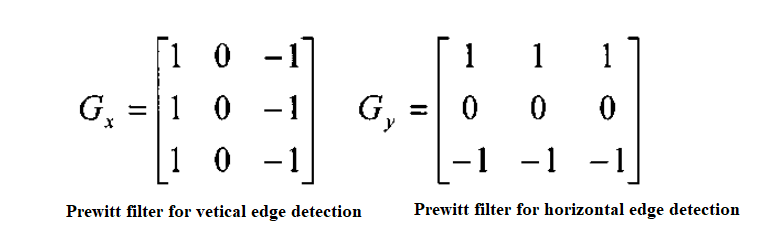
DATE HERE - info, figures, whatever afterwards, DATE EVERYTHING

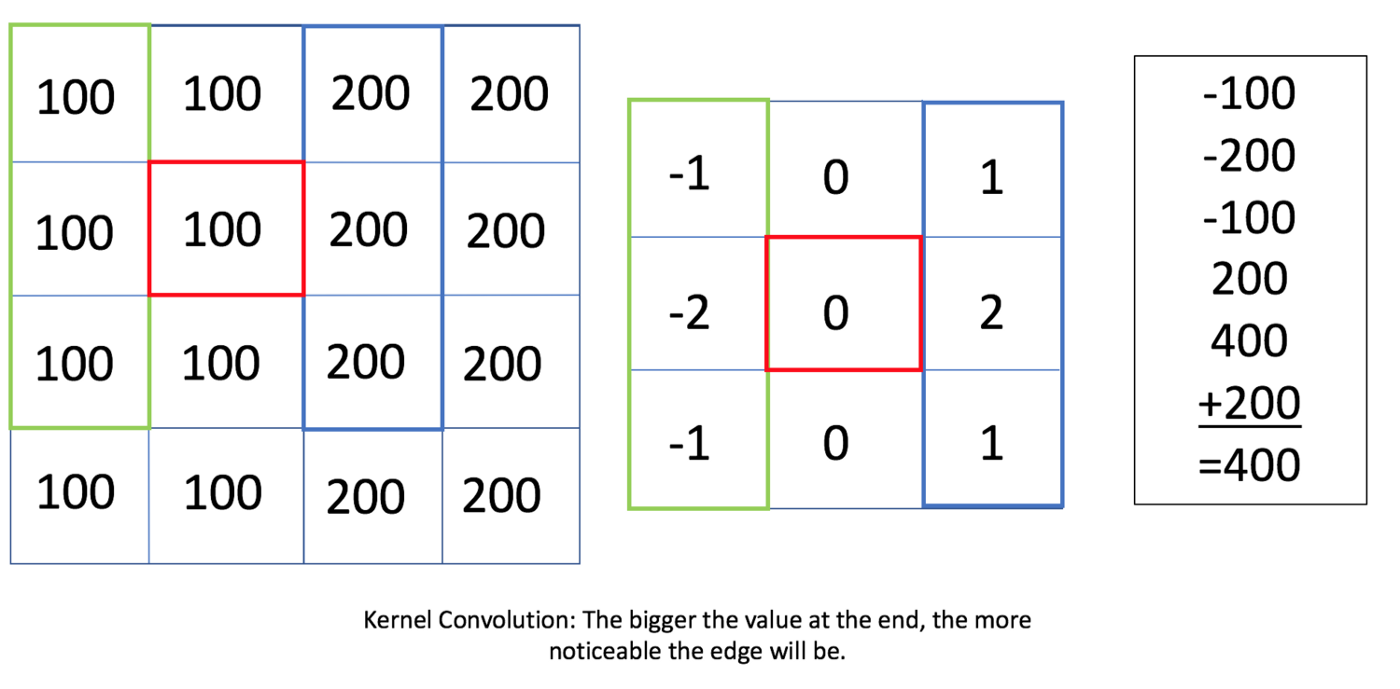
09/10/2022 – Image detection literature study

<https://www.mygreatlearning.com/blog/introduction-to-edge-detection/>

Edge detection described as: “a technique of image processing used to identify points in a digital image with discontinuities, simply to say, sharp changes in the image brightness”

There are several methods, all involving applying a filter matrix to the image at all possible points.

