## The Future of Fitting Shoes - Implementing 3D Scanning Technology in the Online Footwear Industry

<table>
<thead>
<tr>
<th>Institution</th>
<th>Amsterdam Fashion Institute</th>
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<tr>
<td>Department</td>
<td>International Fashion &amp; Management</td>
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<td>Student</td>
<td>Paulina Henrich-Bandis</td>
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<td>Graduation 2017/2018</td>
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<tr>
<td>Coaches</td>
<td>Lisette Vonk, Hein Daanen</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENT

I would like to express my gratitude to my mentors Lisette Vonk and Hein Daanen for the continuous support over the past five months. Your encouragement and knowledge, patience and enthusiasm have motivated me and enabled the results of this research.

A big “thank you” also to Nicole Malucha from Zalando, Joost Alferink from 3Dabout.me and Benjamin Rüsing from Salgert Sports, who shared very valuable insights in interviews with me which helped to evaluate the relevance of my topic and brought me huge steps forward.
PERSONAL MOTIVATION

While studying Fashion Management, I always asked myself: What will the future bring for the fashion industry? What could change the way we shop today? Where is room for improvement?

During my internship at Lidl Hong Kong Ltd., the company was working on their expansion to the US market and I worked on a project researching differences in sizing between Europe and the USA. I realised, how confusing the sizing systems were. And looking deeper into the topic and comparing the exact measurements in the company’s size charts, I recognised that there are even differences within the same size among different brands.

From my personal estimation, the described problem seems to be even more crucial, when it comes to footwear. Having a deformation of the bone structure (hallux valgus) of my left foot myself, it is a big difficulty for me to find a fitting pair of shoes online.

Today’s 3D scanning technologies could be a promising solution to the problem of in-transparent sizing systems. In my research, I want to find out, how 3D scanning is applicable to the fashion industry, in particular in the online footwear retail.

But does 3D scanning have the potential to change the way we shop today? And how can it be integrated into the processes of online shopping?
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RESEARCH PROPOSAL
Problems

“High return rates: 30% to 40% of fashion items are returned due to the wrong choice of size and these returns cost the fashion industry $7.5 billion a year.” (Burrows, 2017).

No universal sizing system: The consumer has to deal with EU, US, UK sizes plus sometimes S, M, L or French, Italian etc. and convert from inch to cm

Sizing systems were developed in the 19th century and do not represent the variations of body measurements around the world (Innes, 2014).
RESEARCH QUESTION

First version:

How can 3D scanning be used to determine the perfect shoe size?

How does 3D-body-scanning work?
What is the “perfect shoe size”?
What are the consumer’s opinions on body scans?
What are the possibilities and limitations of today’s 3D scanning technologies?
How are 3D scanning techniques applicable to the purchasing process of shoes?

The research questions need to be more specialised: only focus on 3d body scanning and the online retail of footwear.

Second version:

How can 3D body scanning be used in the online footwear retail?

How does 3D body scanning work?
What are the possibilities and limitations of today’s 3D scanning technologies?
What are the consumer’s opinions on body scans?
What measures need to be taken to apply 3D scanning to the footwear online retail?
HYPOTHESIS

With this research, I want to evaluate whether 3D scanning is a possible solution to the formerly described problems regarding non-transparent shoe sizing systems and the consumer’s insecurity to purchase footwear online. I am of the opinion that:

By enabling virtual fitting, 3D body scanning has the potential to change the way we shop footwear online today.

In order to evaluate that topic, will research the technological opportunities, the state of the art of 3D scanning and the application possibilities. Next to that, I will take the consumer’s and retailer’s attitude towards body scanning into account.

The goal of my research is to create a model infrastructure for a footwear purchasing process using 3D scan technology.
METHODOLOGY

In order to be able to discuss my hypothesis on a relevant level, my research consists of a combination of various online and offline, primary and secondary sources. Since the arrangement of expert interviews and the gathering of information through an online survey takes a certain amount of time my research phase needs to be organised. Therefore, I decided to organise myself with a step-by-step plan.

Step-by-step research plan:

- Research the **technological background** of 3D scanning using online sources, such as user manuals, consumer reviews, research studies and technology platforms
- Constructing a **consumer survey** at an early stage, in order to have a run-time of at least four weeks
- Arrange **expert interviews** in field of retail and manufacturers.
- Test **3D scanning apps**
- Test **3D foot scanner**
RESEARCH PHASE
DEFINITION ACCORDING TO ISO

“three-dimensional/ 3-D
pertaining to the use of three orthogonal scales on which the three coordinates, x, y and z, can be measured to give the precise
position of any relevant anatomical point in the considered space

3-D body scanner
hardware and software system that creates digital data representing a human form, or parts thereof, in three dimensions

3-D processing software
operating system, user interface, programs, algorithms and instructions associated with a 3-D scanning system

3-D scanner hardware
physical components of a 3-D scanner and any associated computer(s)
anthropometric database
collection of individual body measurements (anthropometric data) and background information (demographic data) recorded on a
group of people (the sample)

accuracy
extent to which the measured value approximates a true value
Note 1 to entry: Since it is difficult to trace the accuracy of complex hardware and software systems to recognized ISO sources, for
the purposes of this International Standard true value is taken to mean the measured value obtained by a skilled anthropometrist
using traditional instruments such as tape and calliper. (Lee, Lin, and Wang, 2014)

point cloud
collection of 3-D points in space referenced by their coordinate values

ISO STANDARD - ISO 20685
The intent of ISO 20685 is to ensure comparability of body measurements as specified by ISO 7250-1 but measured with the aid of
3-D body scanners rather than with traditional anthropometric instruments such as tape measures and callipers. It is further intended
that by conformance with this International Standard any data extracted from scans will be suitable for inclusion in international databases such as those described in ISO 15535.

This International Standard addresses protocols for the use of 3-D surface-scanning systems in the acquisition of human body shape data and measurements defined in ISO 7250-1 that can be extracted from 3-D scans. It does not apply to instruments that measure the location and/or motion of individual landmarks.

While mainly concerned with whole-body scanners, it is also applicable to body-segment scanners (head scanners, hand scanners, foot scanners)” (ISO, 2010).
**HOW DOES 3D SCANNING WORK?**

In order to be able to discuss the impact of 3D body scanning, it is first of all important to understand the technology behind it. 3D scanners are ideal for measuring complex shapes which otherwise would require huge amounts of measurements to accurately describe them.

A 3D scanner requires an image or light sensor with positioning techniques, a space and an object (Aniwaa.com, Anonymous n.d.). 3D scanners can be considered as intense cameras which produce 3D renderings instead of pictures (Smith, 2015). During the scanning process, these cameras detect the position of an object in a space by calculating the distance between the known position of the sensor and the unknown position of the source.

For short-distance scanners (underneath 1m) there are two different methods used:

**Laser triangulation**

The sensor shoots a laser onto the surface and receives a reflection somewhere else. By using geometry and calculating the angle of the reflected laser the sensor is able to assemble the structure of the object.

**Structured light**

Alternatively, the sensor uses a linear light pattern to develop a map of the object and observes how the pattern is reflected around the object.
Laser-pulse
More complex scanners use lasers-pulse systems or GPS to detect the structure of the object. With the help of a time-of-flight measurement, they calculate the amount of time the lasers needs to hit the object and return. These measurements are precise down to a picosecond (1/1,000,000,000,000 of a second).

As a result, million points on a XYZ graph are detected and generate a point cloud or polygon meshes (triangle meshes) which represent the digital 3D model of the scanned object (Laserdesign.com, n.d.). Depending on the used software, there are several output formats, such as CAD, Inventor, SolidWorks and more (Wright, 2016).

