1.1 Summarize the status and progress of the activities in relation to the development of the product / service and indicate to which degree the milestone objectives have been met

This document will refer to the advancements of AlterEgo obtained in the period 1st March 2024 - 21 August 2024, from the beginning of the SIP Project to the submission of this report.

The team members we acquired helped move our technology forward in various aspects, driven by their respective and specific expertise we achieved great advancements in several aspects of our product and technology. Some of these are going to be documented in the following milestone reports which explain how we measured against the main milestones presented in the SIP application.

During this period we also engaged with Intellectual property firm EBlum to progress on our IP protection strategy and to assess once again our Freedom To Operate. In the process of filing a patent for our technology we forwent a FTO Search at the Bern patent office. This followed a first FTO search that was done in November 2022. The recent FTO search confirmed that we are not infringing any existing patent and that we have space to file a patent regarding some specific aspects of our technology.

The product was released to 3 additional customers since the application was submitted. The results of the integration in terms of return rate reduction is still uncertain. Initially, we saw a 22% decrease in returns from the Muntagnard shop, with an engagement rate of around 15%, which is considered high in the industry. As Muntagnard was our first customer, and the first to integrate a 3D try on solution, we were actively working on encouraging shoppers to use the tool. As we integrated further customers, we didn't have the capacity to offer the same visibility around the tool as we did for Muntagnard. Furthermore, small Shopify customers, focused on other priorities and couldn't invest much effort into this. This led to lower user engagement and therefore lower impact on return rate.

In the following, we will report the progress of activities with respect to the milestones planned for the first 6 months of project development.

Milestone: WD-SI
Milestone Name: Launch Of Shopify Application
Month of Accomplishment: 2
Description of progress:
The shopify public application was successfully launched and can be found at https://apps.shopify.com/alterego-virtual-fitting. The application consists of the following components:

- Dashboard: The dashboard is the home page of the application and displays all the most important information about the application and its usage by the customers.
- Subscription: To be able to integrate garments in the Alter Ego virtual fitting room on their store customers will need a subscription. We currently offer three pricing tiers: Starter plan, a Basic Plan and an Enterprise plan reserved for bigger customers. The billing is completely automated and handled through Shopify.
- Garment Upload: The garment upload page is where customers can upload the production data of their garment and other information to allow us to integrate their garments on the Alter Ego virtual fitting room. The customer will be able to select a product from their existing collections, then it will have to upload the DXF and RUL file (production data). Once they upload a garment it will be linked to an entry in one of our databases and we will be automatically notified. The garment needs some processing, so we set the processing status to processing and we show a yellow flag

on the garment. After we process the garment and we deemed it ready to be deployed, we change the flag to ok and the customer will see a green flag on the product and will be able to enable the virtual fitting room for that product on their website.

- Integration process: once the customer has installed the AlterEgo application he will be able to add the AlterEgo button (that will open the fitting room) on their store with a simple drag and drop gesture on the Shopify theme editor. The button is customizable: they can choose the text that will be shown on the button, the font size and color and a few other options.

The milestones objectives have been fulfilled:

WD-SI2 Protected/Authenticated Database of client garments' submission: clients are authenticated using the Shopify Admin API, their garments upload are safely stored on our infrastructure and can be deleted/accessed by customers.
WD-SI3 Billing System and Dashboard from Shopify Application: billing is fully automated and based on the shopify Billing API.
WD-SI1 Upload Page for client to upload DXF files and metadata: customers can upload the production files autonomously and the garments will immediately appear as processing on the dashboard and sent tou our database.
WD-SI4 UI of Public Application (as described above)
WD-SI5 Submission Until Approval of Shopify Application to Shopify Store: the application was published as a public application on the shopify store after undergoing the review process from the shopify management. The shopify listing also received two 5 star ratings.

Milestone: WD-UI
Milestone name Launch of Universal Integration
Month of accomplishment 4
Description of progress:
After releasing our shopify application we started working on extending the shopify application to non shopify customers. We started from the integration plugin.

The first problem we tackled is how to integrate the plugin on any kind of platform, this was done by using an injection script that can be copy pasted into the clients website with ease. The integration script is literally one line of code.

A preview of the new UI can be found online at: https://plugin.alter-ego.ai/ and on our customers websites.

