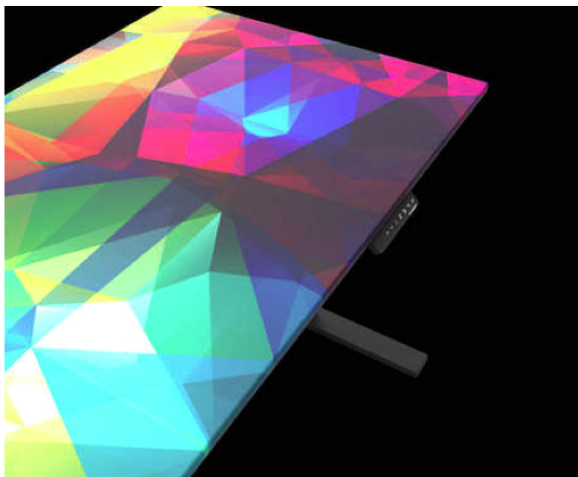
## FASHION TRENDS

### Self expression customization



Consumers looking to alleviate the boredom of routine find expression

Implications - Minimalist design and its concurrent lifestyle -- Marie Kondo's teachings, for example -- have risen in popularity due to information overload. As a backlash to this movement, a sub-segment of consumers is going in the opposite direction, seeking excess. This is an act of rebellion, but also a method of alleviating the boredom of routine through unabashed self expression.



### Customizable Desk Covers

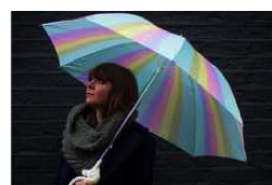
Evodesk Allows Consumers to Personalize Their Workspaces With Vinyl Skins



**Branded Luxury Hair Ties**  
Chanel Hair Ties are a Chic 90s-Inspired Accessory for the Spring



**Vibrant Tie-Dye Sneakers**  
Maison Margiela Released a Pair of Multicolored Sneakers for Spring



**Rainbow Unicorn Umbrellas**  
The Magical Unicorn Umbrella Adds an Air of Whimsy to a Rainy Day

## Artified collectors

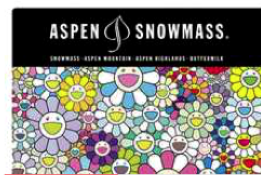


Collectors are enticed by special design-led ticketing collaborations

Implications - While the phenomenon of collecting ephemera is rooted in the old world, recently, brands and institutions are collaborating to transform everyday paper tickets into treasured pieces of art. In addition to solidifying the social and cultural currency of such brands, this progression suggests a new collective nostalgia for printed matter in the digital age, and the opportunity for brands to insert themselves in this meaningful space.



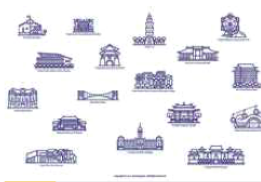
**Streetwear Brand Transit Cards**  
Supreme Created Custom MetroCards for Style-Savvy Commuters



**Artist-Designed Ski Lift Tickets**  
Takashi Murakami Has Designed Souvenir Lift Tickets in Aspen



**Special-Edition Movie Tickets**  
Regal Cinemas is Offering an 'Ultimate Ticket' to Star Wars Fans



**Commemorative Subway Passes**  
The Taipei Metro Has Released a Year of the Monkey Pass



**Ticket-Inspired Towels**  
This Beach Towel Design by Cineplex Provides a Free Trip to the Movies

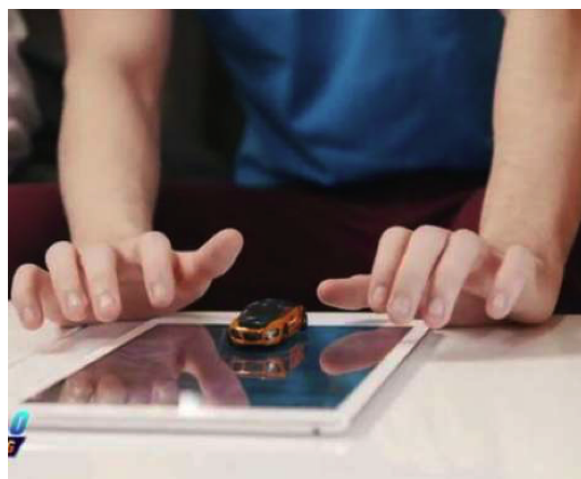
## LIFE STAGE TRENDS

### Analog + digital game interaction



Brands merge analog & digital to create games that involve physical interaction

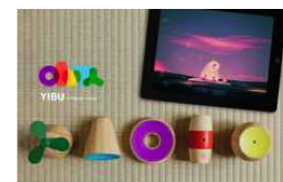
Implications - Seeking to maintain an element of physical engagement, toy brands are creating games and platforms that combine digital software with tangible interactions. Integrating this dual-functionality into the foundation of the toy itself, brands are requiring kids to use physical objects like building blocks and letters as a means to activate digital platforms and games. This physical component not only speaks to the benefits of analog play, but it also signifies a turn toward hybrid forms of engagement.



**Physical Touchscreen Toys**  
The 'Pocket Racing 2.0' Racing Cars React to the On-Screen Action



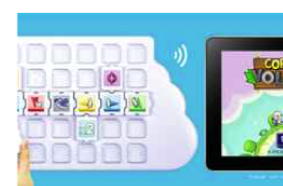
**Talkative Smartphone Toys**  
The Smapon Communication Toy Works in Tandem with a Phone



**Toy-Incorporating Game Platforms**  
The 'Yibu' Gaming Platform Blends Real World Toys with Digital



**Smart Alphabet Toys**  
These Classic Wooden Letters Teach via iPad Apps



**Gaming Puzzle Toys**  
Learning Game System Puzzlets Gives Kids Coding and Game Development Skills

## Child co-creation



In-store customization stations generate engagement from Gen Z

Implications - In an effort to make brick and mortar retail spaces more of a destination for families, brands are offering in-store customization of toys and products for kids. Encouraging the children of maker parents to add their own personal touch to a product and make it truly unique to them, these brands are creating memorable moments for families to share in, enhancing engagement within the retail space. This interactivity appeals to the Gen Z demographic as they are interested in taking their world into their own hands and creating rather than passively buying.



### DIY Toy Store Figurines

The 3DplusMe Kiosks Allow Consumers to Create Personalized Action Figures



**Interactive Doll Retailers**  
The American Girl New York Shop is Dubbed "The Store of the Future"



**Branded Emoji-Themed Pop-Ups**  
Pepsi's New 'Have Fun' Pop-Up Showcases the Brand's Custom PepsiMojis



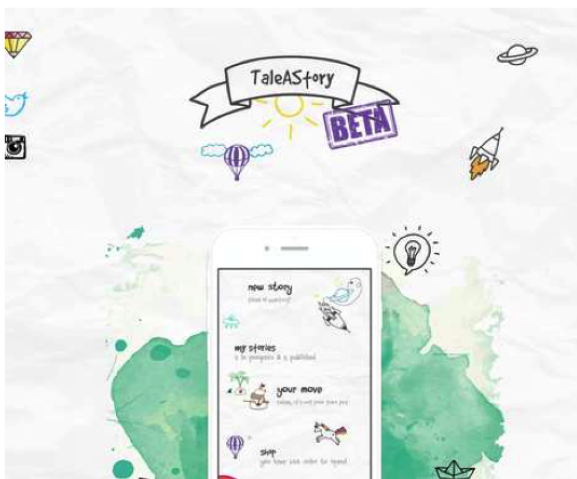
**Personalized Building Block Kits**  
This LEGO Store Produces Custom Lego Kits in a Child's Likeness

## Collaborative narrative



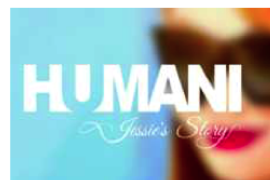
Choice-based storytelling engages children through confidence-boosting

Implications - Giving children a chance to have some flexibility and control of the narrative presented to them in character-driven stories sends a powerful message to young Gen Zs that their decisions have implications and make an impact on the story's final outcome. This not only fosters critical thinking and confident decision making early on, it also encourages young minds to become more invested in the narratives that they've contributed to.

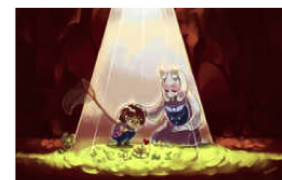


### Collaborative Story Apps

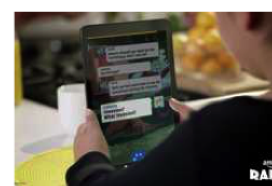
The 'TaleAStory' Lets Users Create their Own Tale One Line at a Time



**Chat-Based Adventure Games**  
'Human: Jessie's Story' is Told Through the Facebook Messenger App



**Empathy-Based Video Games**  
This Battle Game Lets Players Fight Monsters or Make Friends With Them



**Interactive Reading Apps**  
'Amazon Rapids' Gets Kids Interested in Reading Through Text Messaging

## Peaceful play



Soothing toys attract both adults and kids

Implications - An under-discussed side effect of play is relaxation. This is boosting the adult desire for mindless enjoyment by way of small, tactical toys, while also boosting mindfulness components in toys targeted toward children. Stress is high in the digital age due to the frequency and volume of content consumption, making incremental relaxation more necessary than ever.



### Wooden Fidget Toys

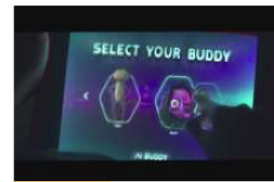
MOKURU is a Desktop Toy That Flips, Rolls and Does Tricks



**Responsive Tactile Stress Balls**  
The Interactive 'Stressball' Senses Body Data and Responds



**Heatable Plush Toys**  
The Microwaveable Heat Therapy Stuffed Animals Offer Soothing Warmth



**Comforting AI Characters**  
'AI Buddy' is a Virtual Friend for Kids in Military Families

## Productionized prodigy



The high capabilities of Gen Z are maximized through services and products

Implications - Where the Millennial generation had teen entrepreneurs, Generation Z has child prodigies. This is due to the increased accessibility and range of information, which in turn breeds a highly competent generation of children and tweens who are redefining the idea of what kids are capable of. Products and services that aid in this natural sense of entrepreneurship among children ensure Generation Z reaches their full potential.



### Empowering Entrepreneurial Toys

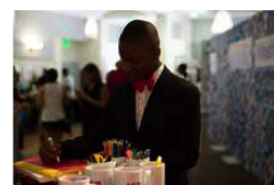
Fashion Angels' 'It's My Biz' Toys Inspire Careers in Business



**Tween Influencer Communities**  
The AwesomenessTV Network Supports Young Content Creators



**Entrepreneurial Shoe Workshops**  
Savvy Society's Workshops Teach Girls to Use 3D Printing Techniques



**Child-Focused Entrepreneurial Events**  
'Kid Talks' Inspire Young Attendees to Reach Goals

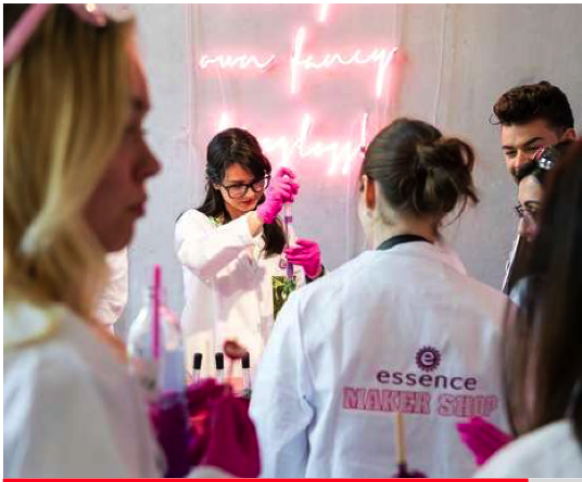
# LIFE-STYLE TRENDS

## Personalised products



Interactive pop-ups invite customers to co-create products

Implications - Meeting the desire for both direct-to-consumer brand interactions and limited edition, personalized merchandise, brands are hosting pop-up experiences that invite customers to experiment in order to co-create custom products. This progression demonstrates the need to engage consumers with memorable brand touchpoints during a time when brand loyalty is at times difficult to garner.



**Fast Beauty Maker Labs**  
The Essence Maker Shop Invited Fans to Co-Create Products In-Store



**Luxurious Ice Cream Pop-Ups**  
This Magnum Pop-Up Featured Edible Flowers and Pearls



**Scarf-Personalizing Pop-Ups**  
Hermes' Pop-Up Store Takes Inspiration from the Task of Doing Laundry



**Special Admission Cafes**  
The Nescafé Taproom Lets Visitors Create Custom Brews on Site



**Customizable Chocolate Bar Pop-Ups**  
London's KitKat Pop-Up Let Fans Create Custom Confections

## Educational health



Health products integrate education into the use process

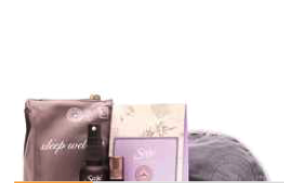
Implications - The wellness wave has created an influx of new health products, making it difficult for brand skeptics to identify which products are most trustworthy. Integrating education into product use alleviates this by establishing a positive brand-customer relationship. Furthermore, this positions the product as a catalyst for the overall betterment of the consumer.



**Pro-Aging Skincare Collections**  
Well Within's Planted in Beauty Emphasizes Wellness and Beauty



**AR Migraine Experiences**  
This Project Uses Augmented Reality to Educate People About Migraines



**Natural Sleep Kits**  
This Sage Set Supplies a Variety of Natural Sleep Aids



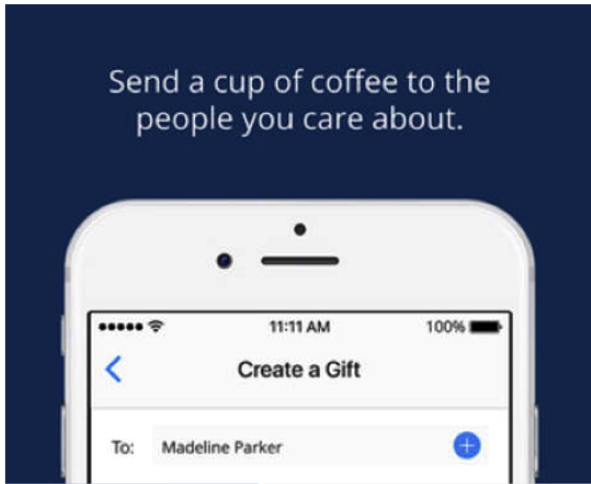
**Scannable QR Wrappers**  
Zego's Snack Wrappers Use Codes to Show Results of Batch Tests for Allergens

## Automated kindness



Consumption guilt drives consumers to find ways to improve their karma

Implications - The rise in curation makes it easier than ever for consumers to remain inside their own bubble of specific content, like-minded people, and tailored products. This self-contained approach to life may be enjoyable, but it can create feelings of guilt for those who want to better the world. Automated acts of kindness alleviate this guilt without disrupting the curated daily routine. In order to truly alleviate this guilt, these products and services are not branded and often consumer-made, highlighting a sense of community over capitalism.



**Charitable Coffee-Gifting Apps**  
The 'Nack' App Allows Users to Buy Anyone a Cup of Coffee



**Karma-Inspired Community Donations**  
The Little Free Pantry is Uniting an Arkansas City With Charity



**Anti-Bullying Mobile Apps**  
The BullyBox App Gives Students a Better Way to Report Bullying



**Relationship-Building Business Apps**  
The 'bonjoro' Customer App Lets Brands Send Personal Thanks

## Lifestyle trial

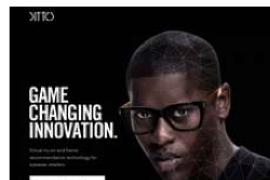


The try-before-you-buy model moves into unexpected places

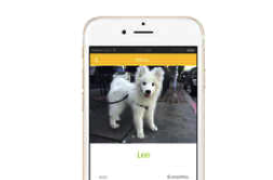
Implications - As retail moves into the digital space, more brands are offering the option to try products before buying them. This concept is easier to execute in spaces such as fashion, but what about larger purchase decisions with long-term lifestyle implications? More accuracy, extended sampling, and the use of data come together to make for more thorough trial periods in an era where consumers expect hyper-curated products and services. This model proves particularly strategic in the face of the skeptical Gen X demographic who prefers proof of value before committing to large purchases.



**High End Rental Experiences**  
The New Neiman Marcus Outlet Includes Rent the Runway Styles



**Virtual Optometry Platforms**  
Ditto Offers Intuitive Frame Recommendation Tech for Retailers



**Dog-Borrowing Apps**  
Bark'N'Borrow Brings Dog Owners, Wannabe Owners and Professionals Together



**Testable Car Purchasing Sites**  
HelloCar Gives Consumers the Chance to Test Out Their Car for a Week

## Stress-free technology



Technology is leveraged to combat stress and promote mental health

Implications - As awareness and de-stigmatization of mental health continues to grow, an increase in technology trends around regulating stress and promoting emotional wellness are becoming more readily available for the everyday consumer. This beneficial shift demonstrates an increase in demand for technology that enhances the user's well-being, not just their lifestyle.



### VR Escapism Programs

This Chemotherapy Patient Program Uses Virtual Reality as a Form of Escape



Hi. I'm joy.|

I'll help you track and improve your

### Mood-Detecting Chatbots

AI 'Joy' Can Keep Track of Human Emotional States on Facebook Messenger



### Stress-Regulating Driver Seats

Faurecia's 'Active Wellness' is a Health-Monitoring Biometric Seat



### Stress-Fighting Gadgets

The Pip Monitors the Skin's Electrical Current to Determine Stress Levels



### Stress-Reducing Health Trackers

The 'Lief' Tracks Heart Rate Variability to Decrease Stress

## MARKETING TRENDS

### Geo targeting



Location-based engagement increases consumer interactivity

Implications - With the rise of geo-tagging and GPS-connected applications, location-aware marketing becomes increasingly targeted. Engaging consumers by creating a more personalized form of brand interaction, location-based sharing taps into the tech-savvy demographic's desire to connect with their surroundings digitally. This omnichannel approach to consumer engagement denotes an evolution in how brands are targeting younger demographics.