3D scanners are available in form of full-body scanners with the size of a fitting room, small hand-held scanners, desktop scanners and integrated in scales and smartphones.

Millimetre waves
Millimetre wave scanners are often utilised for security screening at airports and based on the measurement of electromagnetic radiations. The waves have the ability to pass through lightweight materials, such as lightweight clothing therefore enable scanning without undressing. Millimetre wave scanners can be distinguished by active and passive scanners. Active scanners direct waves onto the body and analyse the reflected energy, whereas passive scanners only measure the radiation emitted from the scanned object or body (Accardo, Chaudhry, 2014).
Many of the existing size recommendation apps (such as CALA, 3Dabout.me) use the principle of stereo photogrammetry.

**Definition**

"Photogrammetry is the science of making measurements from photographs. The input to photogrammetry is photographs, and the output is typically a map, a drawing, a measurement, or a 3D model of some real-world object or scene” (Walford, n.d.).

In a self-test of the Dutch smartphone application 3Dabout.me, I had to place my foot on a blank DIN A4 sheet of paper and take pictures from three different angles of each foot. The app recognises the outline of the sheet of paper and helps to point the camera in the correct angle by showing the outline on the screen. After taking the pictures, a 3D model of each foot appears and stating the foot measurements. This is possible, by comparing the (unknown) foot measurements to the known measurements of the standardised A4 sheet of paper (3D about.me, see picture: 3D foot model by 3D about.me). (The picture on the left is a screenshot from a digitised foot captured with 3Dabout.me.)

Even though the digitised 3D model of the foot cannot reach a very high precision by only taken three photos, photogrammetry is regarded as one of the most promising technique for the development of virtual fitting technology.

**The scanning techniques most suitable for virtual scanning are: structured**
HOW DOES 3D SCANNING ON THE SMARTPHONE WORK?

In order to use a conventional smartphone camera (or digital camera) as a 3D scanner, one has to take photos of the object from different angles. “Every part of the object must appear in at least 3 photos”. With the help of a processing program, different points on the object are recognised and put together in a three-dimensional structure. “By identifying enough of these spots (sometimes literally millions of them) the program is able to make a digital reconstruction of the object” (Instructables.com, n.d.).

In an experiment, I downloaded the smartphone app trnio to test this concept myself. The app is available for free in the German iOS AppStore and the utilisation is quite simple. By opening the camera via the app and pointing and moving it around the object, the app automatically takes photos. Once the whole object is covered, the app processes the photos into a 3D model. It takes some practice to move the phone steadily around it.

The pictures show an actual photo of my scanned object and a screenshot of the 3D model of it. Because of the high number of photos taken, the app uses a lot of storage and takes several minutes to process each scan. As visible in the screenshot, the result lacks precision but it is still interesting to see that the technology already exists for conventional cameras.
EXPERT INTERVIEW: BENJAMIN RÜSING

(interview and self-test of 3D scanner in the store, following interview freely reworded from notes, 28 October 2017, 10.30am)
Salgert Sports is a sports store in Bergisch Gladbach, Germany, that uses 3D scan technology and virtual fitting to customise running and skiing shoes.

What do you use the 3D scanner for?
We use the 3D scan technology in our store to custom fit skiing boots to the feet of our customers.

Which 3D scanner do you use?
We use a lightbeam 3D scanner and virtual fitting software from corpus.e.

How does the 3D scan process work?
The 3D scanner is embedded into the floor in a separate room of our store.
1. First of all, the customer needs to put on knee-high socks, which have a structure of squares on them, comparable to a net. This helps the sensor in the scanner’s camera to detect the shape of the feet. It is important that the socks have two different colours, in order to guarantee a differentiation between the two feet.
2. Then the customer is supposed to place his feet on the surface of the scanner. The scanner takes two separate scans, one of each foot, by moving a camera with a flashlight around the foot. The measurement takes around 10 seconds per foot.
3. At the same time, the weight distribution (weight bearing) is measured from the platform underneath, giving additional information for the fitting of the mid soles.

What are the requirements for a good scan?
1. The socks need to be very tight because otherwise sticking out material is measured as part of the foot. Additionally, it is important that the seams and the net structure on the sock are placed neatly around the foot and the leg.
2. The customer needs to stand straight and still during the scan (for skiing boots the knees should be slightly bent).
3. There need to be good lighting conditions, which are guaranteed by the integrated light source on the head of the sensor.

What information do you get from the scan and which measurements are most important?
Within a few seconds, the scanner is able to precisely measure all points the feet’s surface and automatically creates nine different measurements about the customers feet and legs which are relevant for the fitting of skiing boots:
1. Recommended shoe size
2. Foot length in cm
3. Foot width in cm
4. Instep height in cm
5. Ball girth in cm
6. Calf girth on 15cm height and 25cm height in cm
7. Heel angle in cm
8. Achilles tendon angle in cm
9. Weight distribution on the sole

How do you get from the foot to the shoe?
After scanning the foot and analysing the measurements, the next step is to choose the best fitting pair of shoes. Therefore, we work together with the Munich skiing boot producer Ertlrenz. The boots are scanned from the inside and the corpus.e software is able to access these information and match them with the 3D model of the foot. It automatically gives the information which boot in which size would be the best fit for the customer. The level of skiing experience and the individual preferences are included in the size selection as well. The scan of the foot and the shoe are layered and you can see on the screen with the help of a heat map, where the shoe fits well and where it fits less, meaning where is needs to be adjusted. Afterwards, the customer is able to try on the boot in the store and give feedback on the fit.

How are the shoes fitted afterwards?
At Ertlrenz, the ski boot is customised. The hard shell of the shoe is heated and adjusted. Afterwards, the customer puts on the inner shoe, which is foamed. The last step is to adjust the insole with the help of a mouldable vacuum pillow and the information from the weight distribution.

How much is a customised ski boot?
A complete package is around 1.100€

Video explanation of lightbeam and corpus.e technology by Sporthaus Schuster  https://vimeo.com/79085064
3D Scanner from lightbeam used at Salgert Sport in Bergisch Gladbach.
Left: 3D foot scanner in the store, centre: two differently coloured, knee-high socks, right: my foot on the scanner before the scan.
Analysis of my 3D foot scan, showing the weight bearing underneath my foot and nine different performed measurements. On the bottom right-hand side, the software shows recommended ski boots for my foot.
Virtual fitting of a ski boot with the corpus.e software: the heat map shows the distance of the shoe and my foot. The red areas have a gap of 35mm to my foot, the blue areas only 2mm. (Note: usually, a 3D scan for ski boots should be performed with slightly bent legs.)
EXPERT INTERVIEW: NICOLE MALUCHA

(Free translation from notes from German interview, 25 October 2017, 6.30pm)
Zalando is an internationally operating online retailer offering a range of 2,000 brands in 15 European countries.

What is your position at Zalando?
• Business Development Manager within the sizing team

Is Zalando interested in 3D body scanning and virtual fitting technology?
• Yes, in fact, we researched and looked into several 3D scanning companies 1.5 years ago

How did the proposed technology work? Did you have to measure the garments yourself or did the scanning company take over that part?
• The scanning company took that part over. Zalando has over 100,000 items live online and therefore, it is impossible to ensure that ourselves.

Why did you decide against the technology?
• Scanning companies scan the customer’s body with the help of the laptop camera (photos in underwear or without clothing) plus manual information about height and weight, software gives size advice based on those information
• Problem: software did not include any information about the material composition, whereby stretch or wanted fit were not taken into account
• Example: H&M has a way more body near and smaller sizing system than s.Oliver

Do you think your customers are willing to use 3D scanning technology?
• The software we looked at was too time consuming and too difficult to use. Especially taking into account, that most of our customers are people who are very busy and don’t have a lot of time to go shopping. Will those customers be willing to go through the procedure of body scanning?
• Besides, customers were sceptical about their data privacy (what happens with the photos and the measurements? Who sees them?)

