**Incorporating Smart Technology in the Retail Industry**

**By Will Amidei, Clare Herrig, Ryan Lee, and Zhaozhi Li**

**Problem Formulation**

The Covid-19 pandemic has changed the way we all live our lives. We are doing things now that we would not have dreamed of doing a year and a half ago. Many people stopped going into the office and moved to working remotely. Universities have moved to Zoom and lecture halls are nearly empty. As we were brainstorming, our group focused on problems that were caused by the pandemic, more specifically problems in the retail industry.

One industry that has been greatly affected by this pandemic is the retail industry. According to an article about retail stores and the pandemic, “Retail clothing and accessory stores suffered a 62% loss in sales during the critical months of the pandemic” (Hamilton). The way we shop has completely changed. Brick and mortar stores now have a limited capacity, people cannot enter without a mask, and many places are not accepting cash. Those are just a few of the ways stores are adapting to this new environment. One common problem that all of our group members have experienced over the course of the pandemic is fitting rooms in retail stores being closed. If one cannot try on garments before they purchase them it makes it hard to commit to making the purchase. If a consumer purchases an article of clothing without trying it on, they run the risk of it not fitting properly. Then the consumer has to deal with the hassle of returning the product to the store.

This is not just a problem for our group members but for many others as well. A study by First Insight found that, “65 percent of women say they will not feel safe trying on clothes in dressing rooms” as well as “54 percent of men said they would not feel safe trying on clothes in dressing rooms” (Jezerc). Clearly, this is a problem many consumers are facing. Even if the fitting rooms were open many would not even want to use them over the fear of becoming ill. This is a legitimate fear because fitting rooms are small, enclosed areas where aerial diseases can easily be transmitted. Also, with consumers trying on clothes they run the risk of spreading disease through the articles of clothing.

This is not only a problem for consumers but also for the retail industry. As previously mentioned, retail stores are suffering great losses because of this pandemic. Some of these losses can be attributed to the negative sentiment towards coming into the store and trying on clothes. People are more apprehensive to purchase clothing if they can’t see how it fits on them.

Our goal is to solve this problem of finding the correct fit of clothing without trying the the items on. We want to achieve a solution that is both safe for the consumers as well as efficient and cost effective for the retailer.

**Scope**

Our goal is not to build a full-stack solution but to focus on areas in which we are most likely to succeed with our available time and resources. We are setting the scope of our solution based on several factors including the quantity and types of data available, the amount of time we have for developing the solution, and our knowledge of technology and the retail industry.

Our solution embeds machine learning algorithms, so its success depends on the quantity and types of data available for training and testing models. We have obtained a data set containing ratings and reviews, fit feedback, customer and product measurements, and category information. We will build a model that can match customers with outfits based on these variables and their previously recorded values. Since we lack data such as color and weather, our solution’s primary feature would be making size recommendations for customers. We may seek additional data for optimizing our model.

The amount of time we have will also shape the outcome. We will meet weekly to assign duties among team members and address any issue to make sure we are making progress. Specifically, we will assign duties to do research in technology and the retail industry to ensure we have everything needed by April 17. We will then work on the project and meet up on April 24 to address any issue we have in development. After that, we will use the remaining time before the deadline to improve our solution by fixing identified issues and incorporating new features. We aim at building a minimum viable product to illustrate our solution within the time frame.

Our knowledge of technology and the retail industry will also have a say in the quality of our solution. We have prior experience with the TensorFlow framework and some Python libraries such as Pandas and NumPy. We will leverage these strengths in development and incorporate other applicable technologies, such as natural language processing, if there are remaining time and resources. We will make sure that we have a working solution by the time this project is due.

**Team**

When it comes to solving any technical problems in life, it is best to approach it by researching potential solutions that are innovative and feasible. Some trends and topics that we should be mindful of include Artificial Intelligence, Internet of Things, and Blockchain. In the retail industry, it is especially important for a company to be aware of and predict which latest apparel is trending. Artificial intelligence can forecast such fashion trends through the algorithm behind chat-bots (Kochar). After analyzing data related to the consumers preference, the chat-bot can then match them with the right product. The correct utilization and knowledge of AI can vastly enhance a customer’s shopping experience and how a designer might work. The Internet of Things can help increase customer satisfaction and brand loyalty by the network it can create through clothes. One popular example are smartwatches which can calculate a person’s heart rate and the daily number of steps a person took. By knowing how to incorporate IoT, we can really revolutionize the retail industry. There can be sensors implemented within a piece of clothing that can be tracked on a smartphone or be bought instantaneously through a store’s sensor door. IoT has a variety of benefits that can be creative and convenient for retail stores around the world. Blockchain is also important to be aware of as it influences the supply chain of a company. There are hundreds of thousands of clothes that are kept in warehouses and need to be tracked. Blockchain creates a cryptographic seal on each piece of clothing to act as an identifier that is easily recorded (Kochar). This reduces the risk of counterfeit goods which is a big issue in clothes.