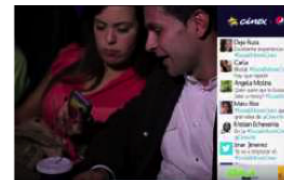
### Location-Based Movie Posters

Thinair and Panasonic Partner to Create Interactive Digital Poster



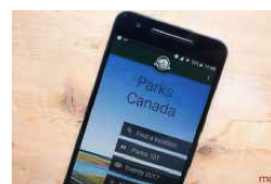
### Geo-Targeted Truck Billboards

The RoadAd Boards Change Content Depending On Trucks' Location



### Interactive Social Cinemas

Cinex Lets You Tweet Live on the Big Screen While Watching a Movie



### National Park Geofilters

The Parks Canada App Unlocks Hidden Filters at Various Locations

## Advertisement triggers



Street-level activations help brands connect with on-foot commuters

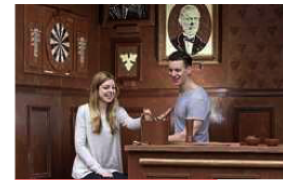
Implications - As brands have almost seamlessly intergrated themselves into the commute experience of drivers and those who use public transportation, many are launching campaigns that help them embed into the daily commute of those who walk to work. This progression speaks to the need to brands to adapt their advertising efforts to reflect the daily physical and digital spaces occupied by consumers.



**Secret Celebratory Burgers**  
A foodora Burger's Priest Pop-Up Hit Toronto, Montreal and Vancouver



**Sleep-Based Brand Activations**  
This Bold Event from Greggs Promotes Its New Flat White Coffee



**Chocolate-Built Pop-Up Bars**  
The Carlsberg Chocolate Bar Has Opened Its Doors in Shoreditch



**Emergency Soup Can Campaigns**  
Heinz is Helping Londoners Beat the Winter Blues with Free Soup



**Rock Wall Billboards**

**Friendship-Forming Bench Stunts**

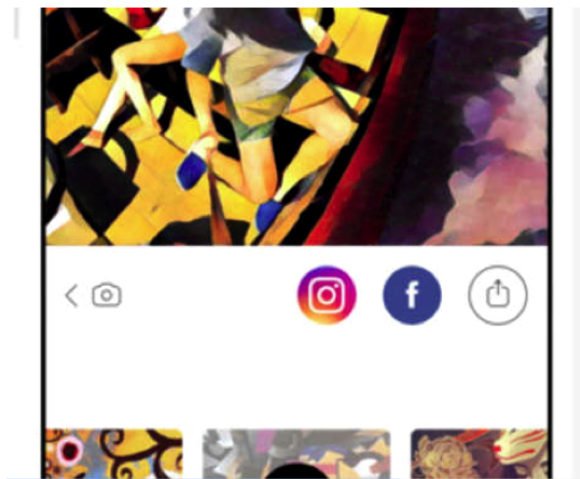
## TECHNOLOGICAL TRENDS

### Artificial intelligence



The world of design implements artificial intelligence

Implications - The intersection of technology and design is complex, as technology can be seen as a way to hinder creativity. The use of AI in this space finds a happy medium, democratizing creativity and enabling easier methods of self expression. This is especially important to today's aesthetic-obsessed consumer.



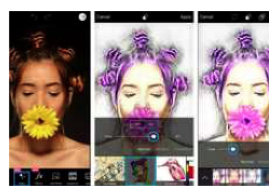
**Stylistic Photo Filter Apps**  
The Prisma App Transforms Selfies Into Veritable Works Of Art



**Photo-Edited Music Videos**  
Junk-E-Cat Has Produced a Prisma-Made Music Video



**AI-Based Reality Platforms**  
Baidu's 'Dusee' is a New Chinese AR Platform for Mobile Devices



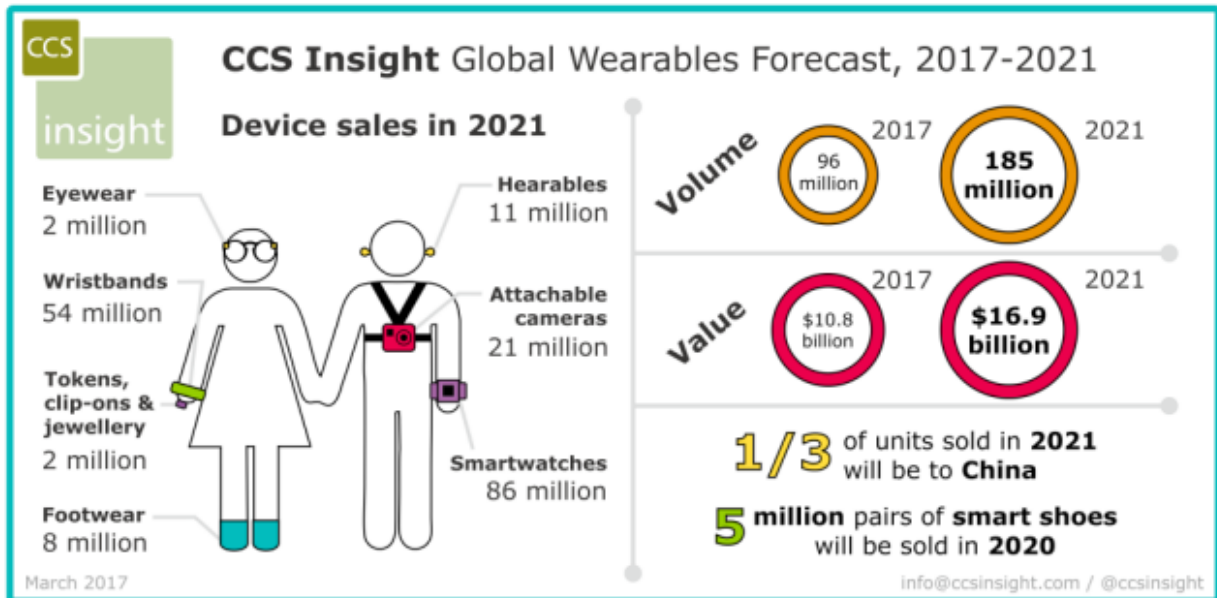
**Creative Photo Transformation Apps**  
PicsArt Turns Pictures and Videos into Magic Graphics



**Object-Recognition Imaging Softwares**  
The iOS 10 Photo Update Can Self-Identify Faces and Items

## Increase of (fitness)wearables

Fitness is the overwhelming driver for wearables today, there are a number of micro-segments emerging, ranging from kids' watches, to smart footwear, to new healthcare devices like wearable patches that will drive this market forward. In the upcoming years, the volume of these fitness wearables will only accelerate in growth. Examples like smartwatches, wristbands and attachable camera's will increase in volume te most.

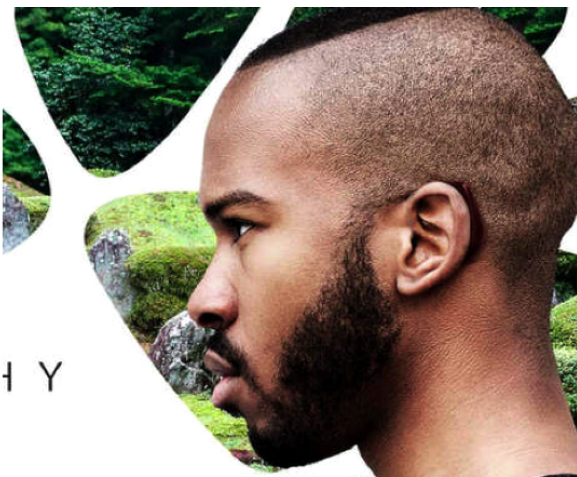


## Invisible technology



The oversaturation of technology creates a consumer desire for subtlety

Implications - In the early stages of the technology age, when the novelty of connectivity was still intact, consumers sought conspicuous devices as a status symbol. Now that technology is more prevalent than ever, it no longer carries a sense of novelty or status. This calls for more subtle, undetectable technology. Ultimately, technology is now omnipresent and connectivity is a consumer expectation, as opposed to a feature.



### Undetectable Wireless Earphones

The Third Skin 'Hy' Wireless Ear Headphones Offer 18-Hours of Use



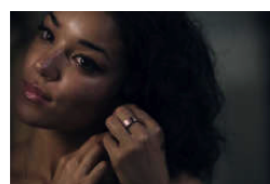
### Digital Cooking Tables

The New Concept Table from IKEA Will Suggest Recipes Based on Leftovers



### Bed Phone Chargers

Phone-Charging Furniture Like This Thrive Global Bed are Very Convenient



### Non-Obstructive Activity Trackers

CES 2017 Reveals the Sleek Yet Functional Motiv Ring



### Heart-Monitoring Bras

Bloomer Tech Created an Undergarment Integrated with Sensor Technology

## Minimalistic wearables



Wearable tech takes on a more streamlined approach for seamless integration

Implications - As wearable technology becomes more commonplace for everyday consumers, chunky wearables are seeing a sleeker exterior as consumers look for pieces that suit their aesthetics and lifestyle aspirations. Armed with the knowledge that the future of technology is becoming an extension of the human body, many brands are opting for thinner and more streamlined designs that can be almost forgotten by the wearer, opening them up to a world of connectivity without the bulk.



### Wearable Calendar Countdown Timepieces

The 'Piece of Time' Timepiece Concept is Minimal in Design



**Smart Meditative Headbands**  
'Elf mmmitt' is a Smart Wearable Device That Relieves Stress as Its Worn



**Discreet AR Wearables**  
This Innovative Ring Design Allows AR to Be Easily Integrated into Life



**Fashionable Event Wristbands**  
Wristbanditz Combines Style and Function in Its Event Wearables



**Biometric Connected Rings**  
The Token Ring Allows for a Host of Features Including Payments

## Technology trust



Increasingly humanized A.I. establishes widespread trust in technology

Implications - In today's culture of digital migrants raising digital natives, there is not only an increasing reliance on hyperconnectivity, but also a shift towards endearment and full acceptance of technological presence within the roles of caretakers and safety providers. As artificial intelligence becomes increasingly humanized, we begin to recognize a spreading of unquestionable trust in technology as part of the home and even as part of the family.



### Child-Tracking Wearables

The Joey Tag is a Wearable GPS Unit to Keep Children Safe



**Autonomous Beach Lifeguards**  
The Amphibious Joint Lifeguard UAV Helps Provide Aid to Those in Need



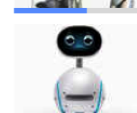
**Reactionary Robotic Pets**  
The Hasbro 'Joy for All' Robot Cat is Designed for Elderly Owners



**Stroller-Rocking Devices**  
The 'NoomiNoomi' Baby Rocking Device Aids Parents in Soothing Infants



**Autonomous Robotic Babysitters**



**Home Robot Assistants**

## Second skin wearable

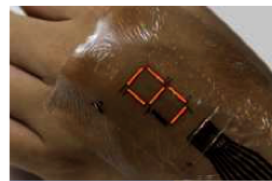


Wearable technology merges with the human body unintrusively

Implications - With the need for constant connectivity inescapable in the modern consumer's lifestyle, wearable technology is becoming more adaptive to the human body through flexible adhesives that can be touched, scanned and tracked for an intuitive experience that is quickly becoming second-nature. As we move towards a future where technology becomes physically integrated into the human body, hesitant consumers are more likely to test out patch wearables that adhere to the skin for a more connected experience before committing to cyborg-style sub-dermal implants.



**Wearable Smart Stamps**  
The Wearable Interactive Stamp Platform Offers Numerous Applications



**Wearable Electronic Sensors**  
The E-Skin Sensors Can Be Fixed to the Skin Like Temporary Tattoos



**UV-Tracking Skin Patches**  
L'Oreal Reveals its Tech-Savvy 'My UV' Skin Patch at CES 2016



**Touchscreen Temporary Tattoos**  
DuoSkin Tattoos Look Like Gold Leaf and Function as Touchscreens

## Self-memeing



The humor of Internet culture becomes customizable to boost shareability

Implications - Memes and gifs are the focal point of humor within Internet culture. What makes them so appealing to the digital consumer, however, is what makes them so difficult for brands to channel: their authenticity. This authenticity is achieved through extreme relatability and a laissez-faire approach to production; both factors are furthered with services that allow consumers to create or curate their own self-referencing content.



**Selfie GIF Creators**  
The Giphy Says App Instantly Turns Your Voice and Face into a GIF



**Musical Selfie Applications**  
'Face Melody' Turns Selfies into Music Based on Facial Features



**Video Meme Creators**  
Startup HashCut Lets You Make Your Own Video Memes From YouTube Videos



**Video Meme GIF Converters**  
'GIPHY Loves Vine' Creates and Saves Vine GIFs

# Gamification

Gamification is a topic, which has been considered one of the significant new trends in the development of services and applications in the software industry. Fundamentally, gamification means that some system applies game-like elements to enhance the user participation, the motivation to keep using the said system or the retention rate to keep the existing customers. (X Publication trends in gamification)



# F

## QUESTIONNAIRES POTENTIAL USERS

Hi,

Tof dat je me wilt helpen d.m.v. het invullen van deze korte vragenlijst!

Deze vragenlijst is bedoeld om een globale indruk te krijgen van wat voor games je speelt en hoeveel je beweegt.

De resultaten van deze vragenlijst zal ik gebruiken in mijn afstudeerproject aan de TU Delft voor de faculteit Industrieel Ontwerpen en de vragen zijn geheel anoniem in te vullen.

Mocht je nog vragen hebben over mijn project of geïnteresseerd zijn in de resultaten, stuur dan even een mailtje naar [jellemeerman@gmail.com](mailto:jellemeerman@gmail.com).

Alvast super bedankt!

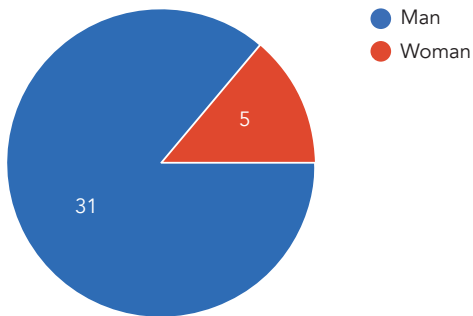
Hieronder nog wat korte aanwijzingen die horen bij enkele vragen.

- Met een game bedoelen we hier een spel dat je speelt met behulp van een scherm. Denk bijvoorbeeld aan een computer, smartphone, Playstation, etc.

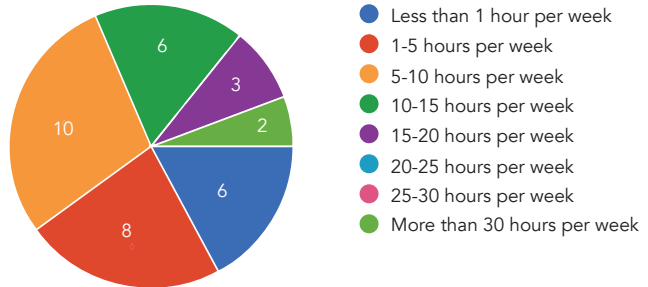
- Met bewegen bedoelen we hier een middelmatige fysieke inspanning zoals: hardlopen, zwemmen, fietsen, dansen, fitness etc.

### RESULTS

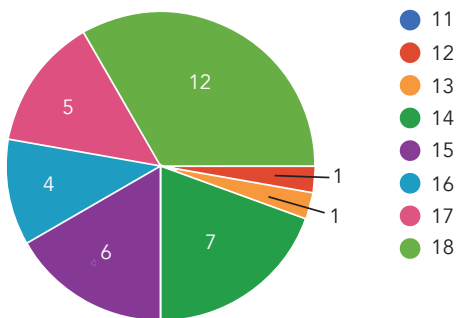
What is your gender?



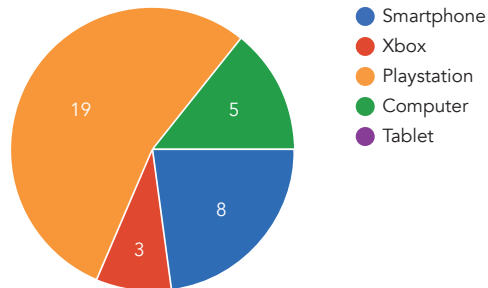
How much time per week do you (on average) spend on playing a game?



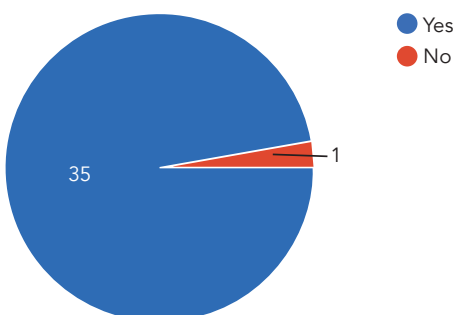
What is your age?



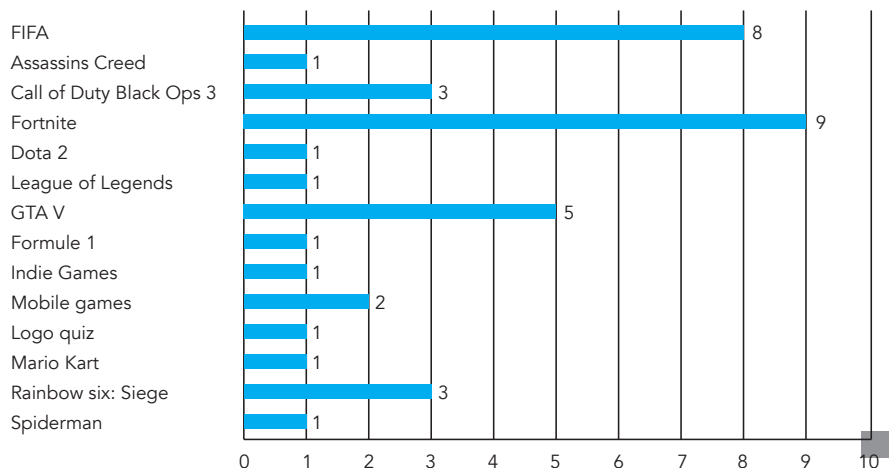
What platform do you preferably use for playing a game?