Do you recognise difficulties with the traditional size guides?
• Zalando has very many different brands from different countries with different sizing systems
• Zalando sells in 15 countries, where the customer needs to be able to buy his size in the particular sizing system.
• What makes it even more difficult is, that Zalando needs the information already before the item goes online, Therefore the sizing team is in close contact with the buyers and producers.
• Difference between Fitting (how does the item fit: loose, body near) and Sizing (actual measurements of the item)
• Loyal customers often know their sizes from experiences with brands, whereas new customers or people with less understanding of fashion are often unable to cope with sizing systems
• In order to give customers a good size advice, Zalando has its own fitting station where we do fittings on live models who have body measurements representing our customer’s sizing. We start off by fitting items with a high return rate to check their fit. After the fitting, we make our advice available in the web shop (e.g. if you are a 34 we’d recommend you buying a 36 because the fit is smaller than usually)
• It is even more difficult when it comes to shoes because there are very many brand-specific grading systems.
• Example: Nike has product different lines such as Nike Performance and Nike SB with again different fit. If a customer orders in our German online shop from both lines in 39, he once gets a UK 6 and once a UK 6.5. This leads to a lot of confusion and increases the return rate.
• We help out with our Customer Care where experts help out by asking shoe sizes from other brands or exact measurements
• We are a team of 13 people only responsible for the sizing, so it becomes obvious how time-consuming and labour-intensive it is.
• Especially fast fashion companies often have less experiences with fitting and cause extra work for Zalando.
THE 3D SCANNING MARKET

Divided into different applications: entertainment & media, aerospace & defence, medical & healthcare, civil infrastructure, industrial manufacturing, and others.

→ different groups interested in the development of the technology

→ the health care industry is regarded as the driving force behind the development (Mordorintelligence.com, 2017)

Most relevant companies involved in 3D scan technology: 3d Systems, Ametek, 3D Digital, FARO Technologies and Autodesk (Person, 2016). Expected growth from USD 3.76 Billion (2017) to USD 5.90 Billion by 2023 at a “CAGR of 7.8% during the forecast period” (Marketsandmarkets.com, 2017).
WHAT ARE THE POSSIBILITIES AND LIMITATIONS OF TODAY’S 3D SCANNING TECHNOLOGY?

This paragraph, outlines the possibilities of the most influential developments in the area of 3D scanning and comments on how these technologies could influence the integration of 3D scanning into the process of online shopping. In doing so, I am aware of the fact that due the immense advancement speed of 3D technology, my evaluation might lose its validity quickly.

Virtual fitting is a complex idea which needs to combine several different existing technologies and ideas to make it possible. The following table show lists of involved companies, combined ideas and technologies make infrastructure for virtual shoe fitting with the help of 3D scanning. 3D scanning is in the development from high professional tools into the everyday life of consumers. Devices become smaller, cheaper and able to integrate into smartphone cameras or as small add-on devices. The software is user friendly and no long manuals are needed. Instead they work intuitive. Several apps use the technology of stereo photogrammetry to mimic 3D scans with 2D cameras. It is only a matter of time until a 3D scanner is integrated into the mass market.

3D scanning technology is developing two major fields: the 3D scanner hardware and 3D scanning software, including virtual fitting tools. Also, relevant for the integration of 3D scanning into the fashion industry, are smartphone applications which give fitting advice with the help of stereo photogrammetric measurements.
The following table shows the possibilities and limitations of today’s 3D scanning technology.

<table>
<thead>
<tr>
<th>Possibilities</th>
<th>Limitations</th>
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</thead>
<tbody>
<tr>
<td>Growing market potential (Marketsandmarkets.com, 2017)</td>
<td>Too high priced for mass market</td>
</tr>
<tr>
<td>Lower prices for higher precision (Marketsandmarkets.com, 2017)</td>
<td>Not a lot of useful application techniques for mobile scanners</td>
</tr>
<tr>
<td>Mobile 3D scanners (portable 3D scanners, hand-held scanners, attachments to mobile devices, smartphone integration: Sony Xperia XZ1)</td>
<td>A lot of storage use on processing devices</td>
</tr>
<tr>
<td>New customisation methods (Adidas Futurecraft)</td>
<td>High set-up costs for retailers</td>
</tr>
<tr>
<td>Virtual fitting software (corpus.e)</td>
<td>No sufficient accessibility for customers (only in highly specialised stores)</td>
</tr>
<tr>
<td>Size recommendation apps (3D about.me, findmeashoe)</td>
<td></td>
</tr>
<tr>
<td>Better precision in foot measurement than traditional methods (Lee, Lin, and Wang (2014))</td>
<td></td>
</tr>
</tbody>
</table>
The following table gives an overview of some relevant 3D scanning technologies which are targeted at the mass market and would have the potential to be used for virtual fitting (no professional 3D body scanning technology):

**3D scanner hardware**

<table>
<thead>
<tr>
<th>Company</th>
<th>Product</th>
<th>Type</th>
<th>Application for virtual fitting</th>
<th>Accessibility</th>
<th>Price</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Styku</td>
<td>Styku</td>
<td>3D scanning scale, home use 3D scanner to measure body and fitness progress</td>
<td>No integrated software to enable virtual fitting</td>
<td>Home use possible, targeted at mass market, user friendly</td>
<td>Request quote</td>
<td><a href="http://www.styku.com">http://www.styku.com</a></td>
</tr>
<tr>
<td>Shape Scale</td>
<td>Shape Scale</td>
<td>3D scanning scale, home use 3D scanner to measure body and fitness progress</td>
<td>No integrated software to enable virtual fitting</td>
<td>Home use possible, targeted at mass market, user friendly</td>
<td>299 USD</td>
<td><a href="http://www.Shapescale.com">www.Shapescale.com</a></td>
</tr>
<tr>
<td>Eora 3D</td>
<td>Eora 3D</td>
<td>Hand-held 3D scanner, small scale mobile scanning device</td>
<td>No integrated software to enable virtual fitting</td>
<td>Not on the market yet but targeted to home use</td>
<td>319 USD</td>
<td><a href="https://eora3d.com">https://eora3d.com</a></td>
</tr>
<tr>
<td>Oppical</td>
<td>Structure Sensor</td>
<td>3D scanning iPad add-on, able to capture small objects and full rooms</td>
<td>No integrated software to enable virtual fitting</td>
<td>Small device for mass market</td>
<td>379 USD</td>
<td><a href="https://structure.io">https://structure.io</a></td>
</tr>
<tr>
<td>Company</td>
<td>Product</td>
<td>Features</td>
<td>Pricing</td>
<td>Link</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3D systems</td>
<td>Sense 2</td>
<td>Hand-held 3D scanner to capture small scale objects</td>
<td>No integrated software to enable virtual fitting</td>
<td>Small device available for the mass market</td>
<td>349 EURO</td>
<td><a href="https://www.3dsystems.com/shop/sense/order">https://www.3dsystems.com/shop/sense/order</a></td>
</tr>
<tr>
<td>3D systems</td>
<td>Geomagic Capture</td>
<td>Desktop 3D scanner for small-scale objects</td>
<td>No integrated software to enable virtual fitting</td>
<td>Precision on industrial level, high priced</td>
<td>20,000 USD</td>
<td><a href="https://www.3dsystems.com/3d-scanners/geomagic-capture">https://www.3dsystems.com/3d-scanners/geomagic-capture</a></td>
</tr>
<tr>
<td>Sony</td>
<td>Xperia XZ1</td>
<td>Smartphone with integrated ‘3D Creator’ scan camera and software</td>
<td>No integrated software to enable virtual fitting</td>
<td>First smartphone with 3D scan technology</td>
<td>699 EURO</td>
<td><a href="https://estore.sonymobile.com/de/sony-xperia-xz1-warm-silver-de-302569/">https://estore.sonymobile.com/de/sony-xperia-xz1-warm-silver-de-302569/</a></td>
</tr>
<tr>
<td>Ametek Creaform</td>
<td>HandySCAN 300 and HandySCAN 700</td>
<td>Portable 3D scanner</td>
<td>No integrated software to enable virtual fitting</td>
<td>High accuracy, measures objects of all sizes but too expensive to be interesting for mass market</td>
<td>50,000 -100,000 USD</td>
<td><a href="https://www.creaform3d.com/en/metrology-solutions/portable-3d-scanner-handyscan-3d">https://www.creaform3d.com/en/metrology-solutions/portable-3d-scanner-handyscan-3d</a></td>
</tr>
<tr>
<td>Ametek Creaform</td>
<td>Go!SCAN 50</td>
<td>Hand-held 3D scanner for Medium and big-scale objects</td>
<td>No integrated software to enable virtual fitting</td>
<td>High accuracy but too expensive to be interesting for mass market</td>
<td>20,000 – 50,000 USD</td>
<td><a href="https://www.creaform3d.com/de/messtechnik/tragbare-3d-scanner-goscan-3d">https://www.creaform3d.com/de/messtechnik/tragbare-3d-scanner-goscan-3d</a></td>
</tr>
<tr>
<td>Shining 3D</td>
<td>EinScan Pro</td>
<td>Hand-held 3D scanner, weighs only 0.8kg, high scanning speed</td>
<td>No integrated software to enable virtual fitting</td>
<td>Small device available for the mass market</td>
<td>4,999 USD</td>
<td><a href="https://www.einscan.com/einscan-pro-plus?gclid=EAIaIQobChMI_m_2Kn-Wn1wIVCeAZCh3L9QfpEAAYAygAEgKvrvD_BwE">https://www.einscan.com/einscan-pro-plus?gclid=EAIaIQobChMI_m_2Kn-Wn1wIVCeAZCh3L9QfpEAAYAygAEgKvrvD_BwE</a></td>
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## Software companies

