# Project Proposal

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## Introduction

I plan to research the possibility of generating arbitrary but consistent values from images. I will implement this algorithm to the best of my ability, and, if feasibility and time permit, explore various applications of it.

## Base Aims

I will aim to create a function that takes a matrix of pixel data and outputs a unique value based on the traits of that data. The aim is so that, for example, the same value will be generated from different pictures of a company logo taken in different lighting conditions (different location, time of day, etc.)

The algorithm will aim to prioritise false positive results over false negatives. For example, a logo which looks similar may generate the same value, while an image of something completely different should not. I would consider these results acceptable.

## Extension Goals

The meat of this project is in the extension goals, which will explore applications of this algorithm.

I would hope to build a simple program for Android phones that will take photos, prompt appropriate cropping to focus on the subject, and perform the algorithm. Once a value is obtained, it will retrieve a url from a server corresponding to that image-key. If this functions with reasonable accuracy, I believe it could be a pretty fun platform for encoding data in real-world objects, similar to how QR codes work. This could be an exciting prospect for marketing and communication.

## Technologies

The images will be obtained using my personal smartphone. I plan to write the algorithm in C/C++ using Cuda multi-threading image processing if necessary, for large numbers of samples. The extension will also be written in C/C++, as well as Java for Android applications.

## Countering Over-Ambition

There are several factors that can make this goal more feasible. I will explore dimension reduction techniques to reduce the number of input pixel permutations, impose reasonable limits on input data, and require user guidance where possible.

The aim of this project is not to classify or identify objects. By generating arbitrary and anonymous values, we avoid the problems presented with identifying objects as part of an existing concept (cars, animals, people, etc.). For example, the algorithm may produce different values for images of a dog from different angles. Unlike image identification, the algorithm focuses solely on identifying 2-dimensional images of the same thing, not necessarily acknowledging or understand what that thing is.

## Permutation Reduction

The most immediate issue I will come across is the sheer number of image permutations.

Once the permutation set has been reduced as much as possible within reasonable accuracy, I will aim to disregard trivial subsets. Within the set of image permutations, an extraordinary number of images will be nonsense. Thus, I believe techniques can be devised that will operate solely within the assumption of a reasonable image.

For sample image input, I will use back-facing camera of a Samsung Galaxy S6 smartphone. To simplify the algorithm, I will limit input image data to no more than 64 by 64 pixels.

## Example

The following are two images after reducing the resolution and number of colour. The algorithm should produce identical values for the two images. The process of obtaining this consistent result will be built on intuitive criteria which will be the main focus of my research. The “arbitrary but consistent” value will essentially be a serialised collection of traits that have, in themselves, been dimensionally reduced. The hope is that the intersection of all classifications will hone in on a value accurately representing the key features that make these images “practically identical”.

 

## Permutation Reduction

If the number of pixels in a resolution is n, and the number of colours possible for each pixel is c, then the number of permutations for that image is nc. Thus, the number of colours is the key factor in the permutation issue, with the resolution being a secondary contributor

### Step 1: Posterisation

It is proposed that we reduce the colors to 32 to best reduce the number of permutations, while maintaining detail.

An important detail to note is that this is largely affected by interchangeable pixel data surrounding the focus of the image. Therefore it is proposed that the user is given the option to crop the image to give focus to the subject. This help Posterisation by reducing the number of colors that would be otherwise

### Step 2: Image Size Scaling

Native resolution of photos from the testing device is 2988x5312, or 15672256

All images will be scaled down to fit within a 128x128 size

Step 3:

Finally: Verifiying that permutation reduction does not diminish important features of the image.