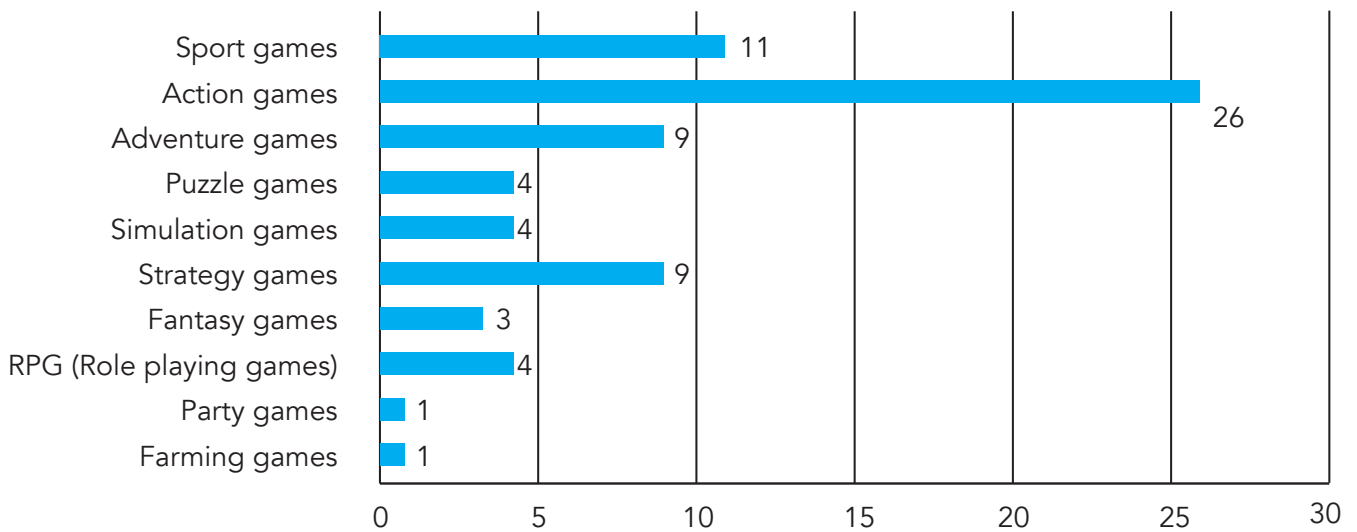
Do you play a game?



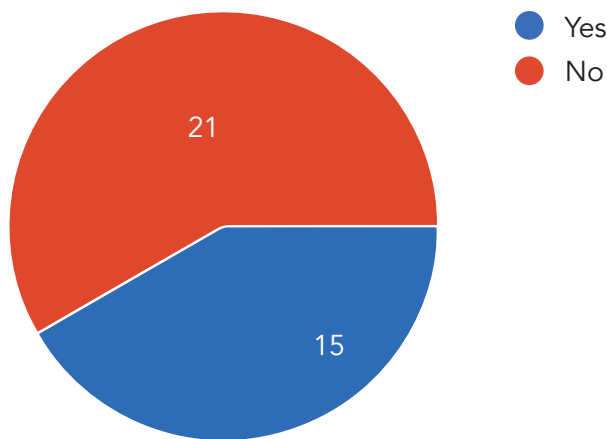
What games do you find the most fun to play?



### What game-genre do you like the most?



### Do you think you spend too much time in front of a screen?

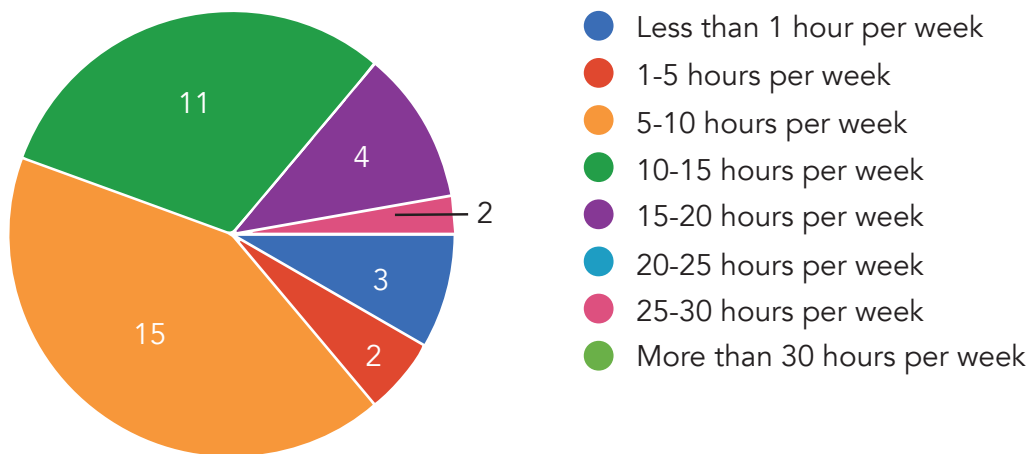


### Can you explain your answer?

- Ik maak muziek dus ik zit naast het gamen veel op een scherm . Daarnaast wordt er ook op school word er veel met computers gewerkt (2)
- Ik game bijna nooit alleen als ik bij vrienden ben (2)
- Niet in het kader van gamen maar meer voor muziek productie
- Gewoon vind ik zo
- Ik doe genoeg andere dingen en andere mensen storen zich niet aan mij
- Omdat ik ook nog veel buiten kom en genoeg tijd aan school besteed
- Niet overdreven veel
- Omdat ik meer focus op school
- Gemiddeld
- Nee want ik sport 6 uur per dag
- Ik zit wel veel achter een scherm, maar dit lijdt niet onder mijn schoolprestaties. Bovendien sport ik ook genoeg.
- Ik zit er eigenlijk best veel op als ik erover nadenk
- Game alleen in het weekend want doordeweeks het ik het te druk.
- Naast de schermtijd ben ik veel buiten en sport ik.
- Ik compenseer met sport etc

- Ik kan er mee stoppen als ik wil
- Zit alleen achter me telefoon als ik echt niks te doen heb en anders niet omdat de tijd die ik aan gamen besteed ik bijvoorbeeld ook aan school kon besteden
- Te veel op mobiel
- Ik sport of lees veel meer dan dat ik game.
- Ik besteed weinig aandacht aan belangrijkere dingen, bvb huiswerk.
- Ik ga ook veel naar buiten maar ik zit wel vaak binnen te gamen omdat al mijn vrienden ook binnen zitten te gamen en dan kan ik met niemand naar buiten
- Soms zit ik super lang netflix te kijke
- Schijnt slecht te zijn voor je ogen
- Want ik ben niet verslaafd
- Gwn ik ben een beetje verslaafd
- Af en toe kijk ik best veel afleveringen van een serie bijvoorbeeld
- Valt mee vergeleken met andere
- Soms, maar dan produceer ik muziek
- Ik sport ook 4x per week
- omdat ik wel wat vaker naar buiten moet. dat vind ik best lastig.
- Ik kan me ook prima vermaken met een potje voetbal, fietstocht, praatjes, etc
- Ik heb genoeg tijd voor school en sport en ik speel altijd met vrienden dus het is niet dat ik mij sociaal isoleer

**How much time per week do you (on average) spend on moderate intensity motion?**



**Can you explain your answer.**

- Voetbal (8)
- Fitnessen, dat is gezellig met je vrienden en het is goed voor je lichaam (6)
- Atletiek (7)
- Ik sport niet
- Fietsen (2)
- Teamsporten
- Dansen
- Volleybal, gezellig met een team
- Hockeyen goeie teamsport veel strategie ook
- Wandelen, zeer rustgevend.
- Trampoline springen
- Dansen daar hou ik van
- Een sport met wat vrienden, bijv voetbal of basketbal, maar ook fietsen vind ik heerlijk
- Hockey, ik vind teamsport leuk
- Ik vind het het leukst om een circuit te doen. Dit kan van alles zijn; conditie, kracht, explosiviteit... Ik vind dit leuk omdat je constant (elke halve minuut/minuut) iets anders doet en je naar een groter doel werkt: het circuit afronden.
- Rennen, fietsen en schaatsen

# G

## MOTION ANALYSIS

### FIFA motion analysis



### In-game movements broken down to core features

**BALL SKILLS** < Limbiness  
Ball control < Balance  
Dribbling

**PASSING**  
Crossing  
Short pass  
Long pass

**SHOOTING** < Strength  
Heading < Balance  
Shot power  
Finishing  
Long shots  
Curve  
Fk. accuracy

**PHYSICAL**  
Jumping < Strength  
Stamina < Balance  
Strength < Strength  
Balance < Strength  
Sprint speed  
Agility < Limbiness  
Acceleration < Balance

**DEFENCE**  
Marking  
Slide tackle  
Stand tackle

**MENTAL**  
Agression  
Reactions  
Att. position  
Interceptions  
Vision  
Composure

**GOAL KEEPER**  
GK Positioning  
DK Diving  
GK Handling  
GK Kicking  
GK Reflex

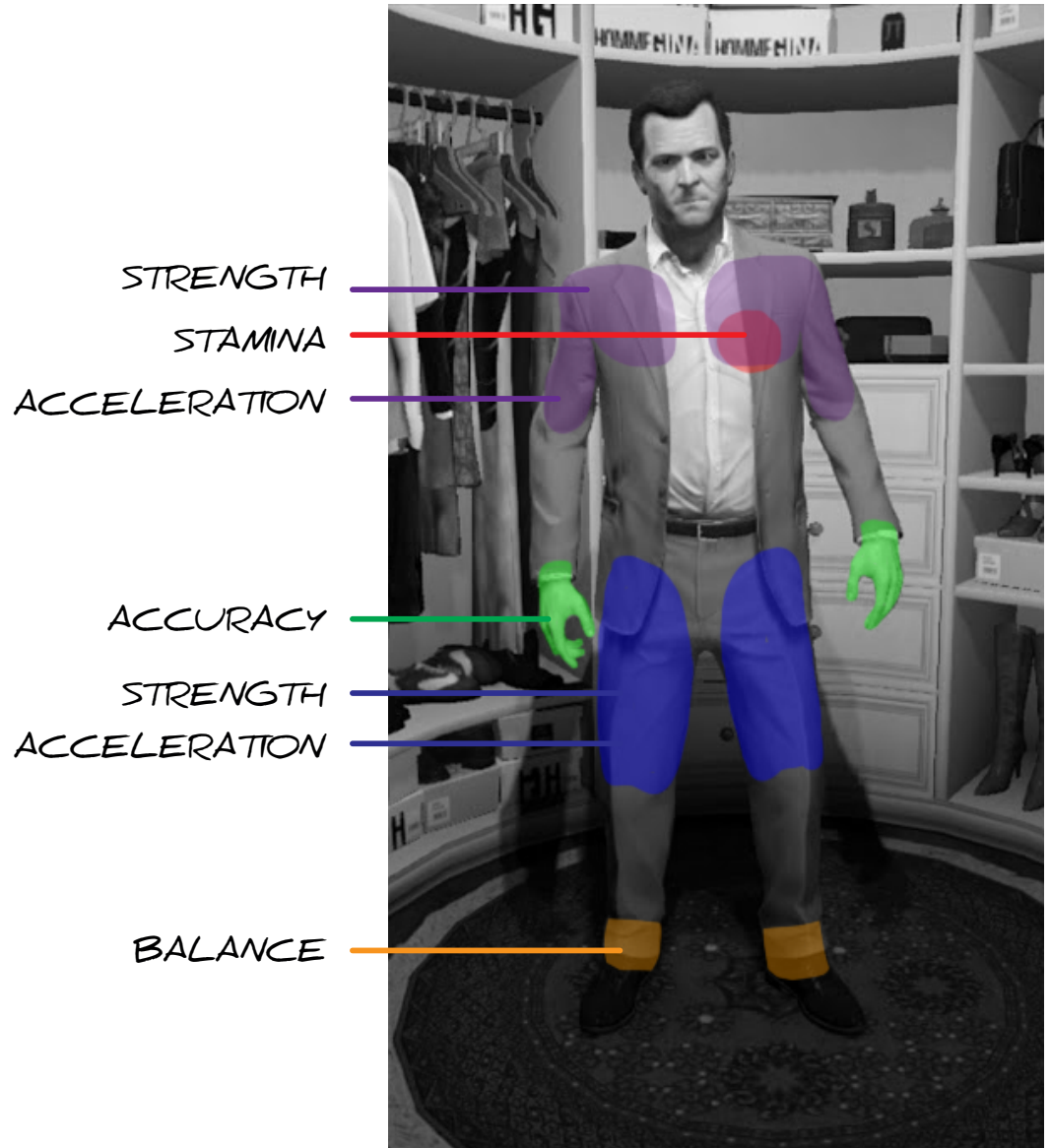
## FORTNITE motion analysis



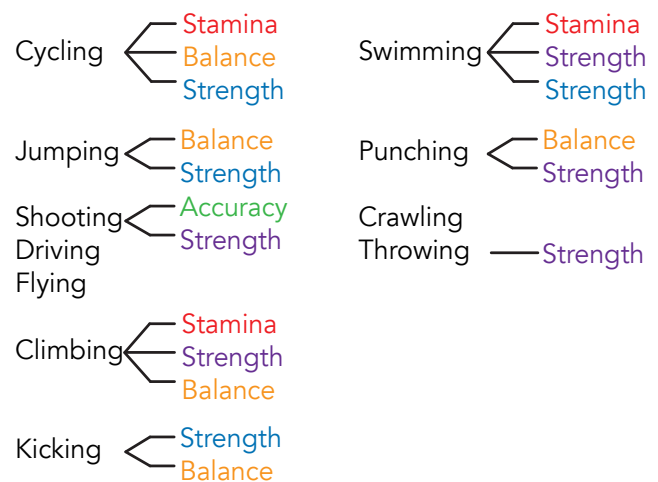
## In-game movements broken down to core features

- Running
  - Stamina
  - Acceleration
  - Strength
- Jumping
  - Balance
  - Strength
- Shooting
  - Accuracy
- Building
  - Strength
- Harvesting
  - Strength
- Dancing
  - Strength
  - Strength
  - Balance
- Defence
  - Strength
  - Acceleration

## GTA motion analysis



## In-game movements broken down to core features


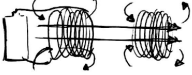
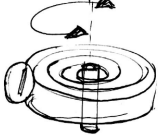
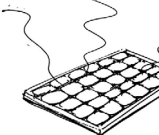
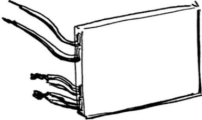

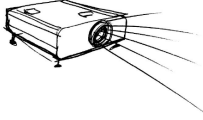

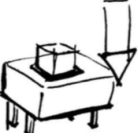


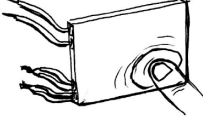

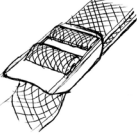


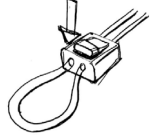
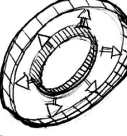




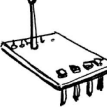
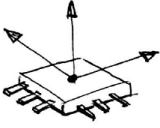







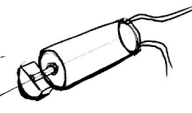


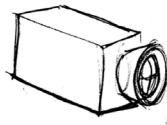
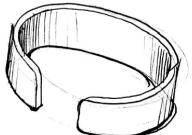
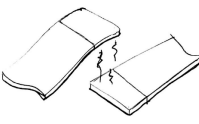
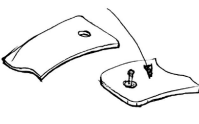


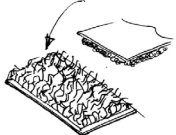


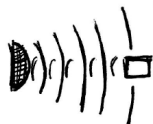
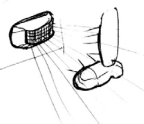



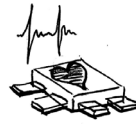
# H MORPHOLOGICAL MAP

PRO

PARTIAL PROBLEMS

	1	2	3	4	5
Processing: Energy supply	 (RECHARGABLE) BATTERY	 ELECTROMAGNETIC CHARGING	 ENERGY GENERATED BY MOTION	 ENERGY STORAGE SPRING	 SOLAR PANEL
Output: Communication	 ELECTRONICAL PULSE	 LCD/OLED SCREEN	 LED	 PROJECTOR	 SPEAKER
Input: Communication	 BUTTON	 MICROPHONE	 TEMPERATURE SENSOR	 TOUCH SCREEN	 TOUCH SENSOR
Connection to body	 BAND STRAP	 BOA CLOSING WHEEL	 CLOTHING	 ELASTIC SQUEEZE CLIP	 FLEXIBLE STRAP
Output: Connectivity	 BLUETOOTH	 INFRARED	 ULTRA WIDE BAND	 WiFi	 ZIGBEE
Input: Movement	 ACCELEROMETER	 GPS LOCATION	 GYROSCOPE SENSOR	 IMAGE RECOGNITION	 MAGNETIC SENSOR

