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| Food Allergies on Skin |  |

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**Business Goals**

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| **Project Overview and Goal**  What is the industry problem you are trying to solve? Why use ML/AI in solving this task? Be as specific as you can when describing how ML/AI can provide value. For example, if you’re labeling images, how will this help the business? | Parents go through hell when introducing new food to their babies, especially for highly allergenic food like tree nuts, cow milk, eggs, wheat, etc.  This usually involves waiting and constantly observing the baby/child for any kind of symptoms that would trigger running to the hospital. One of them can be seen on the skin.  The goal of this project is to enable parents to upload an image of their baby/child and get instant feedback whether he/she has symptoms of an allergic reaction. |
| **Business Case**  Why is this an important problem to solve? Make a case for building this product in terms of its impact on recurring revenue, market share, customer happiness and/or other drivers of business success. | This is a not for profit approach, that will hopefully make life better for anyone raising a child. Once fully functional, I would try to donate it to the healthcare systems of the world, so that they can guide parents to this tool. |
| **Application of ML/AI**  What precise task will you use ML/AI to accomplish? What business outcome or objective will you achieve? | We are talking about image processing, where ML will need to determine whether the skin on the image is healthy or it is showing signs of an allergic reaction that might lead to anaphylactic shock. |

**Success Metrics**

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| **Success Metrics**  What business metrics will you apply to determine the success of your product? Good metrics are clearly defined and easily measurable. Specify how you will establish a baseline value to provide a point of comparison. | Customer NPS from using the product.  Number of hospital visits to the emergency department for simple checks decreasing  Number of unnecessary 000 (emergency) calls decreasing  Number of valid cases brought to hospital increasing  Number of babies/children surviving an allergic reaction increasing  The baselines would be taken from current hospital and emergency services data |

**Data**

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| **Data Acquisition**  Where will you source your data from? What is the cost to acquire these data? Are there any personally identifying information (PII) or data sensitivity issues you will need to overcome? Will data become available on an ongoing basis, or will you acquire a large batch of data that will need to be refreshed? | This will be a slow process as at the beginning the application will ask people to upload data from the skin of their babies/children with two examples:  1. healthy skin  2. skin with allergic reaction (if it exists)  Hospitals will also be contacted to provide similar samples and both sources are with no associated cost.  Once the application is operational, each evaluated sample will be added to the database. Parents will be asked to keep a number generated for them and use it to mark whether everything turned out ok or there was indeed an allergic reaction. This way the database will keep increasing with new cases.  In order to kickstart things an annual subscription from shutterstock.com will be bough. The cost for downloading 50 images each month, comes down to $1099 per year. The cost from Appen for the contributors, is $238 per year for the 600 images to be judged. This will be evaluated each year and if the free sources provide enough data/images, Shutterstock usage will be discontinued.  Since the images are only of part of the skin, without showing faces or asking for names, there should be no problems with personal data. |
| **Data Source**  Consider the size and source of your data; what biases are built into the data and how might the data be improved? | There will be biases in both datasets, regular people probably sending a lot more healthy images, while hospitals send unhealthy.  Regular trimming of excess data from either category should keep things well balanced.  There would need to be at least 1000 images from both categories in order to officially make the application operational. |
| **Choice of Data Labels**  What labels did you decide to add to your data? And why did you decide on these labels versus any other option? | There will be 2 labels, namely: Healthy and Unhealthy. This will be followed up with a question asking for a confidence level, with options: High and Low.  The reason for choosing this scheme is that it is simple as it has only two outcomes, while capturing bias and uncertainty with the follow up question on confidence. Essentially the labels are good for simple categorization, while the confidence level is capturing the probability of making an error. |

**Model**

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| **Model Building**  How will you resource building the model that you need? Will you outsource model training and/or hosting to an external platform, or will you build the model using an in-house team, and why? | It should be a rather standard image processing job, so no need for an inhouse platform.  If the images are not labeled to start with, Appen would be good for image annotation.  Google’s AutoML seems well suited for training and evaluation. Its APIs would be used to communicate with the simple web application.  The initial training for 1000 images using GoogleML is free. Once the application is operational, the monthly cost for deployment & prediction will be about $1310.40. That is based on the following calculation:  ($1.82 per node hour) \* (1 node) \* (24 hours per day) \* (30 days) |
| **Evaluating Results**  Which model performance metrics are appropriate to measure the success of your model? What level of performance is required? | 80% F1 would be good enough for the MVP  after a year of training, the aim would be to get very close to a 100% |