<table>
<thead>
<tr>
<th>Company</th>
<th>Type</th>
<th>Short Description</th>
<th>Relevance</th>
<th>Price</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corpus E</td>
<td>Virtual fitting software</td>
<td>Web and in-store tool to fit customer’s shoes, in-store 3D Scanning</td>
<td>Virtual fitting technology, inside scans of shoes, suggests fitting pairs</td>
<td>n.s.</td>
<td><a href="http://www.corpus-e.com/en/home.html">http://www.corpus-e.com/en/home.html</a></td>
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<tr>
<td>Agisoft</td>
<td>3D processing software</td>
<td>3D processing software</td>
<td>Generate 3D models and point clouds</td>
<td>From 179 USD</td>
<td><a href="http://www.agisoft.com">http://www.agisoft.com</a></td>
</tr>
<tr>
<td>3D about.me</td>
<td>Virtual Fitting App - Feet</td>
<td>Using stereo photogrammetry, giving size recommendation for connected brands</td>
<td>applicable to shoe purchasing</td>
<td>Free</td>
<td><a href="https://www.3dabout.me">https://www.3dabout.me</a></td>
</tr>
<tr>
<td>vFit</td>
<td>Virtual Fitting App - Feet</td>
<td>Using stereo photogrammetry, giving size recommendation for connected brands</td>
<td>applicable to shoe purchasing, not available in EU app store</td>
<td>Free</td>
<td><a href="http://vfitshoes.com">http://vfitshoes.com</a></td>
</tr>
<tr>
<td>Find me a shoe</td>
<td>Virtual Fitting App - Feet</td>
<td>Giving size recommendation for connected brands</td>
<td>applicable to shoe purchasing, App not available in EU app store</td>
<td>Free</td>
<td><a href="http://findmeashoe.in">http://findmeashoe.in</a></td>
</tr>
<tr>
<td>True Fit</td>
<td>Fit Rating Engine</td>
<td>Makes fit recommendation for partnered brands</td>
<td>Connected to a lot of retailers but measuring tools uncertain</td>
<td>n.s.</td>
<td><a href="https://www.truefit.com/Home">https://www.truefit.com/Home</a></td>
</tr>
<tr>
<td>Adidas Futurecraft</td>
<td>Customised shoe</td>
<td>3D scanned feet and turned into customised 3D printed midsole</td>
<td>Limited edition, omni-channel necessary</td>
<td>333 USD</td>
<td><a href="http://www.adidas.com/us/futurecraft">http://www.adidas.com/us/futurecraft</a></td>
</tr>
<tr>
<td>bodi.me</td>
<td>Virtual Fitting App - Clothing</td>
<td>Using stereo photogrammetry to</td>
<td>Connected with a number of bigger fashion brands</td>
<td>Free</td>
<td><a href="http://bodi.me">http://bodi.me</a></td>
</tr>
<tr>
<td>Company</td>
<td>Product</td>
<td>Features</td>
<td>Requirements</td>
<td>Cost</td>
<td>URL</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------</td>
<td>---------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>ca.la</td>
<td>Virtual Fitting App - Clothing</td>
<td>Using stereo photogrammetry, fit via app, custom made clothes</td>
<td>No mass application</td>
<td>Free</td>
<td><a href="https://ca.la/shop">https://ca.la/shop</a></td>
</tr>
<tr>
<td>Trnio</td>
<td>3D Scan App</td>
<td>3D scan small scale objects with smartphone camera, creates a point cloud</td>
<td>Requires some experiences, not very detailed</td>
<td>Free</td>
<td><a href="http://www.trnio.com">http://www.trnio.com</a></td>
</tr>
<tr>
<td>Ametek Creaform</td>
<td>VXmodel</td>
<td>Software complementing CAD to finalize scans</td>
<td>Giving better quality to 3D scans</td>
<td>25,000 USD</td>
<td><a href="https://www.creaform3d.com/en/metrology-solutions/3d-applications-software-platforms/vxmodel-scan-cad-software-module">https://www.creaform3d.com/en/metrology-solutions/3d-applications-software-platforms/vxmodel-scan-cad-software-module</a></td>
</tr>
</tbody>
</table>
ACCESSIBILITY OF 3D SCANNING

This list shows all publicly accessible 3D body scanners in the metropolitan area of the city Cologne, as an example to illustrate the distribution of 3D scanners in urban areas.