For all given pixels that the matrix will fit for, apply these coefficients for a given pixel, then sum the values and take this as the new value to be later normalized for the image:



This method results in the output being shrunk in dimensions, for an n\*n image and a r\*r filter the output image will be ( (n-r)+1)\*( (n-r)+1).

Canny edge detection is the most common. The process involves:

* Convert the image to grayscale
* Reduce noise – as the edge detection that using derivatives is sensitive to noise, we reduce it.
* Calculate the gradient – helps identify the edge intensity and direction.
* Non-maximum suppression – to thin the edges of the image.
* Double threshold –  to identify the strong, weak and irrelevant pixels in the images.
* Hysteresis edge tracking – helps convert the weak pixels into strong ones only if they have a strong pixel around them.

Attempt to implement a Sobel filter in MATLAB:

<https://www.geeksforgeeks.org/matlab-image-edge-detection-using-sobel-operator-from-scratch/>

**Advantages:**

1. Simple and time efficient computation *(for small images, cannot go above 720p at least for Arduino)*
2. Very easy at searching for smooth edges *(good for searching for edges of license plates)*

**Limitations:**

1. Diagonal direction points are not preserved always
2. Sensitive to noise
3. Not very accurate in edge detection
4. Detect with thick and rough edges does not give appropriate results

Overall quality detection if the threshold values are set correctly:



Main concern here is the potential overhead and memory requirements needed for this level of image processing, alongside all the extra processing surrounding finding the bounding box of the plate.

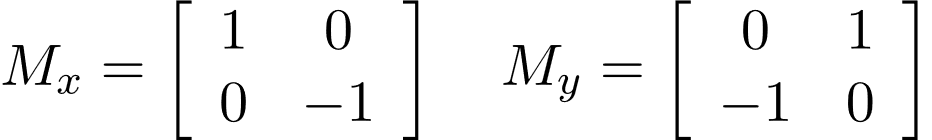
10/10/2022 – Attempts at bounding edged image

Attempted to use code found online to create bounding boxes for the edge filtered image

<https://uk.mathworks.com/matlabcentral/answers/35243-detecting-rectangle-shape-in-an-image>

Not great, will need some tinkering with algorithm to detect correct bounding box.

Need to think of extra info that could help detect corners of plate. The corners themselves seem fairly distinct, perhaps a similar filter to the edge detection could be used to find the corners of the plate. A filter for this use may have been found by using the **Robert Operator**.



This could be utilized to filter out diagonal edges, which the licence plate has at its corners, take the highest intensity spots and use these to find the approximate location for the edges of the licence plate.

12/10/2022 – Checking image processing requirements

Looking at an image size calculator, the stated value of a 1280x720p image in 8bit monochrome would be around 0.85MB which is significantly more than most microcontroller SRAM.

<https://toolstud.io/photo/filesize.php?imagewidth=1280&imageheight=720>

Given that working with the actual pixels of the image itself will be necessary, it doesn’t seem feasible to save the image in a compressed format (unless some Realtime decompression can be performed). The image could potentially be streamed from the onboard storage if necessary, taking the data and reducing it to a very low-level form (4bit mono-chrome) for processing. Although the maximum level of SRAM I have found on an affordable board is 256KB of SRAM. I could find an external module to assist in storing images, but I am uncertain, even 4 bits per pixel on 480p leaves very little room for processing. I should probably work on getting the system working at a higher level before attempting to design anything though.

12/10/2022 – diagonal edge detection



The Robert filter doesn’t work well. I might need to design my own filter to get the corners I want, or find another method.