The redesign and injection strategy ideation for the Universal Integration took more time than previously planned, and was completed at month 5. We should also consider that as we will describe in section 4.1 that our web developer joined the team one month after the starting date of the project.

This led to delay in the dashboard implementation. Additionally we decided to put lower priority on the dashboard with respect to a very compelling user facing component since the volume of customers did not require such automated onboarding process. Furthermore, based on our customer interviews the most critical component of our applications is the user facing part.

For the admin panel, we plan to have an operational application by 1st of September 2024. A preview of the dashboard can be found at: test.admin.alter-ego.ai

WD-UI1 Embeddable Plugin component that can be copy pasted by clients on existing website - Completed, with redesigned and improved UI/UX.

WD-UI2 Client Dashboard for Non Shopify Customers - Partially completed.

Milestone: DS-AGP1
Milestone name Automatic Garment Processing 1
Month of accomplishment 6
Description of progress:
In our pipeline, the auto-draping of a garment involves two primary steps: auto-positioning the garment pieces around a 3D body model and automatically sewing the pieces by predicting which sides of each piece should be joined. A garment is defined by a set of panels (Figure 1a) which we extract from DXF source files. These source files often contain duplicated panels, half-panels, unconventional naming, and are generally unstructured.

The auto-positioning pipeline takes as input the 2D representations (image) of each panel, predicts their labels (e.g., full or half, front, back, sleeve, band, etc.), and selects the panels that constitute a complete garment. These selected panels are then assigned to arrangement points around a 3D human avatar.

The auto-sewing model initially took as input a 2D vector of the panel edges and their curvature values. For each pair of sides in a whole garment, the model would predict a binary label indicating whether the two sides should be sewn together.

To train the auto-positioning and auto-sewing models on garment panels, a large and diverse dataset is essential. This dataset must cover a wide range of variations within each garment category to encompass the full design space. To address this challenge, Korosteleva et al. proposed a pipeline where garments are templated into a predefined set of corners and edges, that can be programmatically modified and arranged to generate multiple variations. By using this pipeline, Korosteleva et al. obtained and published a large dataset of sewing patterns which we initially used to train our models.

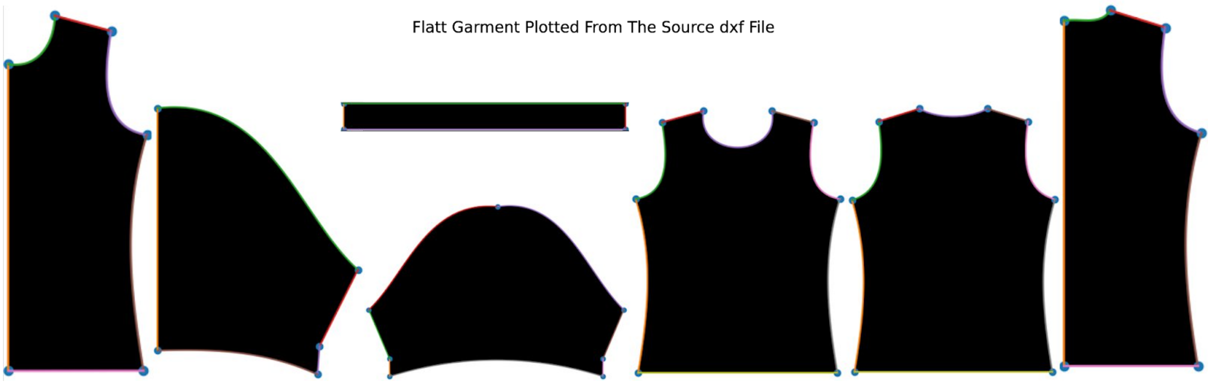
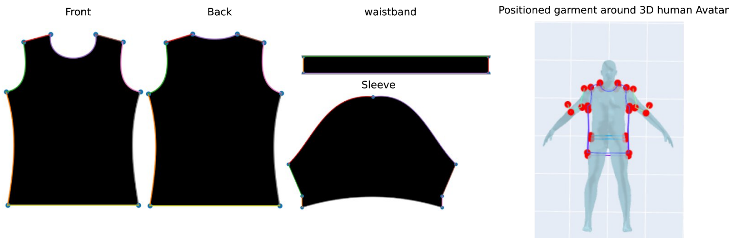