# PROBLEM SOLUTIONS

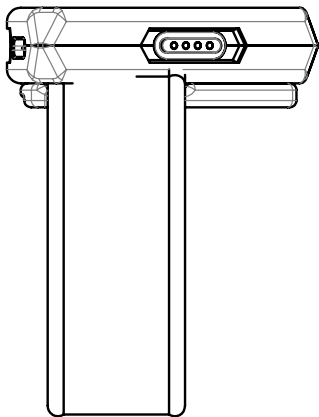
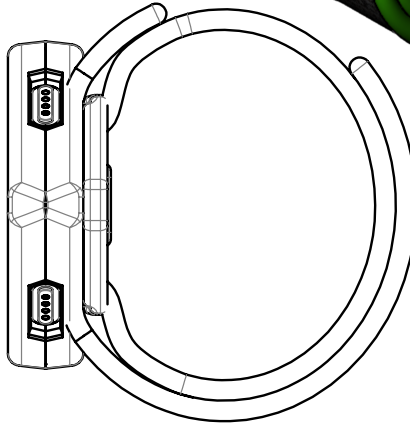
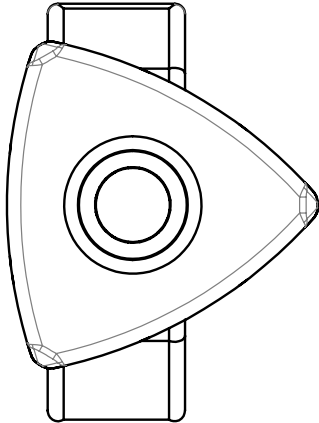
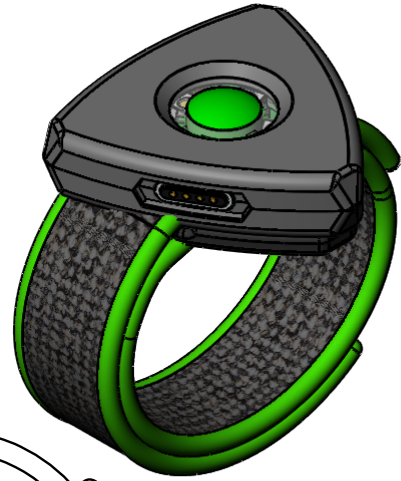
	6	7	8	9	10	11
 THERMOELECTRIC GENERATION						
 VIBRATION MOTOR	 FAN					
 WATER DETECTION SENSOR	 CAMERA					
 FORM CLAMP	 MAGNETIC CONNECTION	 PIN-HOLE CONNECTION	 SQUEEZE CLIP	 TEMPORARY TATTOO	 VELCRO	
 WIRED	 NFC/RFD	 ULTRASONIC				
 MOTION SENSOR	 PEDOMETER	 RADAR	 THERMAL CAMERA	 HEART RATE SENSOR		

# BUSINESS MODEL CANVAS

<p><b>Key Partners</b></p> <p>Possible potential partnership with different type of both gaming-developers, console-manufacturers and health insurances</p> <ul style="list-style-type: none"> <li>- Playstation</li> <li>- Xbox</li> <li>- Nintendo</li> <li>- Microsoft etc.</li> <li>- Guerilla games</li> <li>- Rockstar games</li> <li>- Epic games etc.</li> <li>- Achmea</li> <li>- VGZ</li> <li>- CZ etc.</li> </ul>	<p><b>Key Activities</b></p> <ul style="list-style-type: none"> <li>- Looking out for new partnerships with other game-developers or console manufacturers. By integrating as many games as possible, more users will come and therefore revenue streams will grow.</li> <li>- Developing new peripherals for new in game experiences.</li> </ul>	<p><b>Value Propositions</b></p> <p>The ability to let the user be more physically active by extrinsic stimulation of their favorite game. These values are combined into a day-to-day product-service combination</p>	<p><b>Customer Relationships</b></p> <p>The customers will enhance their online game experience, healthiness and become part of an community, which make them want to keep using the product.</p>	<p><b>Customer Segments</b></p> <p>Adolescents (or parents) in the age of 12-17 years old.</p> <ul style="list-style-type: none"> <li>- The target group does, in general, not comply to the Nederlandse Norm Gezond Bewegen, average of 1 hour moderate intensity physical activity for a minimum of 2 days a week.</li> </ul>
<p><b>Key Resources</b></p> <p>Algorithm to detect specific type of movements and connect to the app on the smartphone.</p>	<p><b>Channels</b></p> <p>Customers can buy the product at several physical stores, like Mediamarkt. At experience centres around the country, the sensor suits can be tried out and new products will be exposed.</p>	<p><b>Revenue Streams</b></p> <p><b>Financial revenue</b></p> <ul style="list-style-type: none"> <li>- Sales of the Sensor suit.</li> <li>- Possibility of subscription fees for several games.</li> <li>- Sales of new peripherals to enhance other types of motion for experience</li> </ul> <p><b>Social/emotional revenue</b></p> <ul style="list-style-type: none"> <li>- Improvement of users' health well-being</li> <li>- Improvement of users' emotional well-being</li> </ul>	<p><b>Cost Structure</b></p> <p><b>Product-level</b></p> <ul style="list-style-type: none"> <li>- Development of the algorithm, to registrate the specific movements</li> <li>- Developing electrical system for sensors</li> <li>- Developing housing for components</li> <li>- Developing new peripherals</li> </ul> <p><b>Company-level</b></p> <ul style="list-style-type: none"> <li>- Negotiating with key partners</li> <li>- Assembling costs</li> </ul>	

# J

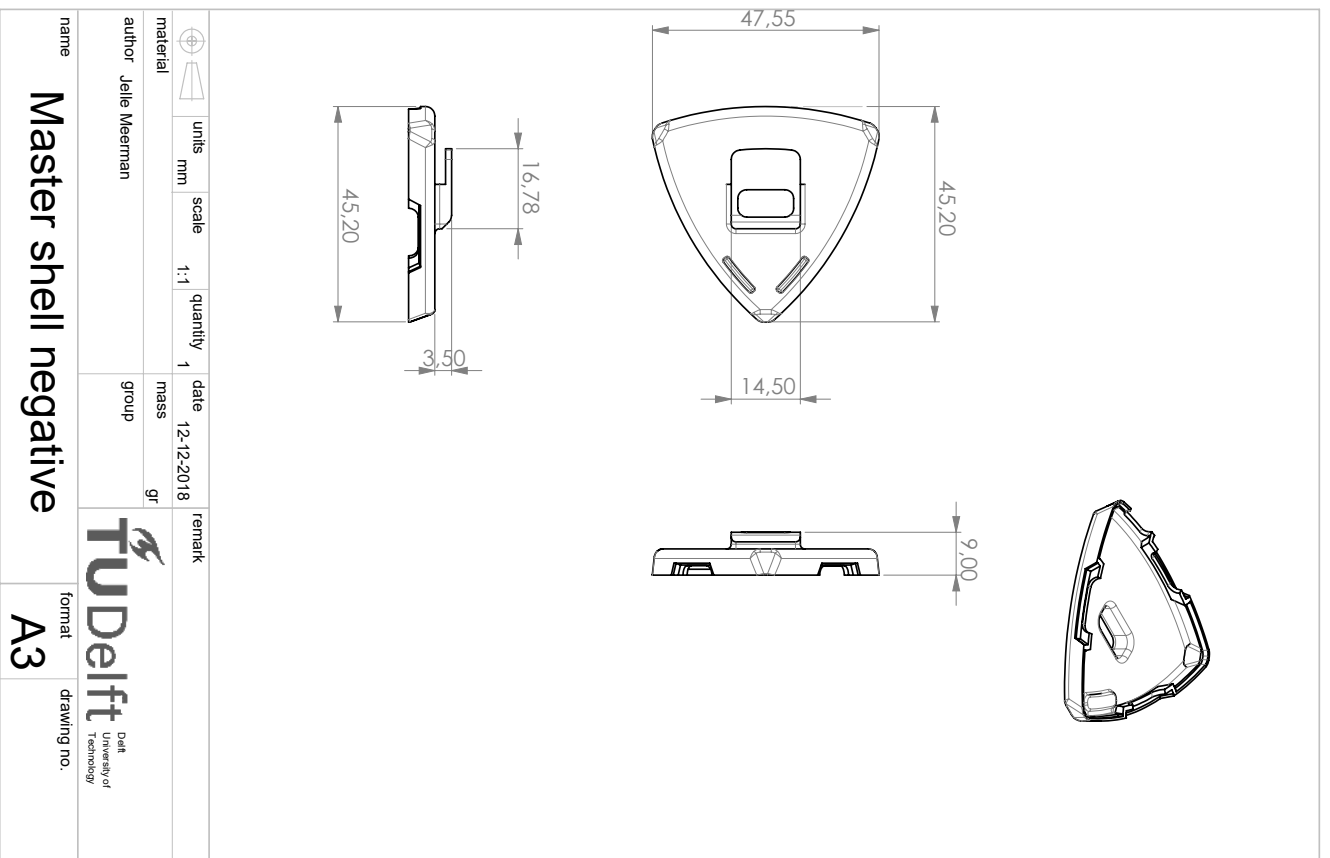
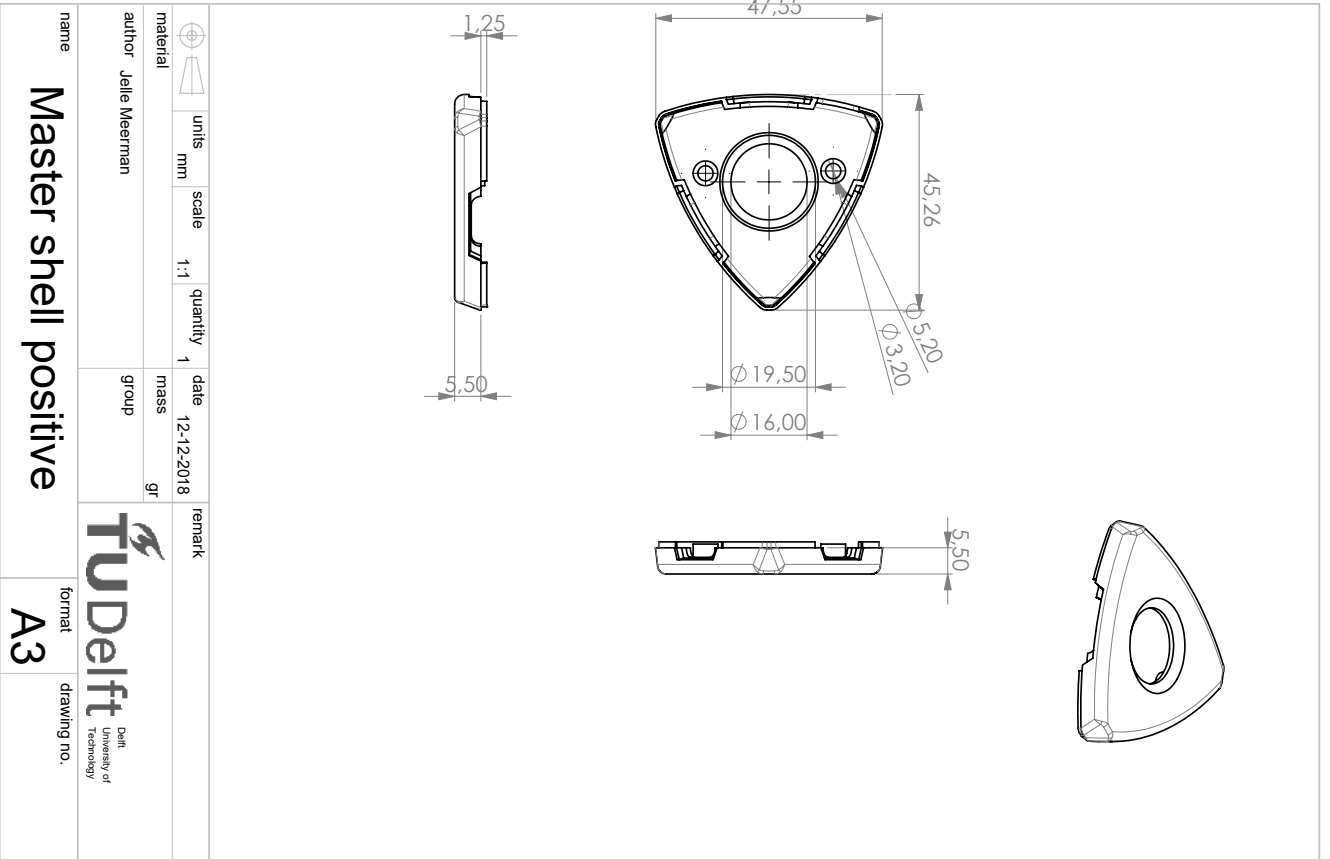
## TECHNICAL DRAWINGS

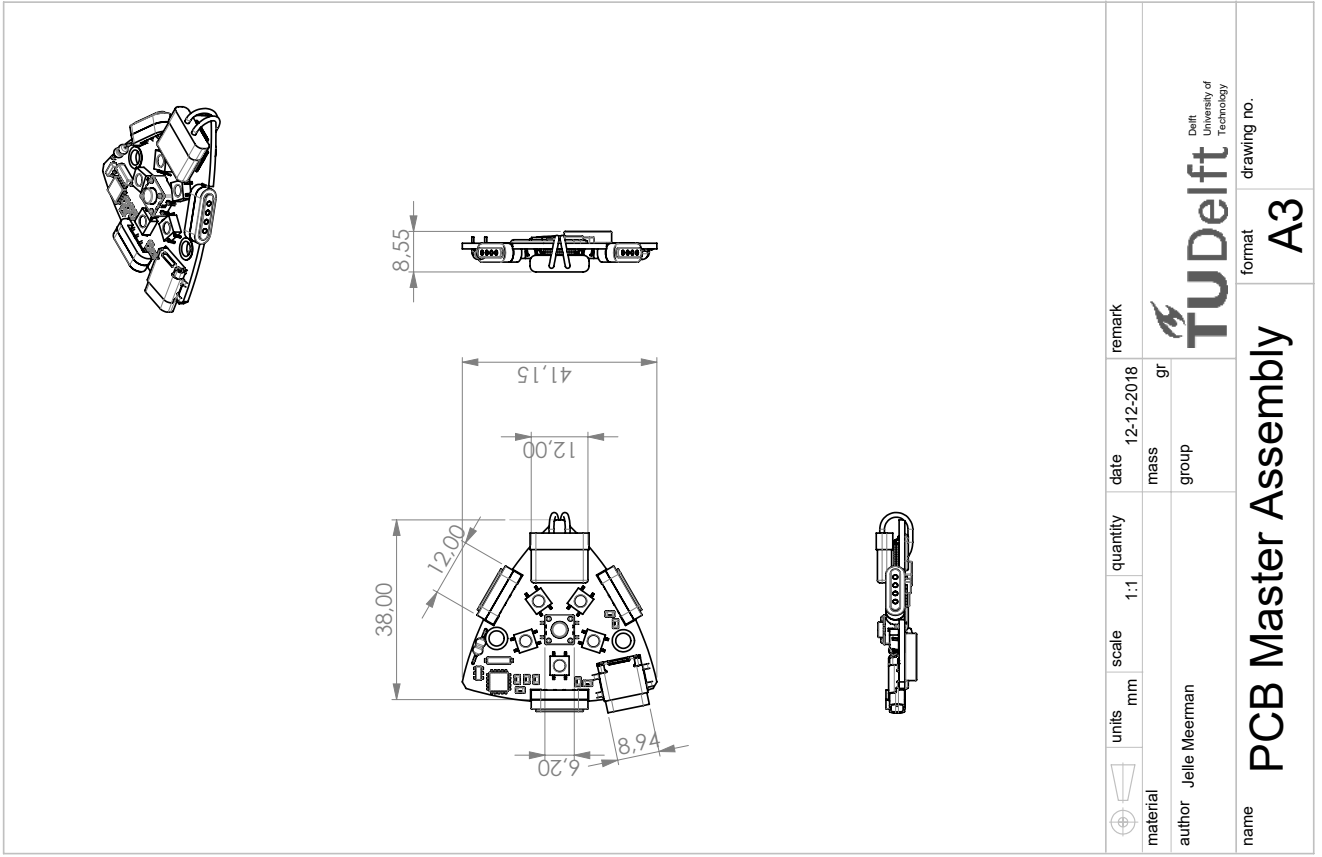


ITEM NO.	PART NUMBER	QTY.
1	Master shell negative	1
2	Master shell positive	1
3	PCB Master Assembly	1
4	Diffuse ring	1
5	Plastic button	1
6	Heartbeat sensor	1
7	Strap connection	1
8	M2 thread insert	2
9	Band Master	1