Cologne

City area: 405.17 km²
Population: 1,027,504
Density: 2,600/ km²
Metropolitan population: 3,573,500

Online findings using google search engine with keywords: 3d scanner köln, 3d scanner cologne, 3d body scanner köln

<table>
<thead>
<tr>
<th>Company</th>
<th>Type of 3D scanner</th>
<th>Accessibility</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go3</td>
<td>Foot scanner</td>
<td>Only for ski boot customisation</td>
<td><a href="http://www.go-drei.de">http://www.go-drei.de</a></td>
</tr>
<tr>
<td>SalgertSport</td>
<td>Foot scanner</td>
<td>Only for ski boot customisation, in the rural area 23km outside Cologne</td>
<td><a href="http://www.salgertsports.de">http://www.salgertsports.de</a></td>
</tr>
<tr>
<td>FormFab</td>
<td>Small-scale object scanner</td>
<td>Service fee, only for replica of small-scale objects (35 x 25cm)</td>
<td><a href="https://www.formfab.de/digitalisierung/scan/">https://www.formfab.de/digitalisierung/scan/</a></td>
</tr>
<tr>
<td>Public Library</td>
<td>Small-scale object scanner</td>
<td>Free use, only for replica of small-scale objects (35 x 20cm)</td>
<td><a href="http://www.stadt-koeln.de/leben-in-koeln/stadtbibliothek/bildungsangebote/3-d-drucker-und-3-d-scanner">http://www.stadt-koeln.de/leben-in-koeln/stadtbibliothek/bildungsangebote/3-d-drucker-und-3-d-scanner</a></td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------</td>
<td>-------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3DScan Works</td>
<td>All object sizes</td>
<td>Offer a service to digitise objects, all object sizes</td>
<td><a href="http://3d-scanworks.com/3d-digitalisierung.html">http://3d-scanworks.com/3d-digitalisierung.html</a></td>
</tr>
<tr>
<td>Die Schuhleister</td>
<td>Foot scanner</td>
<td>Customisation of business shoes</td>
<td><a href="https://www.schuhleister.com">https://www.schuhleister.com</a></td>
</tr>
<tr>
<td>3D Me</td>
<td>Body scanner</td>
<td>3D body scan to print replica, 49-199 Euro</td>
<td><a href="http://www.3d.me/de/">http://www.3d.me/de/</a></td>
</tr>
<tr>
<td>Dooblex</td>
<td>Body scanner, photogrammetry</td>
<td>Service to digitise 3D objects</td>
<td><a href="https://www.dooblex.de/en/3D%20SCANNING/">https://www.dooblex.de/en/3D%20SCANNING/</a></td>
</tr>
</tbody>
</table>

The table shows that 3D scanning technology becomes more and more distributed and is used as part of different interesting business models. The only publicly and freely available 3D scanner is a small-scale object scanner which belongs to Cologne’s public library. Besides, there are three retail concepts using 3D foot scanning for customisation of different kinds of shoes. However, there is no publicly accessible body scanner for size advice in Cologne (e.g. in a shopping centre or store).
WHAT ARE THE ADVANTAGES OF 3D BODY SCANNERS?

The introduction of 3D body scanning to the process of shoe online shopping is of advantage for both, consumer and retailer. In the following table, I am summarising the most striking arguments for 3D scanning technology based on the interview with Nicole Malucha, Zalando and online research on online shopping behaviour.

<table>
<thead>
<tr>
<th>Consumer</th>
<th>Retailer</th>
</tr>
</thead>
<tbody>
<tr>
<td>More transparency regarding size systems</td>
<td>Less returns, higher conversion</td>
</tr>
<tr>
<td>Online virtual fitting room helping with size decisions</td>
<td>More information about actual fit, can be used for prototyping</td>
</tr>
<tr>
<td>More regular and precise foot measurements ((Lee, Lin, and Wang (2014)</td>
<td>Less size advice through customer service necessary</td>
</tr>
<tr>
<td></td>
<td>USP</td>
</tr>
<tr>
<td></td>
<td>Incentive to visit local stores, support for retail staff</td>
</tr>
</tbody>
</table>

As pointed out already in the paragraph [possibilities and limitations of 3D scan technology], the major problems and disadvantages of 3D scanning technologies are: the limited distribution and accessibility of 3D body scanners for customers, high set-up costs for retailers and current application possibilities of the technology.
WHAT IS THE PERFECT SHOE SIZE?

Traditionally the foot is being measured with a digital calliper, a tape measure or an ink footprint (Lee, Lin, and Wang, 2014). Well-fitting shoes support the muscles and bone structure of the feet. It is recommended to check the shoe size every year because the foot proportions change throughout lifetime (Holmes, 2014).

- The average shoe size has grown 2 sizes since the 1970s (Holmes, 2014).
- Badly fitted shoes can lead to health issues, pain and deform the feet and toe shape over time
- “Regardless of how long you’ve been buying and wearing the same pair of shoes in the same size, if you want the best fit, you should get your feet measured in store about once a year.”, “Your foot changes throughout your lifetime, so it is always good to get it correct when purchasing new shoes,” (Kitchen, n.d.).
- “The inner cavity of a shoe must typically be 15–20 mm longer than the foot, but this relation varies between different types of shoes” (Boehm, 2015).

Sizing systems were developed in the 19th century and do not represent the variations of body measurements around the world. (Innes, 2014)

<table>
<thead>
<tr>
<th>EU shoe size</th>
<th>(foot length in cm + 1,5cm gap) x 1,5</th>
</tr>
</thead>
<tbody>
<tr>
<td>US shoe size</td>
<td>3 x last length – 24</td>
</tr>
<tr>
<td>UK shoe size</td>
<td>3 x last length – 23</td>
</tr>
</tbody>
</table>

(Blitzrechner.de, n.d.)
In 1991, the International Organisation for Standardisation (ISO) introduced a universal sizing system for shoes called Mondopoint (ISO 9407) which has mainly established itself for military shoes and safety shoes today (ISO, 1991).

In general, the foot length and width, the ball and calf girth and the instep height are the most relevant measurements to be determined.

<table>
<thead>
<tr>
<th>EU</th>
<th>US</th>
<th>UK</th>
<th>Fußlänge (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36</td>
<td>5</td>
<td>3</td>
<td>22,9</td>
</tr>
<tr>
<td>36,5</td>
<td>5,5</td>
<td>3,5</td>
<td>23,4</td>
</tr>
<tr>
<td>37</td>
<td>6</td>
<td>4</td>
<td>23,8</td>
</tr>
<tr>
<td>38</td>
<td>6,5</td>
<td>5</td>
<td>24,3</td>
</tr>
<tr>
<td>38,5</td>
<td>7</td>
<td>5,5</td>
<td>24,6</td>
</tr>
<tr>
<td>39</td>
<td>7,5</td>
<td>6</td>
<td>25,1</td>
</tr>
<tr>
<td>40</td>
<td>8</td>
<td>7</td>
<td>25,4</td>
</tr>
<tr>
<td>40,5</td>
<td>8,5</td>
<td>7,5</td>
<td>25,8</td>
</tr>
<tr>
<td>41</td>
<td>9</td>
<td>8</td>
<td>26,3</td>
</tr>
<tr>
<td>42</td>
<td>9,5</td>
<td>9</td>
<td>26,7</td>
</tr>
</tbody>
</table>
CONSUMER ATTITUDE TOWARDS 3D SCANNING

In a research study on 3D body scan technology from Cornell University College of Human Ecology by professors Susan Ashdown and Suzanne Loker, several subjects were scanned with a 3D scanner in order to evaluate the fit of a pair of pants. After the scan, the researchers asked the subjects about their experiences in the body scanner and "found the answer to be a resounding "yes" for interest and comfort, regardless of size, age, or their satisfaction with the fit of available ready-to-wear pants. Almost all were willing to be scanned again and many were willing to be scanned every year or whenever their weight changed." Nevertheless, "the participants were less comfortable seeing their scans as a still or moving picture on the computer screen and least comfortable showing their scans to family and friends." As a possible solution, the researchers abstracted the scan "by reducing the number of data points, changing the colour and lighting on the scans, and placing several scans together for context" (Ashdown and Loker, 2011).

A different study from Iowa State University "Exploring Consumer Perceptions toward the Use of Me-Altity Body Scanner for Clothing Selection in U.S. Shopping Malls" found out, that the most common reasons for participants to test the 3D body scanner in a mall were "to check their right clothing size, for fun, and because another person asked them to try the body scanning". Further it states that the subjects had a generally positive attitude towards 3D body scanning and "expressed their interest to use this technology in the future, especially obtaining their accurate sizing information in a retail store setting" (Lee, Lin, and Wang, 2014).