Figure 1a: *Entire garment plotted from a source DXF file. DXF files sometimes have half panels or duplicates.*



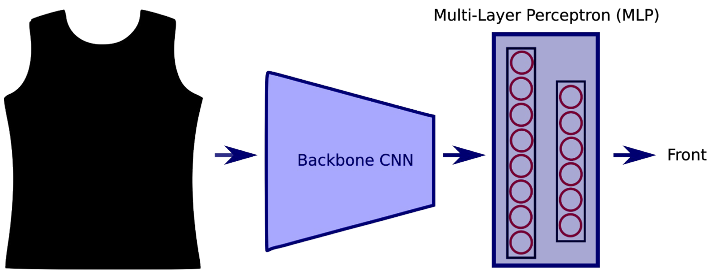
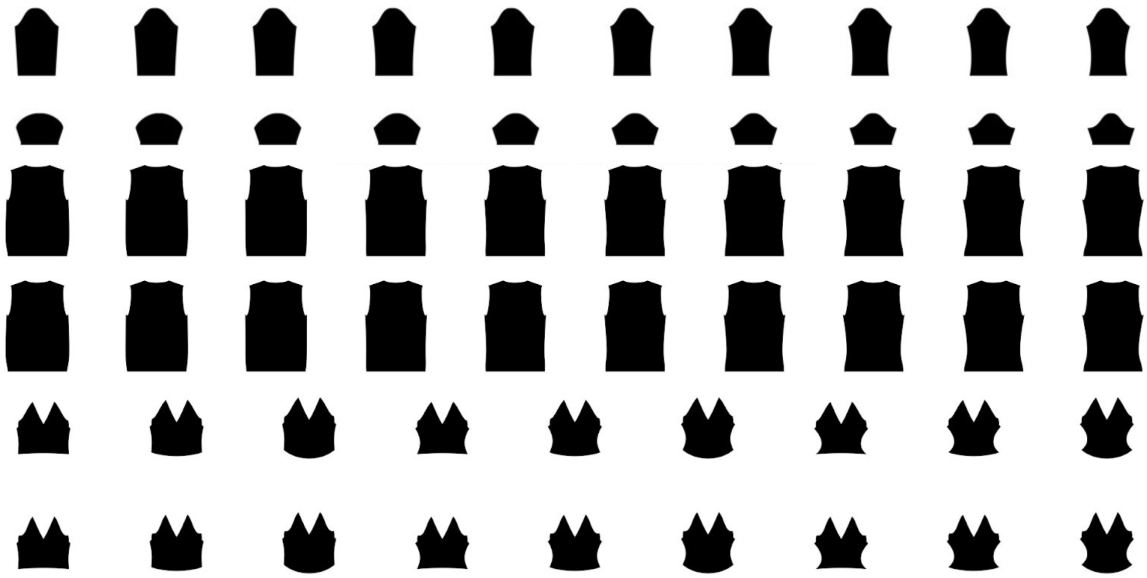


Figure 1b: *Our auto positioning Module takes one panel at the time, extract features using EfficientNet. Features are then fed to a MLP for predicting the class label of the panels, and its position around the human body.*

Both models behaved well on a test set from the same training dataset (same characteristics but unseen patterns), but struggled on real world data (DXF from our clients).
Upon deeper investigation, we discovered significant differences in the distribution of panels, side lengths, and curvatures between the templated dataset and real-world data. These discrepancies likely contributed to the poor performance of the models on real-world data. Similar findings were reported in the study "DiffAvatar: Simulation-Ready Garment Optimization with Differentiable Simulation," where challenges in aligning synthetic data with real-world applications were also highlighted.

We had to change our approach and try to make our training data closer to the real world sewing pattern. However, obtaining such a big dataset of real world patterns is challenging, expensive, and time-consuming, as each garment piece needs to be meticulously designed by a fashion designer, the panels need to be labeled, and the stitches as well.