Unfortunately, bias does exist in artificial intelligence which can frustrate and hurt customers who experience it. There is a rather strong bias in fashion where certain clothing is labeled based on gender or culture. For example, suits are strongly associated with men and skirts with women. One way to reduce bias could be to train the AI with datasets containing “neutral” information. Instead of having labels based on gender, there are clothing brands and collections that are gender fluid. The AI should also be able to generate images of clothes for other cultures and underrepresented groups. Having a high level of diversity within a team can really lower the amount of bias in an AI model. Diversity encourages conversation that is innovative and open-minded. Each member has a unique approach to an issue as a result of differing nationalities, cultures, and backgrounds. This is great to have as it provides greater insight and creativity on what needs to be done.

**Data**

The use of an algorithm to predict the proper clothing size for customers can be incorporated throughout the retail industry. To thoroughly establish the model, it is important to prepare the learning algorithm with various retailers’ data. The data will come from a combination of open-source information and online ordering databases from partnering companies. Accumulating clothing sizes and customer feedback from various companies will diversify the machine learning process. This will improve the reliability of outputs as customers will be using the application for a variety of retail stores. The learning algorithm will consider the actual dimensions of the product, the customer’s measurements and monitor their feedback to determine whether they were satisfied with the product.

The initial subset of data will include a small segment of online retail stores. One publicly available dataset includes the clothing item’s dimensions and connects it to reviews from Rent the Runway and ModCloth (Misra, 2018). These stores have brick-and-mortar locations as well as an online site. With shopping transitioning mostly online, it is important that the customers are recommended the size of clothing that will fit them most comfortably. This dataset will allow the algorithm to pair the clothing item’s dimensions with the customer’s sizing measurements and relates the predicted fit with their published review. The data is in a JSON file which is compatible with Python. We will be able to complete a machine learning model that will demonstrate the satisfaction in the purchase of clothing for these two retail companies, however, the goal will be accommodating the model to more retail websites and as a feature on smart mirror technology.

The opportunity to implement our machine learning algorithm to more retail companies will make our model unique in comparison to other companies. Currently the dataset that will be analyzed is open-source, meaning that any individual will be able to access this information. The models being created may differ based on layers used within our neural network. Additionally, the complementary dataset to analyze the overall emotion in the customer’s feedback may result in different models. With that said, the complementary dataset will be selected to align closely to the retail industry so the model is formulated with compatible customer information. Ultimately the model created in the initial subset may match models that other companies create, however, the combination of decisions for our neural network and the partnership of other retail companies’ feedback will reduce similarity in our model.

**Solution**

The retail industry has unfortunately suffered quite a bit from the on-going pandemic as many customers continue to stay at home. The transition from in-person to online shopping for clothes might generally be safer and faster, but it has lost the appeal of physically trying on a piece of clothing to see if it’s the right fit. For virtual customers who are struggling to find the right size based on their body measurements, we plan to introduce smart mirrors to solve this issue. Smart mirrors are essentially a two-way mirror that has an infrastructure of sensors, cameras, and displays (Jesus). The technology and algorithm behind smart mirrors can bring back that desired feeling of being in a fitting room. The only difference is that it’s virtual and there is an AI fashion assistant to recommend items related to their preferences. This eliminates “two birds with one stone” regarding concerns related to the pandemic and the desire of finding the correct measurements. Along with clothing, smart mirrors can be utilized for eyewear, makeup, and other fashion accessories the customer may be interested in. Overall, this can really stem the issue of customers regretting their purchase because the clothing or accessory turned out to be too big or small.

Customers will reap many benefits with the introduction of smart mirrors into the retail space. The functionality of a smart mirror allows the user to view their presentation each day like a normal mirror would. The innovation is introduced as the user views clothing on retail websites and is considering making a purchase. The user can visualize each piece of clothing that they consider purchasing by standing in front of the smart mirror (Tyghe, 2019). If the user then choses to purchase the item, they will be recommended for a size based on measurements acquired from the mirror’s image. Additionally, the user will be able to modify these measurements using the AI chat-box functionality (that will be described next). The experience of shopping will be improved as users of the smart mirror are not required to enter brick-and-mortar retail stores. The rate of clothing items being returned will also decrease because of the machine learning algorithm that is suggesting the clothing size to purchase.

The Internet of Things will make this feature accessible, but with that comes privacy concerns. It is imperative that the smart mirror will incorporate techniques for managing cyber risk. The smart mirror is an intermediary for purchasing clothing, which means it captures a variety of information on the user. The data being collected includes the image from the mirror, the user’s sales information, and data based on their search history. The collection of this data is primarily used to benefit the customer experience as they can visualize their prospective clothing item, make an online purchase with proper sizing, and be recommended similar clothing items based on their previous searches. The databases collecting such information should be secure enough where cyber threats are limited. One way to improve cyber threats is by encrypting the data before it gets sent to retailers. This will ensure that the user and retailer have a shared proactive method on encrypting/decrypting their user’s data. Other options include consistent testing for potential vulnerabilities within the smart mirror technology (Wald). Implementing multiple methods for limiting cyber risk will improve the user experience and ensure that their personal information remains used for its intended purpose.