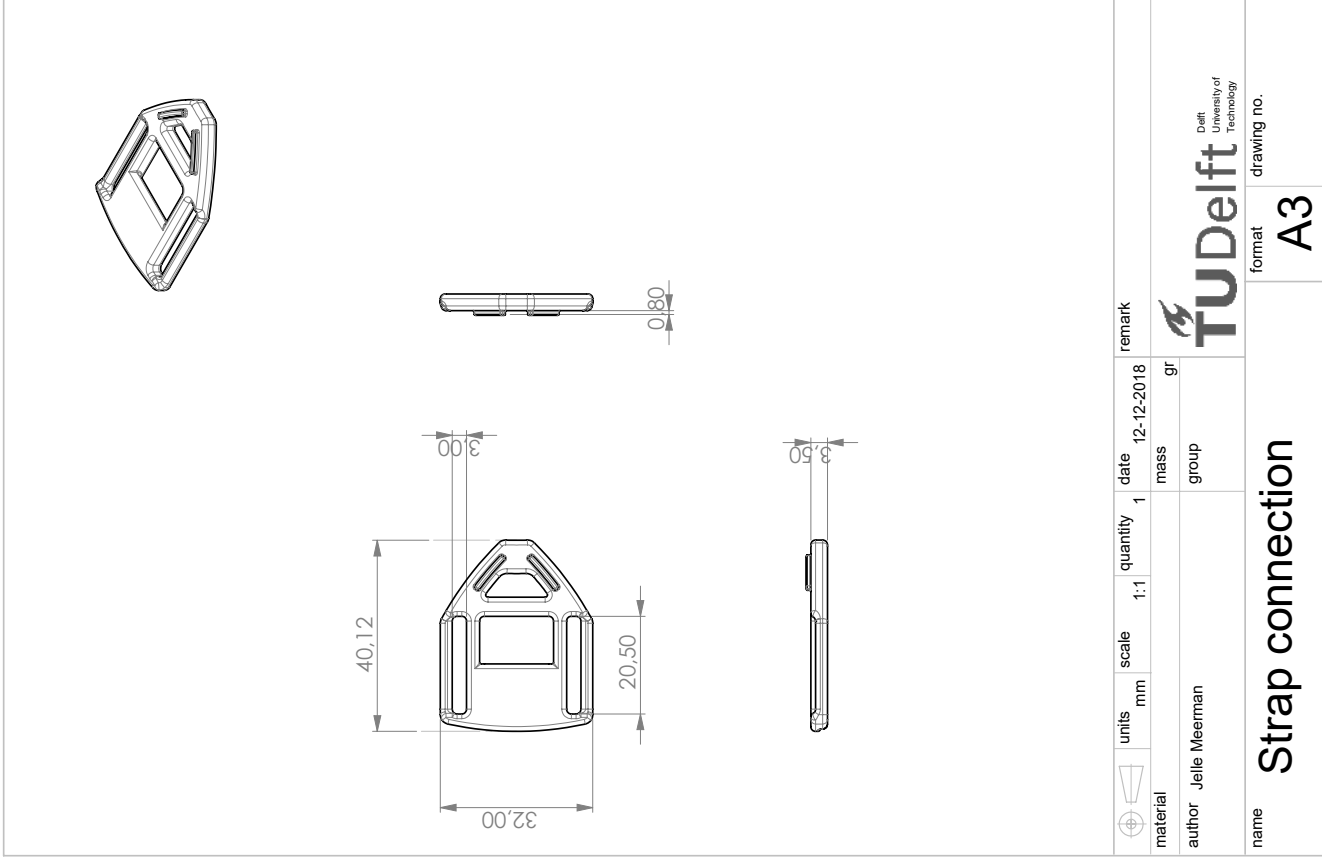
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author Jelle Meerman		group		
name <b>Master device</b>		format <b>A3</b>	drawing no. <b>1</b>	



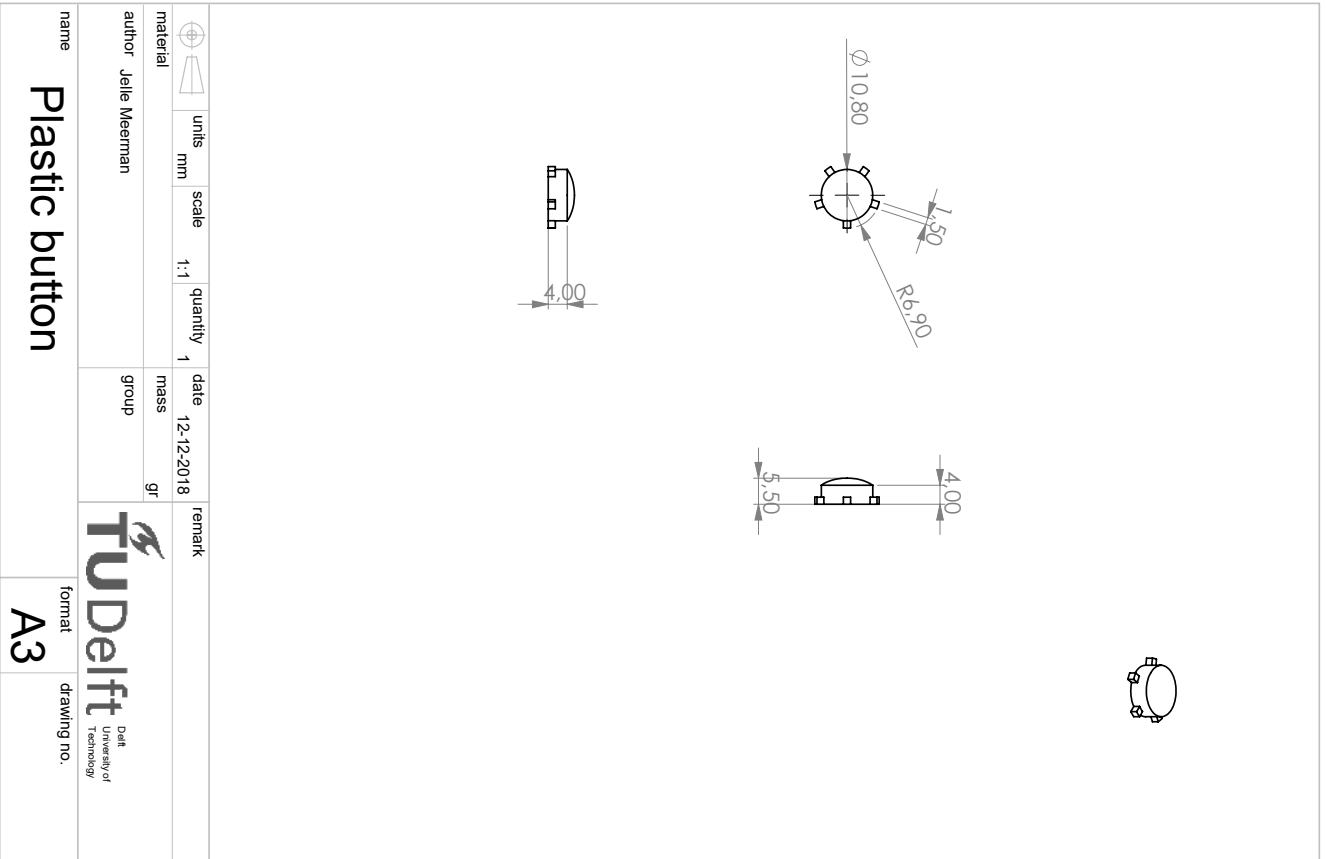




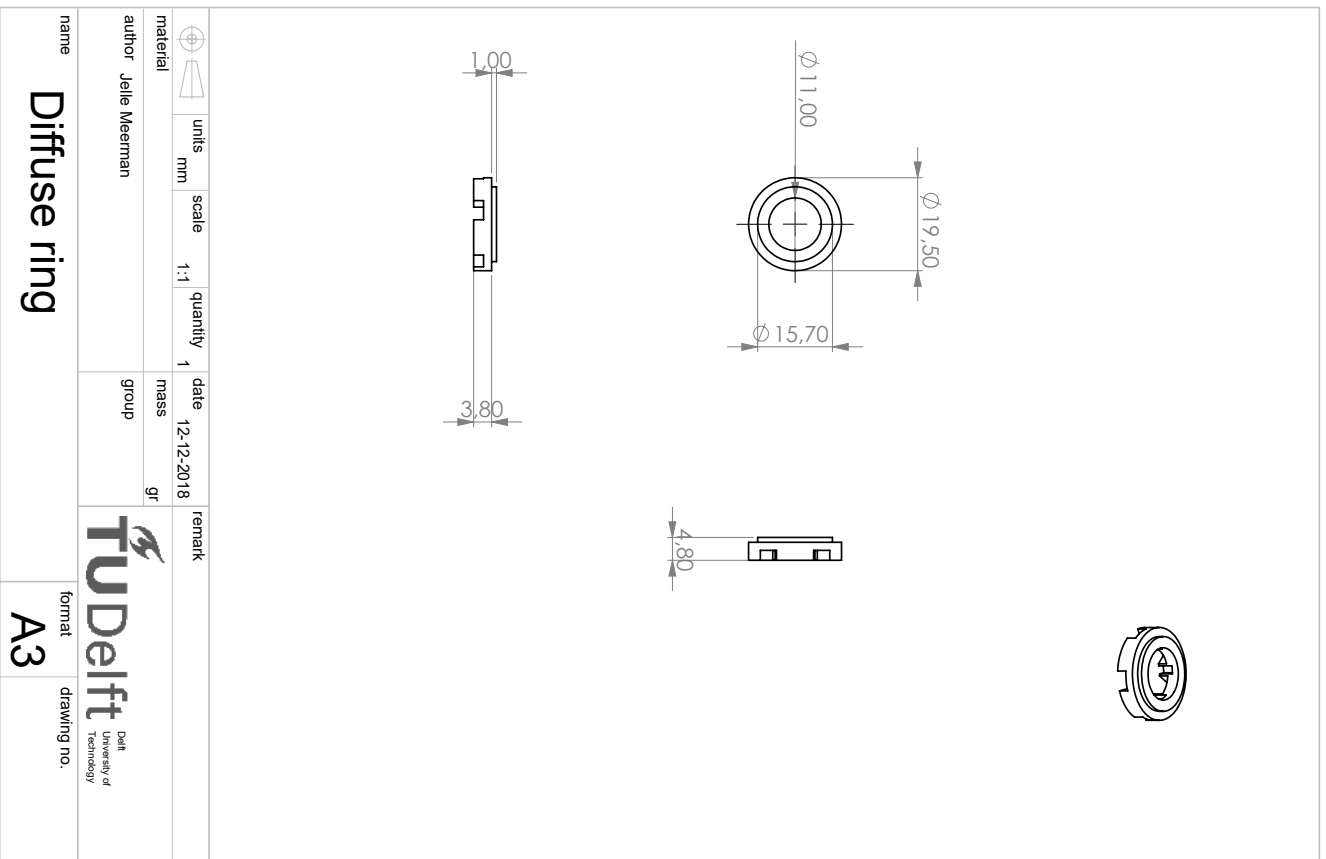
SOLIDWORKS Educational Product. For Instructional Use Only.



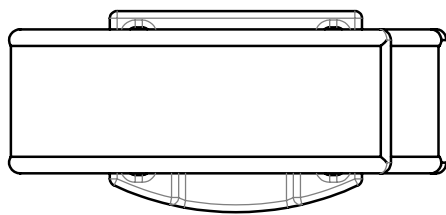
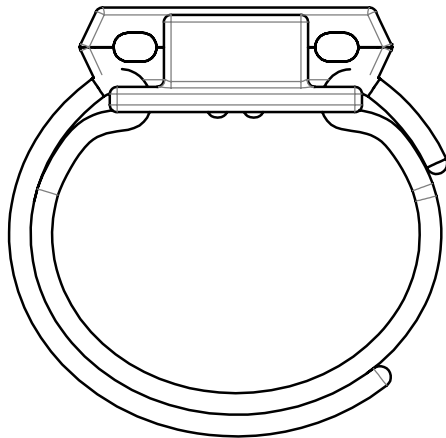
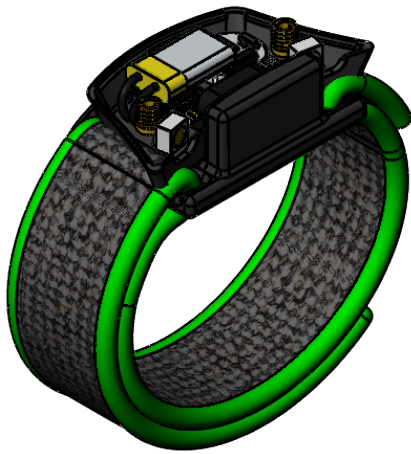
SOLIDWORKS Educational Product. For Instructional Use Only.



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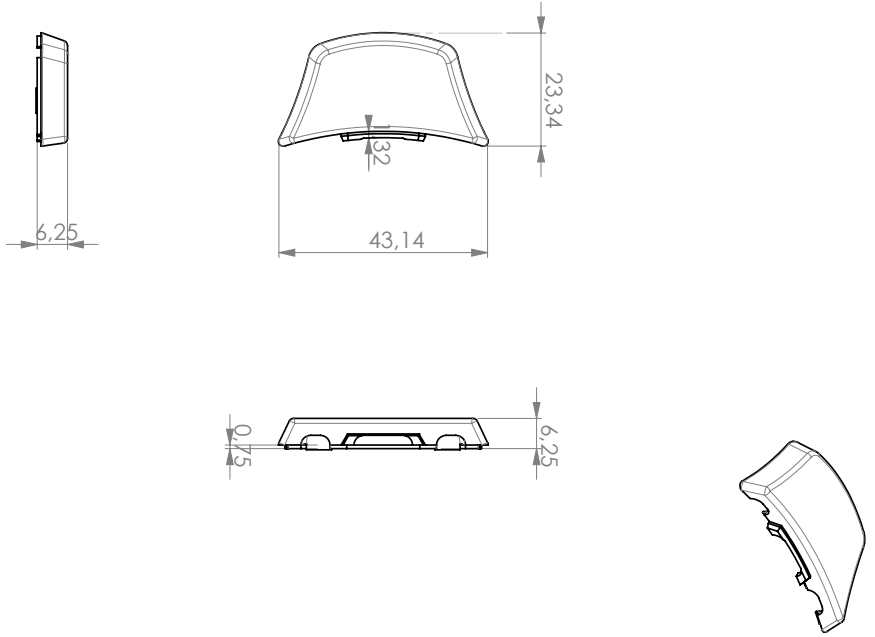
SOLIDWORKS Educational Product. For Instructional Use Only.




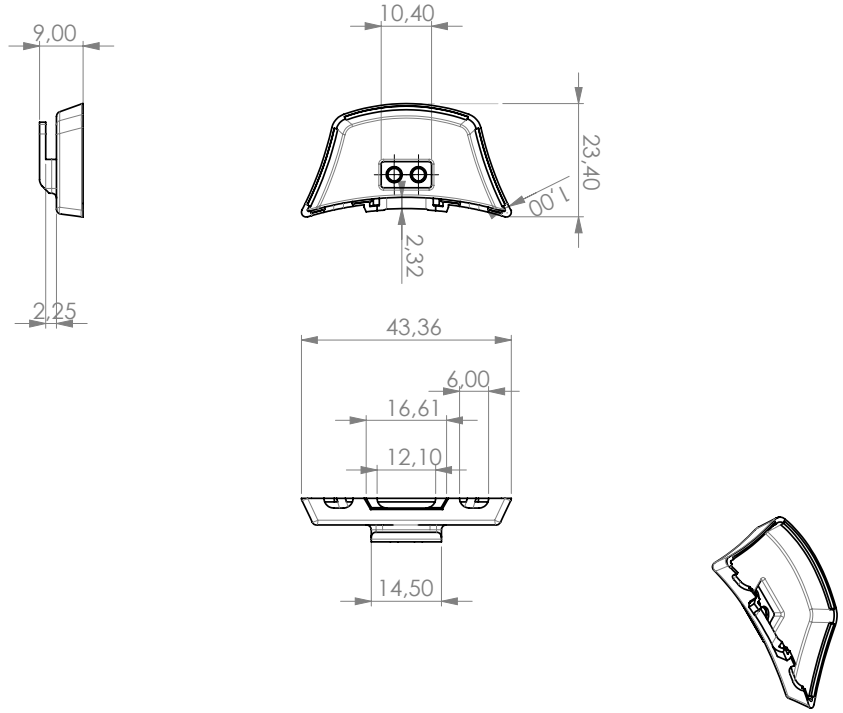
ITEM NO.	PART NUMBER	QTY.
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2	Slave shell positive	1
3	PCB Slave	1
4	Light diffuser	1
5	Light diffuser 2	1
6	Magnetic charger female	1
7	Accelerometer +Gyroscope	1
8	LED single housing	2
9	LED single light	2
10	STM32F103C8T6	1
11	Battery Slave NEW	1
12	Capacitor_Package_0805_SMD	2
13	Capacitor_Package_0805_GREY	3
14	Capacitor_Package_0805_BLACK	1
15	Resistor	1
16	Vibration motor SLAVE	1
17	M2 thread insert	2
18	Proximity sensor	1
19	Strap connection Slave	1
20	Band Slave	1

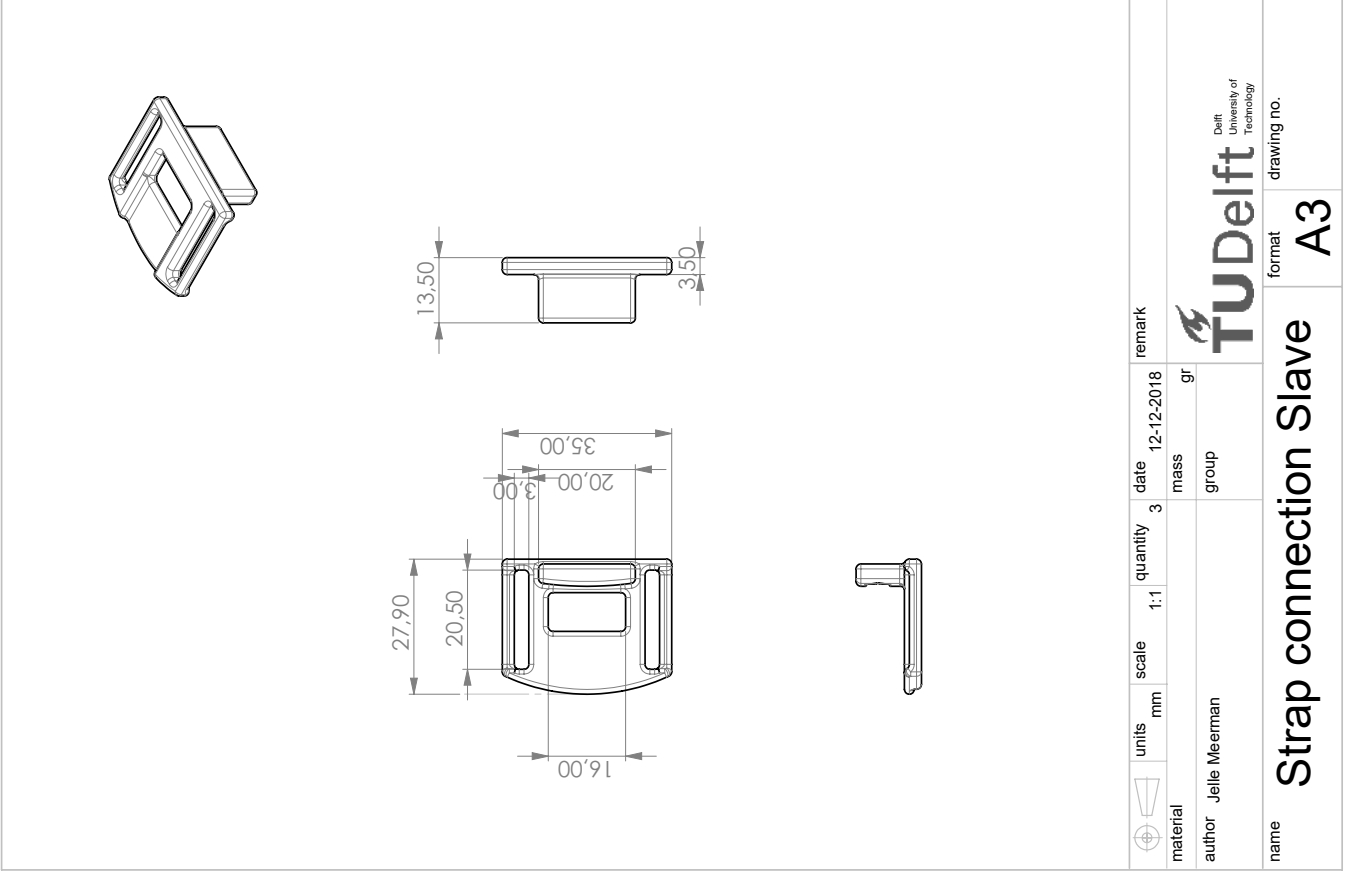
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author Jelle Meerman			group		
name <b>Slave device</b>				format <b>A3</b>	drawing no.
H:\Desktop\Solidworks\Drawings\					

	units	scale	quantity	date	remark
	mm	1:1	3	12-12-2018	
material	author	mass	group		
	Jelle Meerman	gr			
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			format	drawing no.	
			A3		