**Minimum Viable Product (MVP)**

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| **Design**  What does your minimum viable product look like? Include sketches of your product. | The MVP is just an interface to upload two images: 1 healthy and 1 unhealthy  Diagram, text, letter  Description automatically generated |
| **Use Cases**  What persona are you designing for? Can you describe the major epic-level use cases your product addresses? How will users access this product? | This is mainly for parents, but could also be used by caretakers and even hospitals for quick analysis in the triage teams. Hospitals are indirect users, given their goal to lower the number of unnecessary visits to the emergency departments.  Parents: Young children and babies are trying a variety of different foods for the first time in their lives. Some of these foods are allergenic and parents are responsible for introducing them. The process starts with a very small amount and then waiting an hour for a reaction. Then a slightly smaller dose and again waiting for a reaction for about an hour. Finally, a full spoon of the food and another waiting game. That is an extremely anxious process for the parents. Most aren’t medical practitioners, thus every little sign of redness or anomaly, usually comes with a small hearth attack. This application will give them the peace of mind if things are normal or give them a real adrenalin kick if they potentially aren’t, with clear instructions to immediately call emergency services, saving the life of the child in the process.  Caretakers: These are typically grandparents, but could also be childcare workers and such. For them it is about the panic attack when a child in their care suddenly has a reaction. Or if they knew the child is allergenic, but failed to stop them from trying such food, or aren’t sure if the food they digested will make them problems or not. A quick check in the application will give them the right direction, as opposed to calling the parents and waiting for them to arrive.  Hospital emergency department triage team: Life here is extremely hectic with people constantly coming with various issues and it is up to the triage team to very quickly identify the severity of the problem and queue patients accordingly. If they are educated enough on skin issues, they might do it themselves, but if they are not, a simple solution would be to direct the patient to the website for a self-check while they are waiting to be called. That would both save time for the triage doctor and educate the patient how to get better information next time, without even having to enter the hospital.  Hospital management: They wouldn’t use the application directly, but will be interested in the effect this application has on the number of allergy patients coming to the hospital and the seriousness of their problems. They will need to be sold the idea for the application to get hospital support.  The product will be web based, so users will access it via a browser. The assumption is that there won’t be many heavy users, but if that gets invalidated, a simple mobile app can also be developed for both iOS and Android. |
| **Roll-out**  How will this be adopted? What does the go-to-market plan look like? | Stage 1: First just the MVP to collect images. The target audience are hospitals and parents with children who are allergenic. Trips to hospitals will be needed in order to get their support. For individuals, my personal social networks will be used to gain initial traction.  At this point the costs are just for the simple one-page application, the Shutterstock yearly subscription and the Appen initial classification. This should not exceed $5000.  Stage 2: A couple of months later, the beta version goes live with 80% accuracy. This will be a second page where users can upload images, they would like an answer to.  Diagram, schematic  Description automatically generated  The users of the application are mainly the Parent and Caretaker personas, while the buyers of the application are hospitals and their decision makers.  The additional application development, support and GoogleML costs would come to about $2000 per month, or $24000 per year.  The idea is to use hospitals as the main place to advertise the application, both via the triage teams and educational materials placed in the emergency departments. Emergency call operators will also be educated to instruct callers to use the application while they wait for help to arrive. Social advertising will continue as well.  Stage 3: A year in, a decision would need to be made whether to create mobile apps, login functionality, historical data etc. At that point personal data policies will need to be reevaluated. A lot of this will depend on whether the governments / hospitals will be willing to invest in the maintenance of this application as they are the real buyers. The value proposition for them is to provide health education for the general public, while having better utilization of hospital resources. |

**Post-MVP-Deployment**

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| **Designing for Longevity**  How might you improve your product in the long-term? How might real-world data be different from the training data? How will your product learn from new data? How might you employ A/B testing to improve your product? | Asking parents to tell the application if it correctly predicted the outcome will be the first form of validation and improvement as it will add data to the training dataset.  A/B testing can be used to determine whether users would like to have a history of their queries or that would deter them from using the application due to privacy concerns. |
| **Monitor Bias**  How do you plan to monitor or mitigate unwanted bias in your model? | It is very likely that new data will have a lot more healthy cases than unhealthy ones. The training dataset will grow only with the smaller number of the two labels, while the other will constantly be trimmed to match that number. |