Hence, we adopted a different and novel approach: we created a synthetic data generation pipeline that out of one single pattern, annotated with sewing and positioning information could generate an arbitrary number of annotated variations of the sewing pattern. We then collected a series of base sewing patterns from different sources (data from our customers, acquired sewing patterns online). Starting from this and using our generation pipeline we were able to generate a substantial amount of training points for our models. We generated the first dataset of real world sewing patterns. Using our approach we have converted 25 source patterns into a dataset of 7814 images examples for auto positioning and a dataset of 31483 images for auto sewing. Example variations of our dataset can be seen in figure 2.



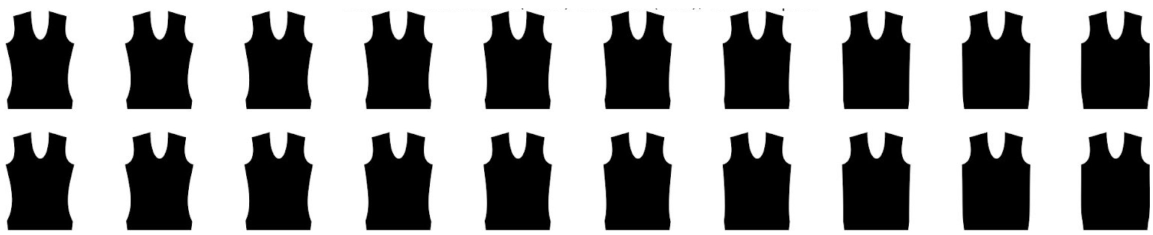


Figure 2: *Example data generated using or data generations, annotations tools. Using our tool we are able to generate sides with varying curvatures, the top two rows shows example of sleeves with different curvatures of the opening and side edges, the middle row shows example variations of the side edges from a back panel and the last two rows shows example variations of the front panels.*

We trained our previous models on new data and devised new model architectures that would improve the previous results. For what concerns the positioning module the previous architecture provided good results (Table 1) and enough flexibility also in this second iteration, so it was conserved.

	Balanced Accuracy	**Precision**	**Recall**
Internal Hold out Test	0.97	0.96	0.69
Korosteleva et al 25	0.86	0.84	0.75

Table 1: *Auto positioning Module Results. Performance metrics for the internal holdout test set reveal a high balanced accuracy of 0.97 and precision of 0.96, indicating the model's strong overall performance in correctly predicting both positive and negative classes. However, the recall value of 0.69 suggests that the model may be missing a portion of true positive cases, indicating room for improvement in sensitivity.*

The sewing module though was redesigned to be more robust and flexible. The input of the previous model did not take into account the shape of the panel the side belonged to and also its relative position with respect to it. To allow the model to be aware also of this information we changed the input format of the model. The new input format still consists of a pair of sides, but now each side is represented as an image. The image shows the whole panel in black and the side highlighted in red, as shown in figure Figure 1c. The two images are fed first into a backbone CNN (EfficientNet in particular) which outputs two output feature vectors. These are then combined into a single one and enter two different MLPs where one predicts the panel label, and the other predicts a binary label which indicates whether the two sides should be stitched together or not. This architecture is shown in Figure 3. The panel label output is not directly used (as the autopositioning model already predicts that), but it is useful to include this in the training because it acts as a regularizer and gives the model more information about the coupling of the panel information and the sewing information. Some stitchings are typical of certain panel combinations (such as front is always sewn to back on the sides). This is a popular approach called multi task learning.

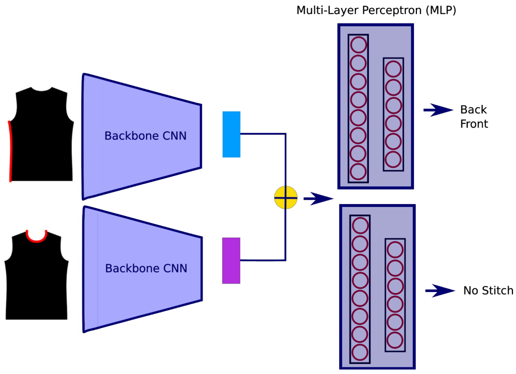


Figure 3: *Our AutoSewing module is run on all the panel sides pairs, for each two edges highlighted in red it predicts if these two edges should be sewn together or not, and the label of each panel.*

The results obtained with the second generation sewing model are shown below, both on the testing sets (same distribution as training set but never seen data) and on the real world data.