In order to explore the subject and the opinions and shopping experiences myself, I conducted a primary research by creating my own consumer survey.
CONSUMER SURVEY

My research includes a consumer survey, in order to discuss my hypothesis with primary research.

Goal: get 300 participants
Distribution: Shared on my Facebook account, reposted by two Facebook friends
Time frame: 4 weeks

The whole survey consists of 12 questions and is supposed to take 2-3 minutes for the respondent.

Questions:

1. Do you prefer buying shoes in-store or online?
2. How often do you order shoes online?
3. How satisfied are you with the overall fit of your purchased shoes?
4. Do you recognise differences in sizing among different brands?
5. What is your shoe size in EU sizing?
6. How sure are you about your size?
7. What is your shoe size in UK sizing? (and try without googling)
8. What is your US shoe size?
9. How do you know which size to buy online?
10. When was the last time you had your feet measured?
11. Have you ever tried 3D body scanning before?
12. Are there any reasons you are sceptical about 3D scanning and using these data online?
13. Personal Data: Gender, Age, Which country do you live in?, Occupation
BEST ONLINE SURVEY TOOL

Before I started to construct my survey, I looked for the most suitable online tool.

<table>
<thead>
<tr>
<th>Service</th>
<th>Amount of Surveys</th>
<th>Questions</th>
<th>Respondents</th>
<th>Custom design options</th>
<th>Data export options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google Forms</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SurveyMonkey</td>
<td>Unlimited</td>
<td>10</td>
<td>100</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Typeform</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>100 / month</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SurveyLegend</td>
<td>3 per account</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Polldaddy</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Unlimited</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

(Stickler, 2017)

After comparing different options, I decided to use Google Forms because it is free, allows an unlimited amount of questions, does not restrict the number of participants, gives the possibility to customise the design and has the option to export the results. Keeping in mind that the participation in the survey is voluntarily and without any direct benefit for the respondents, it was important to me to only include the minimum amount of questions and to use understandable terms in order to make it as convenient as possible.
RESPONDENTS

Since I aimed to reach a very broad audience, I did not restrict the survey to a special group. I wanted to find out how customers in general feel about 3D body scanning and ask about online shopping experiences. For that reason, I could not target a certain focus group. The survey was posted on Facebook and was shared among friends.

129 people participated in the survey from age 16 to 79. Out of which 43% are between 23 and 27 and 20% between 50 and 58 and therefore, represent the biggest parts of the participants. A slight majority (59%) of the participants are female (and 41% are male). The great majority of the respondents live in Germany (80%), 11% live in the Netherlands. The income of the participants differs as well. 30% are students, while the remaining derives from diverse occupational backgrounds, ranging from managing positions (9%) over doctors, pharmacists to lawyers, designers and interns.

SURVEY RESULTS

82.9 % prefer buying shoes in-store, only 16.3% prefer online and one participant claims to buy as often online as in-store.
The great majority of the participants buys shoes online once or twice per year (62.8%). 17.8% never buy online and 12.4% purchase shoes every two months.

On a scale from 1 (most of them don't fit well) and 5 (they all fit perfectly), half of the participants (50.4%) would rate the fit of their shoes a 4. 35.7 % rate a 3 and only 5.4% claim that all their purchased shoes fit perfectly.
46.9% of the participants notice differences in sizing among different brands and claim that they are “entirely different”. 47.7% notice differences but are able to deal with them, with the help of size guides and retail staff. Only the remaining 5.4% never recognised any differences.

This graph shows the distribution of EU shoe sizes. 25 respondents (19%) answered with half shoe sizes (e.g. 44.5), 3 participants gave a range of two sizes (e.g. 39-40), one participant answered with a 10 which is no shoe size is the EU system.
On a scale from 1 (Could vary a size or two.) to 5 (I always buy the same size and am happy with it.) The majority rates a 4 (38.8%), 17.8% are entirely sure about their shoe size, 21.7% only rate a 2.

Looking at the US sizes, the most striking finding is that 51.2% does not know their US shoe size.
A similar result can be found when looking at the UK sizes. Here 48.8% do not know their shoe size in a UK sizing system.

Asking about how the participants decide which size to buy online, most of the participants (48.8%) decide from experiences with brands. Due to changes in the answer possibilities (spelling) after a few days run time, size guides + size charts, size guide + size charts and size charts can be summarised as one answer. In total, 47.2% orientate themselves with the help of size guides and size charts. 12.4% order multiple sizes home and send the others back. And 17.8% are not affected because they do not order online. (Multiple answers were possible.)
Most of the respondents (61.2%) had their feet last measured as a kid, 11.6% never had their feet measured and 20.9% within the last 2 years.

Only 4 out of 129 respondents ever tried a 3D body scanner before, for fitting golf or running shoes, ski boots or lingerie. Whereas, 97% state to have never been in contact with a 3D body scanner. (Due to the formatting, multiple answers were possible, that is why the percentages need to be interpreted differently).
When asking the participants about reasons to be sceptical about 3D scanning and using the measurement data online, multiple answers were possible again: 56.6% of the participants were curious about the technology and are “willing to try it immediately”, while 18.6% would “rather have their feet scanned than the rest of their body”, 17.8% are worried about their data privacy, 10.1% “don’t want to know every measurement of their body” and another 10.1% are worried that the technology is “difficult to use”. 

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curious about technology</td>
<td>56.6%</td>
</tr>
<tr>
<td>Willing to try it immediately</td>
<td>18.6%</td>
</tr>
<tr>
<td>Feet scanned more</td>
<td>17.8%</td>
</tr>
<tr>
<td>Data privacy</td>
<td>10.1%</td>
</tr>
<tr>
<td>Don’t want to know measurements</td>
<td>10.1%</td>
</tr>
<tr>
<td>Difficult to use</td>
<td>10.1%</td>
</tr>
</tbody>
</table>
ONLINE RETAIL IMPLEMENTATION

For a successful application of 3D body scanning into the process of online footwear retail, an interaction of different fields, technologies and platforms is required. It needs a working infrastructure to connect the customer with the retailer via the technology. This could either be in form of a made-to-measure production:

Foot scan in store → manufacturer uses measurements from 3D scan → produces made-to-measure shoes

Or with the help of a virtual fitting tool in online stores:

Consumer scans foot with app at home → uploads data → linked to online shops → scan and shoe are layered → recommended shoe size and possible fit problems are shown

These models are based on the assumption, that 3D body scanning is accessible to customers, either in form of smartphone-integrated 3D scanners or a high distribution of 3D scanners in stores or public areas.
With this flow chart, I am visualising a possible retail process including 3D scan technology:
PRODUCT PHASE
WHAT PRODUCT WOULD ADD VALUE FOR THE INDUSTRY?

I arranged a meeting with the founders of 3Dabout.me in order to hear more about their evaluation of the market. They told me about several problems they are facing.

Notes from the meeting with Joost from 3Dabout.me, 4th December 2017:

How 3D about.me works:

Connected to 7 web shops, database of 450 brands, 1,200-1,500 shoes

Input: 3 photos of each foot
results from 10,000 in-foot scans
Output: 28 measurements per foot
Shoe measurement: with scanner at own lab in Diemen
in-shoe scans
measurement of the smallest and biggest size, in-between with algorithm

Problems:
- Connections to online shops, retailers still don’t see the relevance of 3D scanning
- Online shops don’t want to share client and collection data with 3Daboutme
- Customer’s psychological issue, do not trust app
- What information to give to customers within app
PRODUCT

Based on the interview with 3Dabout.me, I got different ideas for products which benefit the development of 3D scanning technology:

Ideas for the product:

Explore the effect on the return rate with scan test, use shoe sets from 3D about me (Stan smith and converse in all sizes), problem: psychological effect (how do I evaluate if it truly fits and what’s the participants imagination?)