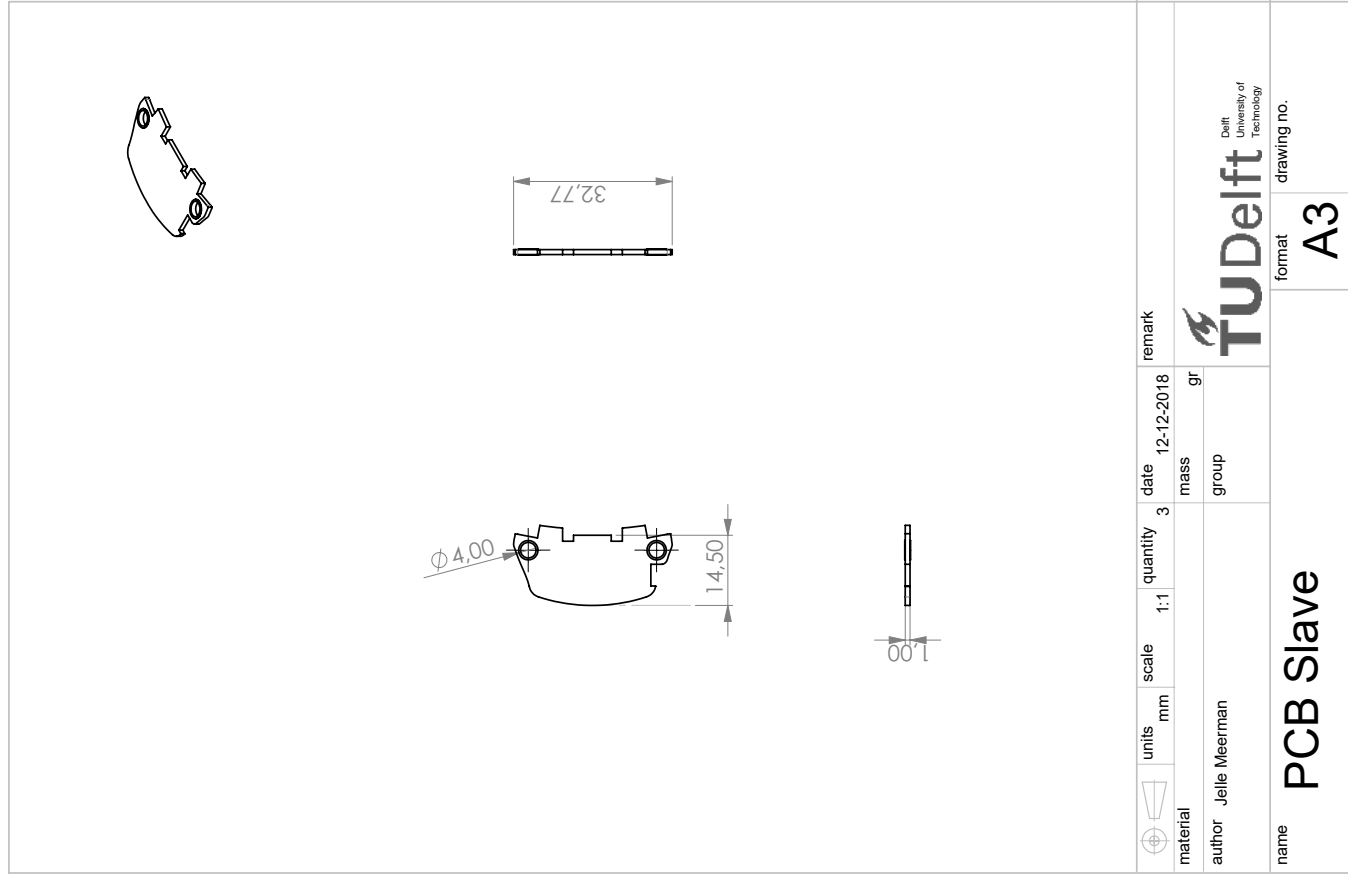


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			format	drawing no.	
			A3		





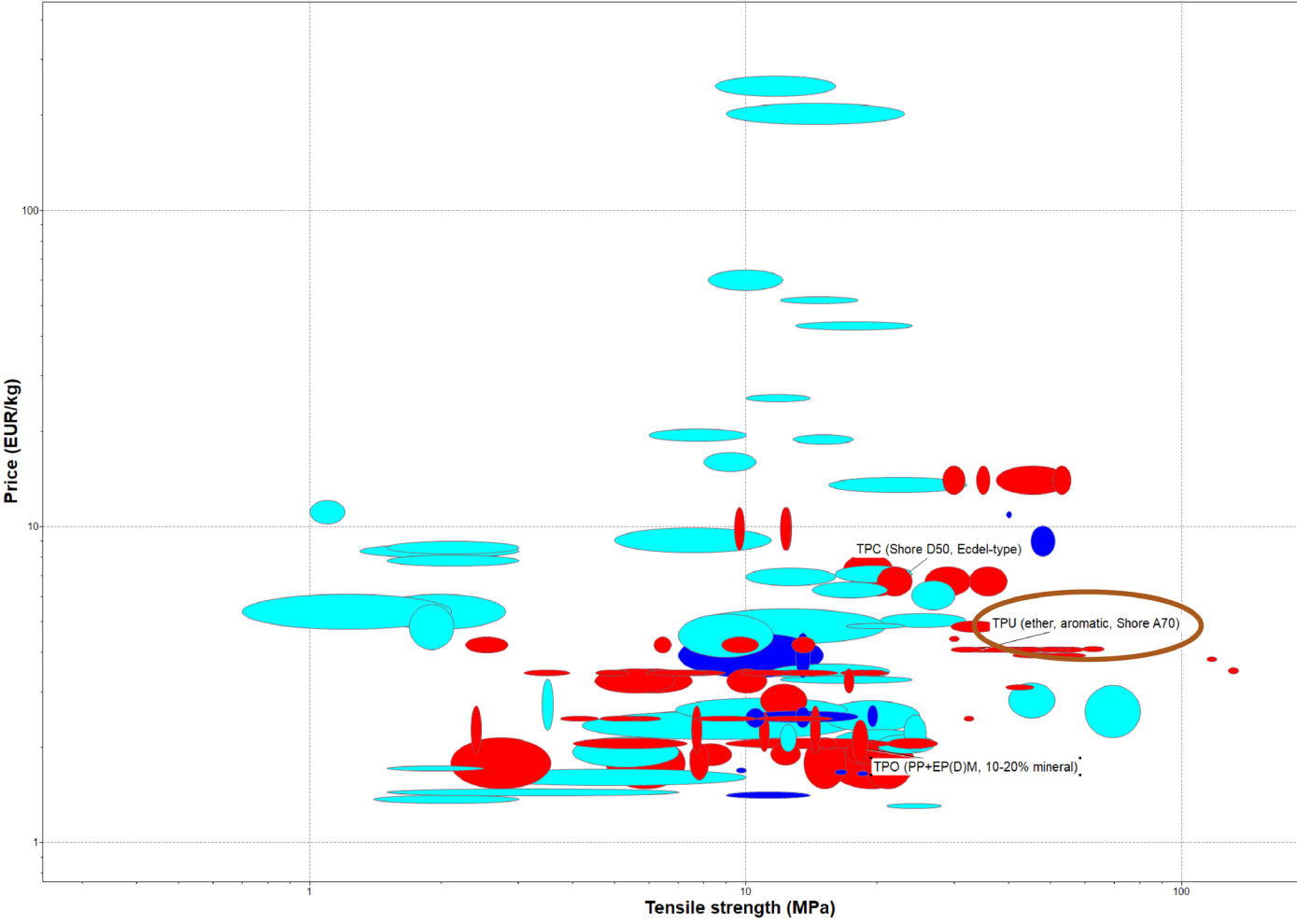
SOLIDWORKS Educational Product. For Instructional Use Only.



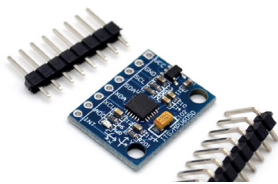
SOLIDWORKS Educational Product. For Instructional Use Only.



# Elastomers: Price vs. Tensile strength



# L PRICING LIST COMPONENTS



## Accelerometer + gyroscope \$0,86

Retrieved from: [https://www.aliexpress.com/item/MPU-6050-module-triaxial-accelerometer-gyroscope-6DOF-module-have-codes-schematics-GY-521/32401358878.html?spm=2114.search0104.3.2.17cc11dfk8oA8P&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_exp\\_id=2accdd2-80fe-4550-be4f-eaebfeb9c9ab-0&algo\\_pvid=2accdd2-80fe-4550-be4f-eaebfeb9c9ab](https://www.aliexpress.com/item/MPU-6050-module-triaxial-accelerometer-gyroscope-6DOF-module-have-codes-schematics-GY-521/32401358878.html?spm=2114.search0104.3.2.17cc11dfk8oA8P&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_exp_id=2accdd2-80fe-4550-be4f-eaebfeb9c9ab-0&algo_pvid=2accdd2-80fe-4550-be4f-eaebfeb9c9ab) at 20-11-2018.



## Vibration motor \$0,16

Retrieved from: <https://www.aliexpress.com/item/10x-DC-3V-70mA-12000-RPM-For-Phone-Coin-Flat-Vibrating-Vibration-Motor-Vibration-Motor-G08/32839179602.html?spm=2114.search0104.0.0.9b722811qOcX80> at 20-11-2018.

## Proximity sensor \$0,87

Retrieved from: [https://www.aliexpress.com/item/APDS-9930-Proximity-Sensor-Approaching-and-Non-Contact-Proximity-Module-CKIN/32748511738.html?spm=2114.search0104.3.23.9b722811qOcX80&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_exp\\_id=792e1424-0a91-4e7d-acef-46a9cbca0c08-3&algo\\_pvid=792e1424-0a91-4e7d-acef-46a9cbca0c08](https://www.aliexpress.com/item/APDS-9930-Proximity-Sensor-Approaching-and-Non-Contact-Proximity-Module-CKIN/32748511738.html?spm=2114.search0104.3.23.9b722811qOcX80&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_exp_id=792e1424-0a91-4e7d-acef-46a9cbca0c08-3&algo_pvid=792e1424-0a91-4e7d-acef-46a9cbca0c08) at 20-11-2018.

## Heart-rate sensor \$2,32

Retrieved from: [https://www.aliexpress.com/item/MAX30100-Heart-Rate-Click-Oximeter-Pulse-Sensor-Pulsesensor-Module-For-Arduino/32769396577.html?spm=2114.search0104.3.8.68a44761Oog5iu&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_exp\\_id=ab322bb1-c02b-444a-a4d0-0ecb75450e6c-1&algo\\_pvid=ab322bb1-c02b-444a-a4d0-0ecb75450e6c](https://www.aliexpress.com/item/MAX30100-Heart-Rate-Click-Oximeter-Pulse-Sensor-Pulsesensor-Module-For-Arduino/32769396577.html?spm=2114.search0104.3.8.68a44761Oog5iu&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_exp_id=ab322bb1-c02b-444a-a4d0-0ecb75450e6c-1&algo_pvid=ab322bb1-c02b-444a-a4d0-0ecb75450e6c) at 20-11-2018.



### Push button \$0,00144

Retrieved from: [https://www.aliexpress.com/item/200pcs-10-models-6-6-Light-micro-touch-Switch-sets-Push-Button-Switch-Kit-Height-4/32838807664.html?spm=2114.search0104.3.47.387b7021sNhQfd&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_exp\\_id=7d0e2e1a-ad36-47b3-9f60-9a7bc707bf93-9&algo\\_pvid=7d0e2e1a-ad36-47b3-9f60-9a7bc707bf93](https://www.aliexpress.com/item/200pcs-10-models-6-6-Light-micro-touch-Switch-sets-Push-Button-Switch-Kit-Height-4/32838807664.html?spm=2114.search0104.3.47.387b7021sNhQfd&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_exp_id=7d0e2e1a-ad36-47b3-9f60-9a7bc707bf93-9&algo_pvid=7d0e2e1a-ad36-47b3-9f60-9a7bc707bf93) at 20-11-2018



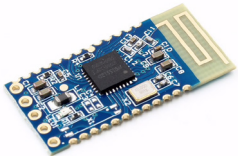
### LED \$0,11

Retrieved from: [https://www.aliexpress.com/item/10Pcs-DC-5V-3MM-x-10MM-WS2812B-SMD-RGB-LED-Mini-PCB-Board-5050-Chip-Built/32872329231.html?spm=2114.search0104.3.29.17c074a8gKHhOc&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_exp\\_id=191dd1da-ccc1-4592-96e4-7bb2eea97713-4&algo\\_pvid=191dd1da-ccc1-4592-96e4-7bb2eea97713](https://www.aliexpress.com/item/10Pcs-DC-5V-3MM-x-10MM-WS2812B-SMD-RGB-LED-Mini-PCB-Board-5050-Chip-Built/32872329231.html?spm=2114.search0104.3.29.17c074a8gKHhOc&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_exp_id=191dd1da-ccc1-4592-96e4-7bb2eea97713-4&algo_pvid=191dd1da-ccc1-4592-96e4-7bb2eea97713) at 20-11-2018.



### Bluetooth 4.2 transmitter \$1,76

Retrieved from: [https://www.aliexpress.com/item/JDY-18-Bluetooth-module-4-2-high-speed-transmission-master-slave-integration-more-than-CC2541/32888929812.html?spm=2114.search0104.3.76.39de6137LSlrk4&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_exp\\_id=f6de551f-42a3-464c-b5c6-abfa89cb1254-11&algo\\_pvid=f6de551f-42a3-464c-b5c6-abfa89cb1254](https://www.aliexpress.com/item/JDY-18-Bluetooth-module-4-2-high-speed-transmission-master-slave-integration-more-than-CC2541/32888929812.html?spm=2114.search0104.3.76.39de6137LSlrk4&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_exp_id=f6de551f-42a3-464c-b5c6-abfa89cb1254-11&algo_pvid=f6de551f-42a3-464c-b5c6-abfa89cb1254) at 20-11-2018.



### Flash memory \$0,46

Retrieved from: [https://www.aliexpress.com/item/10PCS-25L3205DM2I-12G-25L3205-MX25L3205/32790386553.html?spm=2114.search0104.3.61.29e651c0hkyWfHf&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch](https://www.aliexpress.com/item/10PCS-25L3205DM2I-12G-25L3205-MX25L3205/32790386553.html?spm=2114.search0104.3.61.29e651c0hkyWfHf&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch)



[\\_0&algo\\_expid=e36d1950-8bf3-43e2-88b4-b7b5a3b2c1ff-9&algo\\_pvid=e36d1950-8bf3-43e2-88b4-b7b5a3b2c1ff](https://www.aliexpress.com/item/5PCS-Z84C0006PEC-ZILOG-DIP-40-New-spot-Quality-Assurance/32703335749.html?spm=2114.search0104.3.22.5080624bISVggC&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_expid=7e3edb67-2edc-4a1c-900f-e1b04cd68330-3&algo_pvid=7e3edb67-2edc-4a1c-900f-e1b04cd68330) at 20-11-2018.

### Micro-processor \$1,06

Retrieved from: [https://www.aliexpress.com/item/5PCS-Z84C0006PEC-ZILOG-DIP-40-New-spot-Quality-](https://www.aliexpress.com/item/5PCS-Z84C0006PEC-ZILOG-DIP-40-New-spot-Quality-Assurance/32703335749.html?spm=2114.search0104.3.22.5080624bISVggC&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_expid=7e3edb67-2edc-4a1c-900f-e1b04cd68330-3&algo_pvid=7e3edb67-2edc-4a1c-900f-e1b04cd68330)

[Assurance/32703335749.html?spm=2114.search0104.3.22.5080624bISVggC&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_expid=7e3edb67-2edc-4a1c-900f-e1b04cd68330-3&algo\\_pvid=7e3edb67-2edc-4a1c-900f-e1b04cd68330](https://www.aliexpress.com/item/5PCS-Z84C0006PEC-ZILOG-DIP-40-New-spot-Quality-Assurance/32703335749.html?spm=2114.search0104.3.22.5080624bISVggC&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_expid=7e3edb67-2edc-4a1c-900f-e1b04cd68330-3&algo_pvid=7e3edb67-2edc-4a1c-900f-e1b04cd68330) at 20-11-2018.