Another part of our solution we plan on implementing is an AI chat bot. This chat bot will be built into the smart mirror and there will be an interface for the user to type in whatever they want to convey to the chat bot. There are many reasons for adding this feature including privacy, errors in the model, and customer service. Some consumers may not feel comfortable with a machine essentially taking a picture of them and using it to take their measurements. The AI chat bot will allow the user to manually input their measurements as they see fit. Similarly, if the user believes that the model completely failed and got their measurements wrong, they will be able to tell the AI chat bot that their measurements are wrong, and they will be able to input their actual measurements. The AI chat bot will also be programmed to be able to answer any questions pertaining to the retail store the smart mirror is in. The user could ask questions about things like the return policy or the hours of the store or even ask for the assistance of an actual employee.

**In Addition**

As previously discussed, our solution includes multiple components. We expect to roll out the solution by taking the following steps. Since the solution’s primary purpose is to make size recommendations for customers, the machine learning algorithm is the most critical component of the solution. Hence, we will make sure that we develop the algorithm first so that our solution is ready to serve users. This algorithm will determine whether our solution will be successful over the long term and requires constant updates as we improve the model. After that, we will build the application that embeds this algorithm. The way we interact with users is equally important. We will need to make sure that the user interface is intuitive enough for people to understand and use our solution. Finally, we will develop a chat bot and a simulation algorithm to allow customers to supply critical data and illustrate how the clothing looks on customers in a virtual environment. We expect to use image recognition, speech recognition, natural language processing, and virtual reality technologies in our solution.

We will introduce our solution either as an independent application or part of a third-party e-commerce service. Users can download the application to their devices to access the solution. Retailers can supply data of their products such as colors, measurements, and materials, and customers can supply their data such as waist measurement, preferences, and location. Customers can also upload their pictures for simulation purposes. Our goal is to provide an enjoyable user experience. Our solution will include an intuitive graphical user interface that clearly shows the products, relevant data that the model uses for making recommendations, and a simulation of how the outfits look on customers. In addition, we will have a chat bot. Customers can supply their measurement data and leave comments on products to help the model to learn about their preferences. They may either use a keyboard or speech recognition to enter the information. Our model will match customers with the outfits that work best on them with the data that users supply. The solution will grow stronger as we collect more data for training and testing the model.

We will implement our solution on the cloud instead of local machines for a few reasons. First, our model consumes large amounts of data. As our user base grows larger, we expect to store and process much more data than we have today. An advantage of cloud services is scalability. This will be helpful as we scale up operations over time. Second, collaboration is critical to our success. We expect to cooperate closely to optimize the solution. Cloud services allow simultaneous access from multiple developers. This enables our team to contribute to the model and stay updated on the latest developments. The cloud will allow us to update the solution without causing severe service disruptions. Finally, security is imperative. Our solution only works if users are willing to trust us in handling their data. Many cloud service providers offer cutting-edge security features. This will help us persuade more users to use our services.

**Works Cited**

Hamilton, Jori. “Navigating the Hurdles of Fitting Room and Clothing Disinfection Procedures.” *Retail TouchPoints*, 14 Dec. 2020, retailtouchpoints.com/features/executive-viewpoints/navigating-the-hurdles-of-fitting-room-and-clothing-disinfection-procedures.

Jesus, Ayn de. “Virtual Mirrors and Computer Vision - 9 Current Applications.” *Emerj*, Emerj, 22 Nov. 2019, emerj.com/ai-sector-overviews/virtual-mirrors-and-computer-vision/.

Jezerc, Gretchen. “Shoppers Ready To Buy Apparel But Don't Feel Safe Trying It On As Stores Reopen.” *First Insight - Optimize New Product Creation with Predictive Analytics*, First Insight, 11 May 2020, [www.firstinsight.com/press-releases/shoppers-ready-to-buy-apparel-but-dont-feel-safe-trying-it-on-as-stores-reopen](http://www.firstinsight.com/press-releases/shoppers-ready-to-buy-apparel-but-dont-feel-safe-trying-it-on-as-stores-reopen).

Kochar, Sayam. “Top 9 Technology Trends Reshaping The Fashion Industry In 2021.” *Techpacker Blog*, Sayam Kochar, 31 Mar. 2021, techpacker.com/blog/design/top-7-fashion-technology-trends/.

Mira, Rishabh. “Clothing Fit Dataset for Size Recommendation.” *Kaggle Public Domain*. 21 Aug 2018, <https://www.kaggle.com/rmisra/clothing-fit-dataset-for-size-recommendation/version/1>

Tyghe, Christopher. “Take Retail Customer Experience to the Next Level with Augmented Reality and Smart Mirrors.” *Ingenico Blog,* 2 May 2019, <https://blog.ingenico.us/blog/take-retail-customer-experience-to-the-next-level-with-augmented-reality-and-smart-mirrors>

Wald, Ben. “4 Ways to Minimize IoT Cybersecurity Risk.” *GCN Technology, Tools and Tactics for Public Sector IT: Industry Insight*, 10 Apr 2019, <https://gcn.com/articles/2019/04/10/iot-security.aspx>