Presentation from 3D about me for retailers: present the brand, explain idea and benefits

Guide for retailers: What is 3D scanning, how to change process, what providers, what benefits?

After evaluating the relevance and necessity of the proposals, I decided for the Retailer’s Guide. In my opinion, it is the most feasible option with the highest relevance for the industry.

Content:

3D scanning + virtual fitting + shoe sizing (briefly explained)
Benefits of 3D scanning
Changes of retail processes
Market Potential
List + comparison of all 3D scanning companies (apps + in-store scanners)
Consumer Attitude
Recommendations

Goal:

The goal of this product is to save retailers the trouble to research 3D scanning technologies for their retail concept. The document is supposed to summarise all relevant information in the technology, the market, the consumer and it 3D scanning providers. After the completion of the product, I would like to make the document available online and share it with 3D scanning companies in order to help them advertise their service to retailers and therefore make the acquisition of new customers easier.
## WHAT MEDIUM WOULD BE MOST SUITABLE TO CONVEY THE MESSAGE?

<table>
<thead>
<tr>
<th>Medium</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BROCHURE</td>
<td>A brochure can contain a big amount of information. It has a lot of design and layout possibilities. On the other hand, it works best as a print medium and is not sustainable and not easy to distribute among a wider audience. Further, it is not interactive.</td>
</tr>
<tr>
<td>PDF</td>
<td>A pdf is a medium which can present information in a structured way but it does not add any value to the Research Report PDF. Retailers could also just read the report then. It is not very vivid.</td>
</tr>
<tr>
<td>WEBSITE</td>
<td>A website is a medium which is interactive and easy to distribute. It offers the opportunity to show information in a structured and categorised way. Many different design options are possible. But in my opinion, a website needs to be run by an organisation or company and cannot just contain independent information.</td>
</tr>
<tr>
<td>BLOG</td>
<td>Similar to a website, blogs give many possibilities to visualize information. In my opinion, they are also a medium to show independent information. But it does not have a very professional character.</td>
</tr>
<tr>
<td>APP</td>
<td>An app is a modern and nice way to give information on a topic. But I would not be willing to download an app only to get information on a certain technology. And further, it is not very easy to share apps among interested people.</td>
</tr>
<tr>
<td>QUIZ-BASED RECOMMENDATION</td>
<td>A quiz-based recommendation engine offers the best possibilities to recommend a product. The retailer has to answer a small number of questions and gets an automatic product advice based on the results. Therefore, the retailer does not have to read through information, which do not affect his business model.</td>
</tr>
</tbody>
</table>
HOW TO CREATE A QUIZ-BASED RECOMMENDATION ENGINE?

After contemplating different media to convey my research results, I decided for a quiz-based recommendation engine. The retailer gets to answer some questions about his business model and based on the results, the engine will give an automated recommendation on the best virtual fitting tool for the business.

The engines are based on algorithms which evaluate the answers and decide on the best-fitting product. Programming the engines can either be done through coding or through online tools.

After checking the possibilities of different online programs, I decided for the platform: onlinequizcreator.com.

On the website, I created different result categories which include the most relevant information on each fitting technique. And afterwards, I put together a list of questions, which would lead the retailer to the specific result category. Therefore, each answer possibility needs to be evaluated and be given a factor. (e.g. if retailers only use online channels, they should be recommended 3D Scanning Apps or Size Recommendation Tools with the factor +5).
QUESTIONS AND CATEGORIES

QUESTIONS

1. What is your retail concept? (only footwear, shoes and clothing, multi-brand, single-brand, sports shoes)
2. What channels do you utilize? (online, offline, cross-channel)
3. Have you experienced differences in sizing among the shoes in your product range? (yes, no)
4. How high is your return rate currently? (n.s., 10-20, 20-30%, above 30%)

CATEGORIES

1. In-store Scanners
   A 3D foot scanner is the perfect solution for your local store.

   How it works:
   Depending on the technology and the provider, in-store foot scanners consist of both a platform and one or more cameras which take photos around the feet within a few seconds. 3D body scanners capture the human foot and create a virtual 3D model of it. Some scanners are also able to detect and recreate colours and measurements. After the scan, the measurements of the foot are digitally aligned with the internal measurements of the shoe. The fitting software accesses data from inside-scans of available shoes or prototyping models. The technology is able to detect fit problems by calculating the distance between the inside of the shoe and the foot. As a result, the program can display a heat map, exact measurements or gives size recommendations for preselected shoe models.

   Advantages:
   Customers are able to have their feet scanned in-store and get suggestions about shoe sizes and the best fitting model available. It therefore serves as a professional support to your retail staff. The virtual fitting software gives additional information about possible fit problems by showing a heat map or by giving automatic advice. Using 3D scanning technology tools in-store or online indicates high expertise and leads to a higher confidence in size decisions and trust. Offering the new technology means offering an extra service for customers, which can be seen as a USP against competitors. The scanner
serves as an additional incentive to visit the store. Customers using in-store scanners are more likely to purchase shoes after getting scanned. According to different providers, the conversion rate is between 85% and 90%. The software can be used as a basis for customisation.

Providers:
Corpus.e, Volumnetal, 3D-A-Porter, DomeScan, RightShoes, TC2, Voxelcare

2. Cross-Channel
3D foot scanning technology functions as the perfect bridge between the online and offline channels.

How it works:
A 3D foot scanner is installed in the local retail store. Depending on the technology and the provider, in-store foot scanners consist of both a platform and one or more cameras which take photos around the feet within a few seconds. 3D body scanners capture the human foot and create a virtual 3D model of it. Some scanners are also able to detect and recreate colours and measurements. After the scan, the measurements of the foot are digitally aligned with the internal measurements of the shoe. The fitting software accesses data from inside-scans of available shoes or prototyping models. The technology is able to detect fit problems by calculating the distance between the inside of the shoe and the foot. As a result, the program can display a heat map, exact measurements or gives size recommendations for preselected shoe models. The digitalised foot can help finding a shoe both, in-store and future purchases in the retailer’s online shop.

Advantages:
Customers are able to have their feet scanned in-store and get suggestions about shoe sizes and the best fitting model available. It therefore serves as a professional support to your retail staff. The virtual fitting software gives additional information about possible fit problems by showing a heat map or by giving automatic advice. Using 3D scanning technology tools in-store or online indicates high expertise and leads to a higher confidence in size decisions and trust. This increases loyalty and engagement and gives additional incentives to visit local stores. Offering the new technology means offering an extra service for customers, which can be seen as a USP against competitors. Customers using in-store scanners are more likely to purchase shoes after getting scanned. According to different providers, the conversion rate is between 85% and 90%. The software can be used as a basis for customisation.
Providers:
Corpus.e, Volumnental, 3D-A-Porter, DomeScan, RightShoes, TC2, Voxelcare

3. **Size Recommendation Tool**
   As a retailer of shoes and garments, you need one size advice tool for all product groups.

   How it works:
   Size recommendation tools are usually based on the manual input of information. They ask the customer a number of questions about preferred fit and experiences with sizes. Alternatively, they offer a guide for the consumer to take all body measurements manually. As a result, a virtual body double is created.