	Balanced Accuracy	**Precision**	**Recall**	**F1 Score**
Internal Hold out Test	96.07%	0.3377	0.9873	0.5032
Korosteleva et al 25	72.09%	0.8809	0.4876	0.6278

Table 2: *Performance comparison of the Auto Sewing module. The model exhibits excellent balanced accuracy (96.07%) and recall (0.9873) on the internal holdout test set, indicating strong overall performance and the ability to detect true positives. However, the low precision (0.3377) on the internal dataset suggests a higher rate of false positives. On the Korosteleva et al. dataset, the model shows lower balanced accuracy (72.09%) and recall (0.4876), but much higher precision (0.8809), reflecting a trade-off where the model is more conservative in its positive predictions.*

Next steps:

We are currently working on adding pants and bottoms to the dataset and re-training the same models on the extended dataset, we will be able to evaluate the results soon.

We also aim to further enhance the sensitivity of the auto-positioning module by feeding all the panels to the model simultaneously, rather than one at a time. This approach will help the auto-positioning module better learn the relationships between the panels, leading to more accurate positioning.

DS-AGP1.1 Auto Sewing Model Definition: The model is defined as discussed in the previous section.
DS-AGP1.3 Auto Sewing model accuracy: As described in Table 2
DS-AGP1.4 Auto Positioning Model Accuracy: As described in Table 1
DS-AGP1.2 Auto Positioning Model Definition: The model is defined as discussed in the previous section.
DS-AGP1.5 Test of both models on a set of different garments: Our model was tested on a collection of different garments coming from different sources. These garments belong to the top category, such as tshirts, sweatshirts, tanktops, hoodies.
DS-AGP1.6 Test of Models on Real World Data: As per Table 1 and Table 2. Internal hold out test set is a collection of data we collected from our customers.

1.2 Summarize the status and progress of the activities in relation to the commercialisation of the product / service and go to market strategy, indicate to which degree the milestone objectives have been met

Throughout the duration of the period we continuously evaluated our current roadmap and product with the market requirements. Our competitive advantage remains the ability to provide accurate fit predictions plus a compelling visualization of the articles. Our usage of production data, gives us precise information about sizing of garments which other companies do not take into consideration, making their fit recommendation untrustworthy.

Our validation came from different sources. We received positive validation from the attendance of the PI Apparel conferences, which were held in Italy in March 2024 and in the US in June 2024. PI is the most important conference that unites fashion brands and technology providers. Major brands participate in the conference along with several companies in the space of 3D modeling of garments and technologies that aim at improving the fashion industry.

There we met with several brands which exposed excitement and interest for our solution. Some of these brands have engaged to start Proof on Concepts in the next few months and we are in the process of doing the first demos.

We also came in contact with several companies involved in the manufacturing of garments and in their digital production. These companies develop the software that is used to produce the sewing pattern, the input of our processes. We had several conversations with them that validated the need of the technology we are developing as part of the SIP and hinted at possible future collaborations.

These positive feedbacks highlighted how what we are building is not only important right now but will become even more important as more fashion brands embrace digital production, which seems inevitable.

On the flip side, the past few months also highlighted some difficulties in penetrating the market through smaller customers. These often do not have time or do not possess the necessary expertise to go out of their comfort and use our technology, regardless of the low barrier of entry. In addition, returns do not appear to be their top priority oftentimes. The slow adoption from smaller customers led to the decision to focus on bigger customers. Aligned with this, is the decision mentioned in Section 1.1 of delaying the development of the universal dashboard/admin panel in favor of a more compelling and professional user facing component.

In addition to that, we have observed that the bigger customers that we met through conferences and events are really concerned about the product coverage that AlterEgo could offer. To this day, our product coverage did not increase substantially as we still do not have a way to automatically reproduce textures and details on the garments we integrate. Though, this should be solved more and more in the following months as we progress on the SIP roadmap.

Another important input we received is that bigger brands also usually invest more in Digital product creation. Oftentimes they have an entire team dedicated to the creation of 3D assets. On the one hand this would make the “from sewing pattern” technology that we are developing less attractive for them, as they would have to validate twice the 3D assets (once internally and once with AlterEgo). On the other, the integration of a pipeline that starts from 3D assets could make the integration of some articles much less demanding on our side. We are currently exploring the possibility of adapting our pipelines to also include 3D assets as inputs in several Pilot projects with companies that have been willing to share with us this data.

