

# Machine Learning Engineer Nanodegree

## Capstone Proposal

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### Proposal

To develop a complete solution to measure, evaluate and classify products outside predefined quality parameters.

This project aims to solve specifically through computer vision the classification of diamond burs.

1st. step - Develop a system to capture image of the burs. The challenge is to develop a device to facilitate taking images for later adaptation in productive process. Within this stage we still need to qualify a camera that can capture the photos (object is very small and cylindrical).

The device will need to provide a way to handle the bur to capture the image in 360 degrees.

2nd. step - Capture burs images. For the project we will evaluate only 1 model. Each bur should have 3 images every 120 degrees. Among the separated defective burs, separate the images where the defect appears and classify the bur as defective. It may be necessary to turn the 3 images into one image. (In the future we should classify the images by type of defect – too much nickel, lack of diamond and out of measure)

3rd. step - Develop the algorithm based on the knowledge acquired in Deep Learning using convolutional neural networks.

4th. step - Use a robust neural network and adapt to the project.

5th. step - Compare the systems and recommend the best solution.

### Domain Background

Observing a person look daily to thousands of diamond burs, it seems clear to me that in addition to unhealthy job the efficiency can be enhanced through a computer visual recognition system using Neural Networks.

### Problem Statement

Inspection and Quality Control on Diamond Burs

The objective is to be able to improve the classification and separation of burs and disks with less resources and greater assertiveness.

Currently these burs are classified visually with the aid of a magnifying glass by a group of collaborators.

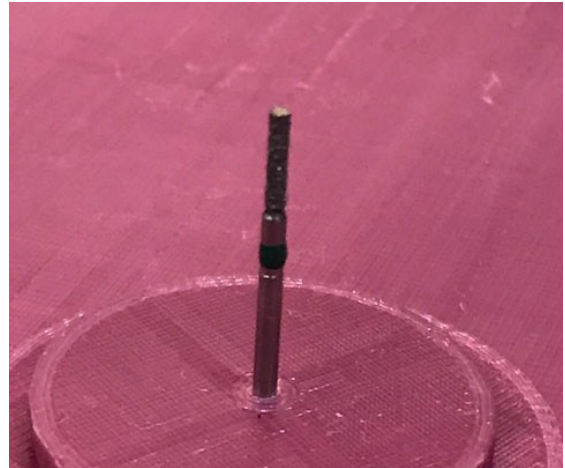


## Datasets and Inputs

Through collected products, I will develop a system for photographing and classifying these burs. There will be 500 conform, 500 non-conform and 500 damaged burs as total of 1500 burs where each bur will have 3 images to get the 360 degrees.

All images will be taken on similar position, angle, focus, size and controlled light.

To get better result, if necessary it will be test keras to generate a bigger dataset of those images.



## Solution Statement

Classify products as conforming or non-conforming. In case of non-conforming classify them by type of failure / problem.

Since we are dealing with labeled images the algorithm will be of supervised learning, and since we will classify unclassified data among the previous categorized samples it will be use a classification algorithm, and to handle images we will choose a Neural Network.

The problem is a image classification supervised learning which will be solved using a classification Neural Network or a convolutional Neural Network.

## Benchmark Model

In addition to developing a specific convolutional neural network for the case, I will seek a robust network to compare results and determine the best way forward.

## Evaluation Metrics

Among several evaluation metrics, it seems a good approach to use **Classification Accuracy**. We need to get as close as possible to 1.

The objective of this system is to avoid non-conform burs go to market and to not send good burs to remanufacturing.

# Project Design

## 1. Preprocessing

Device creation – To get standard images with same size and position. To reduce the need of image pre-processing. The device will take the 3 images automatically. It will turn 120 on every picture.

Image concatenation – Since we will need to get 3 pictures of each bur to get the 360 degrees. The idea is to turn these 3 images into one. That will solve the problem of a non-conformity appear in just one of the images of the same bur.

Image quality – This is where it is necessary to find a way to get good enough pictures to the system be able to classify the burs. They are very small and even smaller the diamond part.

## 2. Elaboration of the image recognition system using the Neural Network

1. scikit-learn MLPClassifier

2. Keras – This is where I believe I will get best result

3. A benchmark of a solid CNN for image recognition

## 3. Select the best one comparing all by accuracy

## 4. Implement on real world

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