### Battery pack \$2,37

Retrieved from: [https://www.aliexpress.com/item/10pcs-350926-3-7V-55mAh-lithium-polymer-battery-pack-for-wearable-electronics-device-wristband-selfie-](https://www.aliexpress.com/item/10pcs-350926-3-7V-55mAh-lithium-polymer-battery-pack-for-wearable-electronics-device-wristband-selfie-stick/32904508757.html?spm=2114.search0104.3.1.2457335eo2rjks&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_expid=8ff273af-d269-469a-b2e9-ab86f5a36a31-0&algo_pvid=8ff273af-d269-469a-b2e9-ab86f5a36a31)

[stick/32904508757.html?spm=2114.search0104.3.1.2457335eo2rjks&ws\\_ab\\_test=searchweb0\\_0,searchweb201602\\_1\\_10065\\_10068\\_318\\_319\\_317\\_10696\\_450\\_10084\\_10083\\_10618\\_452\\_535\\_534\\_10304\\_533\\_10307\\_10820\\_532\\_10301\\_10821\\_204\\_10843\\_10059\\_10884\\_323\\_10887\\_100031\\_320\\_5728511\\_321\\_322\\_10103\\_448\\_449\\_5024911,searchweb201603\\_35,ppcSwitch\\_0&algo\\_expid=8ff273af-d269-469a-b2e9-ab86f5a36a31-0&algo\\_pvid=8ff273af-d269-469a-b2e9-ab86f5a36a31](https://www.aliexpress.com/item/10pcs-350926-3-7V-55mAh-lithium-polymer-battery-pack-for-wearable-electronics-device-wristband-selfie-stick/32904508757.html?spm=2114.search0104.3.1.2457335eo2rjks&ws_ab_test=searchweb0_0,searchweb201602_1_10065_10068_318_319_317_10696_450_10084_10083_10618_452_535_534_10304_533_10307_10820_532_10301_10821_204_10843_10059_10884_323_10887_100031_320_5728511_321_322_10103_448_449_5024911,searchweb201603_35,ppcSwitch_0&algo_expid=8ff273af-d269-469a-b2e9-ab86f5a36a31-0&algo_pvid=8ff273af-d269-469a-b2e9-ab86f5a36a31) at 20-11-2018.



### USB-C \$0,987

Retrieved from: <https://nl.mouser.com/ProductDetail/Molex/201267-0005?qs=sGAEpiMZZMulM8LPOQ%252bykzSQWeMShX%2fG3d0ylfd8QES3f3ckr2i5xQ%3d%3d> at 6-12-2018.



### Magnetic connector \$2,22

Retrieved from: [https://www.alibaba.com/product-detail/Surface-mount-header-4-spring-pin\\_60713636109.html](https://www.alibaba.com/product-detail/Surface-mount-header-4-spring-pin_60713636109.html) at 6-12-2018.



### M2 insert \$0,033

Retrieved from: [https://nl.aliexpress.com/item/100pcs-lot-Brass-insert-nut-slanting-knurled-nuts-M1-M1-4-M1-6-M2-M3/32803818118.html?src=google&albslr=205786338&src=google&albch=s\\_hopping&acct=494-037-6276&isdl=y&slnk=&plac=&mtctp=&albbt=Google\\_7\\_shopping&aff\\_platform=google&aff\\_short\\_key=UneMJZVf&&albcpr=1626925412&albag=6359947](https://nl.aliexpress.com/item/100pcs-lot-Brass-insert-nut-slanting-knurled-nuts-M1-M1-4-M1-6-M2-M3/32803818118.html?src=google&albslr=205786338&src=google&albch=s_hopping&acct=494-037-6276&isdl=y&slnk=&plac=&mtctp=&albbt=Google_7_shopping&aff_platform=google&aff_short_key=UneMJZVf&&albcpr=1626925412&albag=6359947)



[9084&trgt=296904914040&crea=nl32803818118&netw=u&device=c&gclid=Cj0KCQiAurjgBRCqARIsAD09sg9Rw0RgU8c7GyXjf7-qudjB9Co9kN\\_NKN0j-wpF7EdPi4a1DPmSeXQaAjGIEALw\\_wcB&gclsrc=aw.ds](https://www.amazon.com/dp/B07CYWNMVX) at 6-12-2018.

### **M2 Pan head screw \$0,00035**



Retrieved from: [https://www.amazon.com/M2-5-0-45-Screws-Washer-Phillips-ISO7045/dp/B07CYWNMVX/ref=sr\\_1\\_3?s=industrial&ie=UTF8&qid=1544450794&sr=1-3&refinements=p\\_n\\_feature\\_two\\_browse-bin%3A2292861011%2Cp\\_n\\_feature\\_six\\_browse-bin%3A17426664011%2Cp\\_n\\_feature\\_five\\_browse-bin%3A3177285011](https://www.amazon.com/M2-5-0-45-Screws-Washer-Phillips-ISO7045/dp/B07CYWNMVX/ref=sr_1_3?s=industrial&ie=UTF8&qid=1544450794&sr=1-3&refinements=p_n_feature_two_browse-bin%3A2292861011%2Cp_n_feature_six_browse-bin%3A17426664011%2Cp_n_feature_five_browse-bin%3A3177285011) at 6-12-2018.

### **Band \$2,10**



Retrieved from: [https://nl.aliexpress.com/item/Band-Voor-Apple-Horloge-Serie-3-2-1-38mm-42mm-Nylon-Zachte-Ademend-Vervanging-Band-Sport/32879537923.html?spm=a2g0z.search0104.3.9.676346d4fis00X&ws\\_ab\\_test=searchweb0\\_0%2Csearchweb201602\\_1\\_5729911\\_10065\\_10068\\_319\\_317\\_10696\\_453\\_10084\\_454\\_10083\\_10618\\_10304\\_10307\\_10820\\_10301\\_10821\\_538\\_537\\_536\\_5730811\\_10843\\_10059\\_10884\\_10887\\_100031\\_321\\_322\\_10103%2Csearchweb201603\\_51%2CppcSwitch\\_0&algo\\_pvid=9f3ba83b-f6c1-49ec-9f5d-8382d6b47b0a&algo\\_expid=9f3ba83b-f6c1-49ec-9f5d-8382d6b47b0a-1](https://nl.aliexpress.com/item/Band-Voor-Apple-Horloge-Serie-3-2-1-38mm-42mm-Nylon-Zachte-Ademend-Vervanging-Band-Sport/32879537923.html?spm=a2g0z.search0104.3.9.676346d4fis00X&ws_ab_test=searchweb0_0%2Csearchweb201602_1_5729911_10065_10068_319_317_10696_453_10084_454_10083_10618_10304_10307_10820_10301_10821_538_537_536_5730811_10843_10059_10884_10887_100031_321_322_10103%2Csearchweb201603_51%2CppcSwitch_0&algo_pvid=9f3ba83b-f6c1-49ec-9f5d-8382d6b47b0a&algo_expid=9f3ba83b-f6c1-49ec-9f5d-8382d6b47b0a-1) at 6-12-2018.

# M INJECTION MOULDING QUOTE

Item	Snap Shot	Part Number/Name	Material	Surface Finish	Color	Cavities	Sample Quantity	Mold Type	Lead Time	Tooling Price with samples	Up	Down	Delete	Family Mold	Unfamily
1		Mastershellpositive.STEP	PA(Nylon)6+20%GF PA6-G20	Standard No Machine Mai	BLACK PMS-BLACK6	1	5	Production Mold	15 Business Days	\$5,852	↑	↓	✗		
2		Mastershellnegative.STEP	PA(Nylon)6+20%GF PA6-G20	Standard No Machine Mai	BLACK PMS-BLACK6	1	5	Production Mold	15 Business Days						
3		Slaveshellnegative.STEP	PA(Nylon)6+20%GF PA6-G20	Standard No Machine Mai	BLACK PMS-BLACK6	1	5	Production Mold	15 Business Days	\$4,774	↑	↓	✗		
4		Slaveshellpositive.STEP	PA(Nylon)6+20%GF PA6-G20	Standard No Machine Mai	BLACK PMS-BLACK6	1	5	Production Mold	15 Business Days						
5		StrapconnectionSlave.STEP	TPU 92A-Desmopan 2790A D	Standard No Machine Mai	ICE GRAY PMS-COOL G	1	5	Production Mold	15 Business Days	\$3,301	↑	↓	✗		
6		Strapconnection.STEP	TPU 92A-Desmopan 2790A D	Standard No Machine Mai	ICE GRAY PMS-COOL G	1	5	Production Mold	15 Business Days	\$2,880	↑	↓	✗		
7		Plasticbutton.STEP	HDPE Sabic M80064 Natural	Standard No Machine Mai	SHAMROCK GREEN PM	1	5	Production Mold	15 Business Days	\$2,200	↑	↓	✗		
8		Lightdiffuser.STEP	PP Globalene 7633,Natural	Standard No Machine Mai	TRANSPARENT COLOR	1	5	Production Mold	15 Business Days	\$2,200	↑	↓	✗		
9		Diffusering.STEP	PP Globalene 7633,Natural	Standard No Machine Mai	TRANSPARENT COLOR	1	5	Production Mold	15 Business Days	\$2,200	↑	↓	✗		

Item	Part Number/Name	Part Size	Part Weight	Part Quantity	Price without Shipping	Closest Shipping Destination	Price with FedEx	Price with Economy Air	Price with Ocean	Secondary Process
1	Mastershellpositive.STEP	47.6x45.3x6.8mm	0.0026kg	10000	\$0.23	Albuquerque,NM	\$0.42	\$0.28	\$0.30	Click to Select
2	Mastershellnegative.STEP	47.6x45.3x9.0mm	0.0028kg	10000	\$0.24	Albuquerque,NM	\$0.49	\$0.30	\$0.31	Click to Select
3	Slaveshellnegative.STEP	43.4x23.4x9.0mm	0.0017kg	30000	\$0.19	Albuquerque,NM	\$0.31	\$0.22	\$0.22	Click to Select
4	Slaveshellpositive.STEP	43.4x23.4x6.5mm	0.0016kg	30000	\$0.18	Albuquerque,NM	\$0.28	\$0.21	\$0.21	Click to Select
5	StrapconnectionSlave.STEP	35.0x13.5x27.9mm	0.0031kg	30000	\$0.35	Albuquerque,NM	\$0.53	\$0.41	\$0.39	Click to Select
6	Strapconnection.STEP	40.2x32.0x4.5mm	0.0025kg	10000	\$0.35	Albuquerque,NM	\$0.50	\$0.39	\$0.43	Click to Select
7	Plasticbutton.STEP	13.5x5.5x12.9mm	0.0002kg	10000	\$0.19	Albuquerque,NM	\$0.23	\$0.21	\$0.27	Click to Select
8	Lightdiffuser.STEP	6.0x3.4x8.0mm	0.0001kg	60000	\$0.18	Albuquerque,NM	\$0.19	\$0.19	\$0.20	Click to Select
9	Diffusering.STEP	19.5x19.5x4.8mm	0.0006kg	10000	\$0.20	Albuquerque,NM	\$0.25	\$0.22	\$0.27	Click to Select

# N PCB QUOTES

### Assembly Service

3 flexible options:  Turnkey (PCBWay supply parts)  Kitted or Consigned (Customer supply parts)  Combo (You supply some parts we do the rest)

PCB Quantity:  pcs Stencil:  Yes

Number of Unique Parts:

Number of SMT Parts:

Number of Through-Hole Parts:

Board type:  Assembly Side(s):

Detailed information of assembly:

Price does not include PCB fabrication or the cost of components, exact quotation will be updated after all the files you uploaded pass review or contact [service@pcbway.com](mailto:service@pcbway.com) for help.

### PCB Specifications

Board type:  Single pieces  Panel by Customer  Panel by PCBWay

### PCB Price

Build Time	Qty	Total
7-8 days	30000	\$4030

### Assembly Service Price

Per Piece	Qty	Total
0.2/pcs	30000	\$5843

**Tip: Final price can be negotiated**

Shipping Cost:

**DHL** 5-7 Days, wt: 54.500 kg **\$360**

CHN Time Zone(GMT+8): 12/10/2018 2:30:30 AM  
Payment before 2018/12/10 06:00 (GMT+8 Only PCB)

Delivery time: 2018/12/17 AM Receipt confirm: 2018/12/23

PCB Cost: US \$ 4030  
Assembly Service Cost: US \$ 5843  
Shipping: US \$ 325 \$360  
**Total: US \$ 10198**

Email:

**Add to Cart**

### Assembly Service

3 flexible options:  Turnkey (PCBWay supply parts)  Kitted or Consigned (Customer supply parts)  Combo (You supply some parts we do the rest)

PCB Quantity:  pcs Stencil:  Yes

Number of Unique Parts:

Number of SMT Parts:

Number of Through-Hole Parts:

Board type:  Assembly Side(s):

Detailed information of assembly:

Price does not include PCB fabrication or the cost of components, exact quotation will be updated after all the files you uploaded pass review or contact [service@pcbway.com](mailto:service@pcbway.com) for help.

### PCB Specifications

Board type:  Single pieces  Panel by Customer  Panel by PCBWay

Different Design in Panel:  e.g.

### PCB Price

Build Time	Qty	Total
7-8 days	10000	\$2232

### Assembly Service Price

Per Piece	Qty	Total
0.2/pcs	10000	\$2252

**Tip: Final price can be negotiated**

Shipping Cost:

**DHL** 5-7 Days, wt: 48.500 kg **\$330**

CHN Time Zone(GMT+8): 12/10/2018 2:30:30 AM  
Payment before 2018/12/10 06:00 (GMT+8 Only PCB)

Delivery time: 2018/12/17 AM Receipt confirm: 2018/12/23

PCB Cost: US \$ 2232  
Assembly Service Cost: US \$ 2252  
Shipping: US \$ 295 \$330  
**Total: US \$ 4779**

Email:

**Add to Cart**



# COST PRICE ESTIMATION

Quantity products	10000
Quantity master	10000
Quantity slave	30000

Estimated assembly time	4 min/product
Estimated dimensions prc Volume	3375 cm <sup>3</sup>
Estimated packaging cost	€ 1,00

Investments	Price	Price/product
Mould master shell	€ 5.128,11	€ 0,51
Mould slave shell	€ 4.183,46	€ 0,42
Mould strap connection master	€ 2.523,74	€ 0,25
Mould strap connection slave	€ 2.892,67	€ 0,29
Mould plastic button	€ 1.927,86	€ 0,19
Mould light diffuser master	€ 1.927,86	€ 0,19
Mould light diffuser slave	€ 1.927,86	€ 0,39
Total Master	€ 1,15	
Total Slave	€ 1,09	
Software	€ 75.000,00	€ 7,50
Algorithm	€ 50.000,00	€ 5,00

**Total € 145.511,55 € 14,74**

Materials	Weight/part	Total per product
Master shell positive	2,6 €	0,20
Master shell negative	2,8 €	0,21
Slave shell negative	1,7 €	0,50
Slave shell positive	1,6 €	0,47
Strap connection master	2,5 €	0,31
Strap connection slave	3,1 €	0,92
Plastic button	0,2 €	0,17
Light diffuser master	0,6 €	0,16
Light diffuser slave	0,1 €	1,05
<b>Total</b>	<b>€</b>	<b>3,99</b>

Purchase incl	Single part	Amount per product	Total per product
PCB master	€ 0,39	1 €	0,39
PCB slave	€ 0,29	3 €	0,87
Accelerometer +gyroscope	€ 0,75	4 €	3,01
Proximity sensor	€ 0,76	3 €	2,29
Heartbeat sensor	€ 2,03	1 €	2,03
LED	€ 0,04	11 €	0,48
USB-C Female	€ 0,86	1 €	0,86
Battery	€ 2,08	4 €	8,31
Magnetic connector	€ 1,95	3 €	5,84
Push button	€ 0,00	1 €	0,00
Vibration motor	€ 0,14	4 €	0,56
Bluetooth 4.2	€ 1,54	1 €	1,54
Processor	€ 0,93	4 €	3,72
Storage	€ 0,40	4 €	1,61
Band	€ 1,84	4 €	7,36
Insert	€ 0,00	8 €	0,02
Screw	€ 0,00	8 €	0,00
Other components	€ 0,22	4 €	0,88

Total price Master € 14,34  
 Total price Slave € 8,48  
**TOTAL price product € 39,78**

Assembly costs	
Price per hour	€ 3,00
Products per hour	15
<b>Total per product</b>	<b>€ 0,20</b>

**Packaging** € 1,00

Shipping	
Shipment per boat from Shanghai to Rotterdam	€ 3.000,00
Products per container	20000
<b>Total per product</b>	<b>€ 0,15</b>

	Per product
Investments	€ 14,74
Materials	€ 3,99
Purchase	€ 39,78
Assembly	€ 0,20
Packaging	€ 1,00
Shipping	€ 0,15

**TOTAL € 59,86**

# P

## PROOF OF CONCEPT ALGORITHM

### Import Modules

In [269]:

```
import pandas as pd
import numpy as np

from sklearn.model_selection import train_test_split
from sklearn.metrics import confusion_matrix, accuracy_score
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier

%matplotlib inline
```

### Load Data

In [270]:

```
column_names = ["session_id", "A_x", "A_y", "A_z", "G_x", "G_y", "G_z", "is_running"]

walking_data = pd.read_csv("prototype_25x30s_WALK.TXT",
                           delimiter=";",
                           header=None,
                           names=column_names,
                           index_col=False)

running_data = pd.read_csv("prototype_test_25x30s_RUN.TXT",
                            delimiter=";",
                            header=None,
                            names=column_names,
                            index_col=False)
```

### Show first 5 rows

In [271]:

```
walking_data.head(5)
```

Out [271]:

	session_id	A_x	A_y	A_z	G_x	G_y	G_z	is_running
0	1	-1.55	-0.64	-1.44	0.14	-1.00	0.07	0
1	1	-9.77	0.59	6.98	0.11	-0.99	0.04	0
2	1	-17.57	-6.45	15.56	0.14	-0.98	0.02	0
3	1	-24.29	36.12	4.05	-0.21	-1.01	-0.10	0
4	1	-18.95	-27.15	-43.49	0.13	-0.99	-0.17	0

In [272]:

```
running_data.head(5)
```

Out [272]:

	session_id	A_x	A_y	A_z	G_x	G_y	G_z	is_running
0	1	-1.21	-3.21	-0.77	0.20	-0.98	0.11	1
1	1	-1.17	-2.42	-0.78	0.20	-0.98	0.13	1
2	1	0.05	-6.04	-3.34	0.19	-0.96	0.10	1
3	1	-1.18	1.92	1.35	0.22	-0.97	0.13	1

4	session_id	A_x	A_y	A_z	G_x	G_y	G_z	is_running
---	------------	-----	-----	-----	-----	-----	-----	------------

## Check if datatypes are correct

In [273]:

```
print(walking_data.dtypes, "\n\n", running_data.dtypes)
```

```
session_id      int64
A_x             float64
A_y             float64
A_z             float64
G_x             float64
G_y             float64
G_z             float64
is_running      int64
dtype: object
```

```
session_id      int64
A_x             float64
A_y             float64
A_z             float64
G_x             float64
G_y             float64
G_z             float64
is_running      int64
dtype: object
```

## Print summary statistics for 2 random sessions

### Walking sessions

In [387]:

```
value_columns = ["A_x", "A_y", "A_z", "G_x", "G_y", "G_z"]
session_ids = np.unique(walking_data.session_id.values)

for session_id in np.random.choice(session_ids, 2):
    print("Session ID: {}".format(session_id))
    print(walking_data[walking_data.session_id==session_id][value_columns].describe())
    print()
```

Session ID: 11

	A_x	A_y	A_z	G_x	G_y	G_z
count	248.000000	248.000000	248.000000	248.000000	248.000000	248.000000
mean	-12.398226	-3.858911	-10.706935	0.159637	-1.136653	-0.198669
std	78.002760	77.894224	151.040437	0.673368	0.551372	0.366423
min	-226.510000	-250.140000	-250.140000	-2.000000	-2.000000	-2.000000
25%	-28.412500	-34.275000	-114.662500	-0.140000	-1.452500	-0.392500
50%	4.965000	12.360000	-50.185000	0.120000	-1.065000	-0.190000
75%	31.657500	35.790000	121.815000	0.350000	-0.950000	-0.027500
max	190.940000	197.050000	250.130000	2.000000	0.240000	0.900000

Session ID: 6

	A_x	A_y	A_z	G_x	G_y	G_z
count	260.000000	260.000000	260.000000	260.000000	260.000000	260.000000
mean	-14.181885	-0.036962	-7.020000	0.160231	-1.126308	-0.198731
std	68.570241	75.911817	141.85144	0.667981	0.491670	0.403073
min	-197.880000	-250.140000	-250.140000	-2.000000	-2.000000	-2.000000
25%	-35.145000	-39.642500	-101.237500	-0.072500	-1.372500	-0.355000
50%	4.560000	10.490000	-45.810000	0.140000	-1.055000	-0.190000
75%	22.955000	38.225000	107.132500	0.332500	-0.937500	0.000000
max	131.520000	250.130000	250.130000	2.000000	0.140000	1.680000

## Running sessions

In [388]:

```
value_columns = ["A_x", "A_y", "A_z", "G_x", "G_y", "G_z"]
session_ids = np.unique(running_data.session_id.values)

for session_id in np.random.choice(session_ids, 2):
    print("Session ID: {}".format(session_id))
    print(running_data[running_data.session_id==session_id][value_columns].describe())
    print()
```

Session ID: 25

	A_x	A_y	A_z	G_x	G_y	G_z
count	259.000000	259.000000	259.000000	259.000000	259.000000	259.000000
mean	-14.306911	12.735753	-35.533320	0.069266	-1.216139	-0.181853
std	82.935993	117.176373	196.979412	1.191813	0.868862	0.674994
min	-250.140000	-250.140000	-250.140000	-2.000000	-2.000000	-2.000000
25%	-61.605000	-45.630000	-232.450000	-0.795000	-2.000000	-0.460000
50%	-13.740000	18.080000	-81.890000	-0.060000	-1.480000	-0.160000
75%	31.005000	87.630000	250.130000	0.795000	-0.760000	0.145000
max	250.130000	250.130000	250.130000	2.000000	2.000000	2.000000

Session ID: 22

	A_x	A_y	A_z	G_x	G_y	G_z
count	257.000000	257.000000	257.000000	257.000000	257.000000	257.000000
mean	-17.085720	4.450973	-29.154319	0.132802	-1.184591	-0.144397
std	80.437364	118.041617	194.181507	1.110524	0.871340	0.643111
min	-250.140000	-250.140000	-250.140000	-2.000000	-2.000000	-2.000000
25%	-57.240000	-59.330000	-221.840000	-0.690000	-2.000000	-0.410000
50%	-17.440000	7.900000	-65.270000	-0.030000	-1.360000	-0.140000
75%	28.730000	87.570000	224.270000	0.750000	-0.720000	0.150000
max	250.130000	250.130000	250.130000	2.000000	2.000000	2.000000

## Compare raw (i.e. over all sessions) summary stats

### Mean

The table below shows the mean for each variable, computed over all observations (without grouping by session ID), for walking and running

In [380]:

```
walking_means_raw = walking_data[value_columns].groupby(lambda idx: 0).agg('mean')
walking_means_raw["is_running"] = 0

running_means_raw = running_data[value_columns].groupby(lambda idx: 0).agg('mean')
running_means_raw["is_running"] = 1

walking_running_means_raw = walking_means_raw.append(running_means_raw).T
walking_running_means_raw.columns = ["walking", "running"]
walking_running_means_raw
```

Out[380]:

	walking	running
A_x	-9.888419	-13.454573
A_y	0.060281	2.416289
A_z	-8.493079	-30.206193
G_x	0.156797	0.171886
G_y	-1.132090	-1.162044
G_z	-0.191704	-0.160117

is_running	0.000000	1.000000
walking		running

## Standard deviation

The table below shows the standard deviation for each variable, computed over all observations (without grouping by session ID), for walking and running

In [381]:

```
walking_std_raw = walking_data[value_columns].groupby(lambda idx: 0).agg('std')
walking_std_raw["is_running"] = 0

running_std_raw = running_data[value_columns].groupby(lambda idx: 0).agg('std')
running_std_raw["is_running"] = 1

walking_running_std_raw = walking_std_raw.append(running_std_raw).T
walking_running_std_raw.columns = ["walking", "running"]
walking_running_std_raw
```

Out[381]:

	walking	running
A_x	72.794324	73.623048
A_y	72.211878	117.882860
A_z	144.841225	194.344964
G_x	0.667950	1.153270
G_y	0.524732	0.882360
G_z	0.378250	0.659004
is_running	0.000000	1.000000

## Skewness

The table below shows the skewness for each variable, computed over all observations (without grouping by session ID), for walking and running

In [382]:

```
walking_skew_raw = walking_data[value_columns].groupby(lambda idx: 0).agg('skew')
walking_skew_raw["is_running"] = 0

running_skew_raw = running_data[value_columns].groupby(lambda idx: 0).agg('skew')
running_skew_raw["is_running"] = 1

walking_running_skew_raw = walking_skew_raw.append(running_skew_raw).T
walking_running_skew_raw.columns = ["walking", "running"]
walking_running_skew_raw
```

Out[382]:

	walking	running
A_x	-0.917846	-0.029829
A_y	-0.407658	-0.117829
A_z	0.639914	0.382252
G_x	0.287017	0.214754
G_y	0.159693	1.173530
G_z	0.408363	0.090194
is_running	0.000000	1.000000

# Calculating Summary Stats per Session ID

Instead of computing summary stats over all rows/observations, without regard for session ID, the summary statistics here are calculated PER session ID.

That is, each session ID consists of a bunch of rows, and the summary statistics for each variable (A\_x, A\_z etc.) are calculated, across those rows. This is done by "grouping by" session ID, so that each subsequent calculation only takes the rows belonging to that session ID into account.

In [474]:

```
# summary_statistics= ["mean", "median", "std", "skew", pd.DataFrame.kurt]
summary_statistics= ["mean", "std"]
```

Only choose 2 summary stats here for ease of interpretation of the tables

## Walking data

Show top 5 rows after calculating summary stats per session ID for each variable

In [476]:

```
variables_and_summary_stats = {variable: summary_statistics for variable in value_columns}
walking_data_by_session_with_summary_stats =
walking_data.groupby("session_id").agg(variables_and_summary_stats)
walking_data_by_session_with_summary_stats["is_running"] = 0
walking_data_by_session_with_summary_stats.head()
```

Out[476]:

	A_x		A_y		A_z		G_x		G_y		G_z
	mean	std	mean	std	mean	std	mean	std	mean	std	mean
session_id											
1	-8.027977	69.612047	-2.919122	78.156062	-8.069275	153.444957	0.144847	0.667877	-1.141107	0.541094	-0.2251
2	-8.262156	63.803428	-4.709703	69.149532	-6.256283	142.714492	0.165019	0.636578	-1.129665	0.498162	-0.1541
3	-9.159767	71.788278	2.401124	79.687681	-7.206202	144.297910	0.166977	0.603901	-1.124380	0.535702	-0.196:
4	-8.551336	69.693341	-4.293130	72.580099	-6.973740	141.594372	0.185954	0.630193	-1.122366	0.523914	-0.186:
5	-14.535632	73.550623	-1.223333	70.771135	-8.039234	149.337711	0.142912	0.672857	-1.163027	0.539834	-0.179:

## Running data

Show top 5 rows after calculating summary stats per session ID for each variable

In [477]:

```
variables_and_summary_stats = {variable: summary_statistics for variable in value_columns}

running_data_by_session_with_summary_stats =
running_data.groupby("session_id").agg(variables_and_summary_stats)
running_data_by_session_with_summary_stats["is_running"] = 1
running_data_by_session_with_summary_stats.head()
```

Out[477]:

	A_x	A_y	A_z	G_x	G_y	G_z
--	-----	-----	-----	-----	-----	-----

	A_x		A_y		A_z		G_x		G_y		G_z
	mean	std	mean	std	mean	std	mean	std	mean	std	mean
session_id	mean	std	mean	std	mean	std	mean	std	mean	std	mean
1	-1.202857	0.942757	1.952857	2.675542	-0.870000	1.446363	0.202857	0.012536	0.970000	0.008165	0.1
2	-13.113251	56.647120	1.373428	125.648916	30.860671	199.275448	0.203675	1.251097	1.133816	0.951244	0.1
3	-14.400885	58.183695	2.098462	127.014927	35.921231	204.555685	0.252808	1.220780	1.148538	0.957727	0.1
4	-11.395430	64.698954	5.461719	118.969857	36.598984	197.538407	0.192812	1.189107	1.131563	0.915071	0.3
5	-1.191146	70.454283	9.848617	125.518241	31.107431	204.927795	0.204387	1.272041	1.140988	0.992417	0.2

## Creating final dataset

Combine the running and walking data

Show first 10 'walking' rows:

In [532]:

```
input_data =
walking_data_by_session_with_summary_stats.append(running_data_by_session_with_summary_stats)
input_data[input_data.is_running==0].head(10)
```

Out[532]:

	A_x		A_y		A_z		G_x		G_y		G_z
	mean	std	mean	std	mean	std	mean	std	mean	std	mean
session_id	mean	std	mean	std	mean	std	mean	std	mean	std	mean
1	-8.027977	69.612047	-2.919122	78.156062	-8.069275	153.444957	0.144847	0.667877	1.141107	0.541094	0.2
2	-8.262156	63.803428	-4.709703	69.149532	-6.256283	142.714492	0.165019	0.636578	1.129665	0.498162	0.1
3	-9.159767	71.788278	2.401124	79.687681	-7.206202	144.297910	0.166977	0.603901	1.124380	0.535702	0.1
4	-8.551336	69.693341	-4.293130	72.580099	-6.973740	141.594372	0.185954	0.630193	1.122366	0.523914	0.1
5	-14.535632	73.550623	-1.223333	70.771135	-8.039234	149.337711	0.142912	0.672857	1.163027	0.539834	0.1
6	-14.181885	68.570241	-0.036962	75.911817	-7.020000	141.851440	0.160231	0.667981	1.126308	0.491670	0.1
7	-8.104854	71.558361	-3.948870	75.251822	-9.507741	145.762548	0.160586	0.621883	1.139289	0.507783	0.1
8	-6.500675	71.488507	-2.232579	72.366083	10.703730	150.098581	0.187421	0.701978	1.135873	0.551776	0.2
9	-9.278641	64.197886	-0.708850	73.150352	-6.636620	139.427982	0.175157	0.616856	1.111672	0.502874	0.1
10	-12.506459	73.479367	10.323074	74.141539	11.865097	149.044103	0.155837	0.744887	1.142062	0.532630	0.2

Show first 10 rows where activity = running

In [533]:

```
input_data[input_data.is_running==1].head(10)
```

Out[533]:

	A_x		A_y		A_z		G_x		G_y		G_z
	mean	std	mean	std	mean	std	mean	std	mean	std	
session_id											
1	-1.202857	0.942757	-1.952857	2.675542	-0.870000	1.446363	0.202857	0.012536	-0.970000	0.008165	0.000000
2	-13.113251	56.647120	-1.373428	125.648916	-30.860671	199.275448	0.203675	1.251097	-1.133816	0.951244	-0.000000
3	-14.400885	58.183695	2.098462	127.014927	-35.921231	204.555685	0.252808	1.220780	-1.148538	0.957727	-0.000000
4	-11.395430	64.698954	5.461719	118.969857	-36.598984	197.538407	0.192812	1.189107	-1.131563	0.915071	-0.000000
5	-1.191146	70.454283	9.848617	125.518241	-31.107431	204.927795	0.204387	1.272041	-1.140988	0.992417	-0.000000
6	-9.973140	78.936356	10.993798	128.371838	-35.661628	199.077090	0.189147	1.211720	-1.142442	0.958067	-0.000000
7	-8.963992	72.470633	1.649729	129.304177	-31.789457	200.843790	0.166744	1.234233	-1.183023	0.901878	-0.000000
8	-12.906950	72.741173	3.690386	117.959185	-26.842510	191.367346	0.194865	1.107743	-1.174710	0.812474	-0.000000
9	-9.486279	75.007965	-2.602946	112.807045	-30.732171	193.115519	0.211938	1.121663	-1.166938	0.848678	-0.000000
10	-13.465538	76.841016	-0.251192	117.022828	-28.807538	190.646615	0.197923	1.124319	-1.138615	0.894138	-0.000000

## Check for correlations

See which summary stats of the initial variables correlate with the label we want to predict:

In [466]:

```
input_data.corrwith(input_data["is_running"])
```

Out[466]:

```
A_x      mean    -0.401600
         std     -0.096396
         skew     0.902116
A_y      mean     0.234508
         std     0.780118
         skew     0.610124
A_z      mean    -0.905986
         std     0.614535
         skew    -0.817065
G_x      mean     0.199314
         std     0.799420
         skew    -0.161461
G_y      mean    -0.301832
         std     0.786469
         skew     0.917505
G_z      mean     0.347096
         std     0.796165
         skew    -0.377987
is_running
dtype: float64
```

The correlations vary heavily across variables and chosen summary statistics. Some variables show high correlations in general:

- For `A_z`, every summary statistic demonstrates relatively high correlation ( $>0.6$ )

For other variables it depends more on the chosen statistic:

- For `A_x`, we see high correlation for the skewness, but low correlation for the standard deviation.
- For `G_x`, we see high correlation for the standard deviation, but low correlation for the mean and skewness.
- etc.

## Machine Learning

### Set input data with corresponding labels

In [534]:

```
X = input_data[value_columns]
y = input_data["is_running"]
```

### Split into train and test sets

Used 50% of the data for training, 50% for testing. This is unusual but the dataset is very small.

Stratify ensures that the proportion of walking vs running is the same for the training and testing sets

In [535]:

```
TRAIN_SIZE = 0.5
X_train, X_test, y_train, y_test = train_test_split(X, y, train_size=TRAIN_SIZE, test_size=1-TRAIN_SIZE, stratify=y)
```

### Initialize and fit model

The model (in this case a Random Forest) is trained on 50% of the data

In [496]:

```
model = RandomForestClassifier()
model.fit(X_train, y_train)
```

Out[496]:

```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
                        max_depth=None, max_features='auto', max_leaf_nodes=None,
                        min_impurity_decrease=0.0, min_impurity_split=None,
                        min_samples_leaf=1, min_samples_split=2,
                        min_weight_fraction_leaf=0.0, n_estimators=10, n_jobs=1,
                        oob_score=False, random_state=None, verbose=0,
                        warm_start=False)
```

### Check the most important variables

In [553]:

```
importances = model.feature_importances_
std = np.std([tree.feature_importances_ for tree in model.estimators_],
             axis=0)
indices = np.argsort(importances)[::-1]

# Print the feature ranking
print("Feature ranking:")

for f in range(X.shape[1]):
    print("%d feature %s (%.5f) % / %5.1f" % (f+1, X.columns[indices[f]], importances[indices[f]],
```



In [498]:

```
accuracy = accuracy_score(y_test, y_pred)
accuracy
```

Out[498]:

0.9615384615384616

**Correct predictions on the diagonal**

In [526]:

```
confusion_matrix(y_test, y_pred)
```

Out[526]:

```
array([[13,  0],
       [ 1, 12]])
```



**MOVE  
ON**