To summarize, so far we have not advanced as expected in the distribution of our product, but received important customer feedback and validation. We already have put this feedback in practice by starting to engage with bigger brands,researching the possibility of developing a “from 3d assets” pipeline, and focusing less on smaller shopify brands. The engagement has resulted in potential POCs with few international enterprise brands which will take place in the next months.

1.3 Have new risks been identified which could affect the project in the future? Please provide an updated risk matrix from the initial application or last report.

No new risk identified.

1.4 Summarize the status and progress of the activities in relation to the organizational setup, team and skillset, and indicate to which degree the milestone objectives have been met

As planned in the project application we hired 4 engineers to help us further develop our product and meet the Inno Suisse milestones. The team is now composed of founders Pietro Zullo and Faycal M’Hamdi, Senior Machine Learning Engineer Hosna Sattar, Junior Machine Learning Engineer Veronique Kauffman, Computer Graphics Engineer Matthieu Verdet, and Web Developer Marco Bramini.

In January 2024 we started our hiring process. It involved several hiring channels, including Linkedin, personal connection, and our corporate website where we listed the job descriptions for the 4 positions. Our decision process consisted in a CV based screening, then a series of interviews: an introductory interview to align on mutual background information, eligibility for the role and temporal geographical availability. A technical interview which assessed the technical capability of the candidate. Two more personal interviews with two different board members, Faycal M’Hamdi and Nicole Zingg, to assess affinity of the candidate for the company culture and environment.

The hiring process lasted around 2 months, with more than a 1000 applicants. On March 1st, the beginning date of the project, we had filled 3 out of 4 positions: the Senior and Junior Machine Learning engineers and our Computer Graphics Engineer. We still had not found a satisfying role for the web developer position. We decided to not rush the hiring decision and keep looking, we then managed to find an outstanding candidate at the end of March, and started him on the 1st of April, with one month delay according to the project plan.

A few words about our team members:

Hosna Sattar (Senior Machine Learning Engineer): she obtained PhD at Max Planck Institute for Informatics, Saarbrücken, with a Focus on Human intent prediction and body shape modeling. She later joined Zalando as an Applied Scientist working with the size and fit team to develop a deep learning approach to predict clothing size and fit for Zalando’s customers. She has incredible technical expertise in the field of machine learning particularly applied to body reconstruction, along with business expertise and network in the size recommendation business. She is deeply passionate about the size recommendation problem and she joined the startup from a deep belief that this is the right solution to returns.

Veronique Kauffman (Junior Machine Learning Engineer): Freshly graduated from a master in computer science at ETH zurich where she focused on the major of interactive geometry and computer graphics. She has carried out her master thesis at Disney Research, where she worked with diffusion models for image manipulation. She then also worked as a research intern at Disney, working with the Digital Humans group. The skills matched perfectly. A mix of computer graphics and machine learning particularly with experience on diffusion models fitted perfectly, considering the milestone we set and in particular regarding the automatic texture processing problem that we are going to tackle in the next months.

Matthieu Verdet (Computer Graphics Engineer): Matthieu studied at EPFL a master in computer science, with a specialization in multimedia/ geometry processing and computer graphics. What immediately transpired from the interviews was that Matthieu is deeply passionate about computer graphics, simulations and real time applications. The technical problems really lit a spark in his eyes, and he could immediately navigate them with confidence. His deep programming knowledge is also helping us a lot in maintaining state of the art quality in our codebase.

Marco Bramini (Web Developer): Marco holds a BSc and a MSc in Computer Engineering. He has extensive experience in both backend and frontend development as well as devops. This combination of skills and expertise is very rare and makes Marco a very special web developer, with a 360 degree knowledge of what it takes to ship a web application. This made him perfect for our very multifaceted infrastructure where we have to interface with clients, end users, and run high performance computations.

The founders Faycal and Pietro are still fully involved with the startup.
Faycal leads business development and fundraising while Pietro leads the technical team as well assisting in the fundraising efforts.

We believe that the current team at AlterEgo posseses all the technical skills required to develop the product towards product market fit. Nonetheless we plan to reinforce our business deparments as we raise our next round.