   Advantages:
   The software works for both, footwear and clothing. If customers can be sure that they will be able to fit their shoes before they purchase online, the phenomenon of ordering multiple sizes for home try-on can be prevented. 3D scanning technology makes size guides redundant. Different body shapes, variations in sizing and personal preferences are taken into account. Therefore, additional customer service and internal fitting departments become unnecessary for retailers and manufacturers. Most providers of 3D scanning technology offer evaluation tools. Due to that, retailers are able to get to know their customers better and use their valuable data for buying and internal size charts. Being connected with 3D scanning services enables additional marketing exposure for retailers and brands through the provider’s apps and websites.

   Providers:
   Virtusize, Fits.me, Bold Metrics

4. **Virtual Fitting Apps**
   As an online retailer, you want to give your customer additional help with sizing and fitting. The best tool for you are virtual fitting apps by external providers.

   How it works:
Virtual fitting tools can easily be implemented into the web shop with the help of a plugin or widget. The software is connected to an app by an external provider which requires photos from the customer’s foot. Usually, the foot has to be placed on a sheet of paper or a special mat. Afterwards, three or more photos are taken from different angles in order to assemble a 3D model of the foot. The fitting software accesses data from inside-scans of available shoes or prototyping models. The technology is able to detect fit problems by calculating the distance between the inside of the shoe and the foot. As a result, the program can display a heat map, exact measurements or gives size recommendations for preselected shoe models.

Advantages:
The smartphone applications are usually free for consumers, easily accessible in app stores and do not require any expensive equipment or complicated explanation. The application of virtual fitting tools in online shops gives more confidence in size decisions to prospective customers and makes size guides redundant, as the scans function as a universal sizing. Further, 3D scanning takes irregularities of the bone structure and different foot shapes into account and therefore guarantees a more precise measurement than traditional measuring methods. If customers can be sure that they will be able to fit their shoes before they purchase online, the phenomenon of ordering multiple sizes for home try-on can be prevented. Different 3D scanning providers advertise a decrease of returns by 25-31%. Most providers of 3D scanning technology offer evaluation tools. Due to that, retailers are able to get to know their customers better and use their valuable data for buying, internal size charts and prototyping. Offering the new technology means offering an extra service for customers, which can be seen as a USP against competitors. Using 3D scanning technology tools in-store or online indicates high expertise and leads to a higher confidence in size decisions and trust. Being connected with 3D scanning services enables additional marketing exposure for retailers and brands through the provider’s apps and websites. Some 3D scanning tools offer the possibility to show the best fitting shoe from the selected online shop. Therefore, the tool creates a preselection and allows the possibility to give the customer a more personalised offer.

Providers:
3Dabout.me, 3Dlook.me, findmeashoe.com, vFit9

At the end of each category, a link refers to the full PDF of my Retailer’s Guide. That way, the retailers are able to get deeper information on 3D scanning, pricing and descriptions of each provider.

Link to the quiz: https://www.onlineassessmenttool.com/what-shoe-fitting-tool-suits-my-retail-concept/assessment-83789
INTERESTING ARTICLES
Amazon buys 3D scanning start up ‘body labs’

Nonetheless, Amazon’s acquisition of New York’s Body Labs could have interesting consequences for its fashion operations. Even closer to Body Labs terrain is Amazon’s Echo Look, a camera-equipped version of the popular Amazon Echo IoT system. The Echo Look is equipped with a feature that helps customers try on clothes that suit them. It is, however, only equipped with a regular camera, and cannot analyze the shape of a customer in the same way that 3D scanning can. For the former, companies can use Body Labs tech to analyze the unique contours of a customer’s body, fitting them with the right outfit for their shape.
https://www.3ders.org/articles/20171005-amazon-buys-3d-body-scanning-startup-body-labs-for-estimated-50-70m.html

Sony’s new Xperia XZ1 and XZ1 Compact phones come with 3D scanning technology

The 3D scanner in the Xperia’s camera should be straightforward for anyone to use, with a handy on-screen guide provided in the 3D Creator app that serves as the main interface for the scanning technology. Similar to 3D scanning technology built in to various other portable devices, it combines hardware and software elements to scan, but this is one of the most intuitive and advanced examples seen so far. Creating a detailed 3D image of whatever object you choose to point your lens at is almost as simple as taking a regular photo. Also, unlike with many portable 3D scanners in the past, there is no connection to a cloud service required to process the image, as all the processing takes place on-board the mobile device. The 3D Creator app, which is Sony’s in-house algorithm for 3D imaging, comes with four different dedicated scan modes: head scan, face scan, food scan and freeform scan. Once a 3D scan is captured, there’s a number of different things that users can do with it. The files, each of which is around 2MB, are easily shareable with friends via an integrated connection to messaging apps like WhatsApp, and they can also be demonstrated to a wider network on sharing communities such as Sketchfab.
Transform your smartphone into a mobile 3D scanner

"I think our technology and further developments along these lines will lead in the near future to everyone being able to capture realistic visual 3D representations of objects and scenes as easily as photographs are taken today. The impact will be comparable to that of photography today," says Prof. Marc Pollefeys. Solutions for 3D scanning already exist but have required dedicated 3D scanning hardware. However, the idea is to make three-dimensional scanning as easy as taking pictures - a significant and practical benefit for hobbyists and the do-it-yourself crowd, without design or engineering degrees. Instead of taking a conventional photo, the user simply moves his phone around the object of interest and after a few motions a 3D model appears on the screen. As all calculations are performed directly on the phone, the user gets immediate feedback and can select additional viewpoints to cover missing parts of the 3D model. This is an important advantage compared to solutions that ‘batch-process’ all the images in the cloud at a later time. The technology is becoming more and more pervasive not only in daily life, but also in the fields cultural heritage and commerce. The potential to reshape industries

3D scanning and printing are eliciting growing interest from business and industry. Companies grapple with the implications of this relatively low-cost duplicating method. Some pundits consider the technology the spark that will launch the next industrial revolution. 3D reconstruction of existing objects will break down current barriers in ad-hoc object reproduction, as no knowledge of computer design software is needed to recreate (or remix) and existing object. The Boston Consulting Group believes that 3D printing will prove a game-changer for large sections of industry, and 3D reconstruction is its natural counterpart. "In short, 3D printing is on a fast track to mainstream adoption - and the time for companies to weigh the ramification for their business is now." Hearing-aid manufacturers, for example, are producing some custom-fitted ear pieces from scanned molds of patients. The technology will force many corporations to rethink their businesses and business models.

Online Footwear Shopping Made Easy by Find Me A Shoe

Find Me A Shoe has developed an end-to-end footwear size and fit recommendation application that aims at giving all footwear shoppers an oh-so-easy footwear shopping experience online. The mobile and vision-based technology provides consumers with shoe recommendations based on precision measurements and personalized fitting algorithms that go beyond the traditional shoe scale system.

Find Me A Shoe offers its fitting service to footwear retailers and brand outlets. The patent pending technology enables the shoppers to find a shoe that fits in just a click. The recommendation engine simulates a shopper’s foot (with 12+ parameters) inside every model before suggesting the best size and fit. With cloud-based servers running Artificial Intelligence-enabled complex computer vision algorithms in the background, recommendations ensure customer’s toes and heels will fit comfortably in that new shoe.

https://www.digitalcommerce360.com/2017/07/19/next-generation-retail-online-footwear-shopping-made-easy-find-shoe/
http://findmeashoe.com

Invertex Raises $2 Million in Seed Funding Round to Develop Retail Footwear Technology

The Invertex Launch-Pad: an in-store self-use unit that enables customers to independently model both their feet in 3D in less than ten seconds, providing perfect size recommendations for every shoe model in the store as well as online.

REFERENCES


IMAGE REFERENCES

Image 1:

Image 2:

Image 3:

Image 4:

Image 5:

Image 8: