Prediction using FPGA

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Introduction

❖ The aim of this project is detection an object from camera input instantaneously using an Artificial Neural Network.
❖ Input image generated by the VGA camera. (OV7670)
❖ Input image firstly filtered and obtained futures of image. Then, predict object by neural network.

Specifications and Design Requirements

❖ Reading camera input as live stream and predict desired object is whether actual or not.
❖ Use an artificial neural network for prediction on FPGA.
❖ System usable mobile.

Solution Methodology

Figure: An overall description of the project components.

This project has two parts. One of them is preparing weights on PC with python scripts from scratch. All the values on train algorithm has same bit length with FPGA fixed point type structure. And I design all algorithms from scratch according to this rule. Finally, I obtain weights.
On FPGA side, Camera Driver is responsible to communicate and set camera. Read image part is obtain pixel values and addresses from camera.
Camera input is stored in a RAM.
Edge detection process is perform the bounds of pattern on frame for easily predict on neural network.
Rescale algorithm generate a new image compatible with neural network inputs range.
Finally, neural network algorithm, calculate whether input image is similar desired pattern or nor.
Input frame from camera, rescaled frame and output of neural network are represented on a screen.

Application Areas

❖ Unmanned Civil and Military projects.
❖ Help visually impaired.

We can use this system vision part of unmanned civil and military projects. For example, It can be used for detecting helipad or drop area.
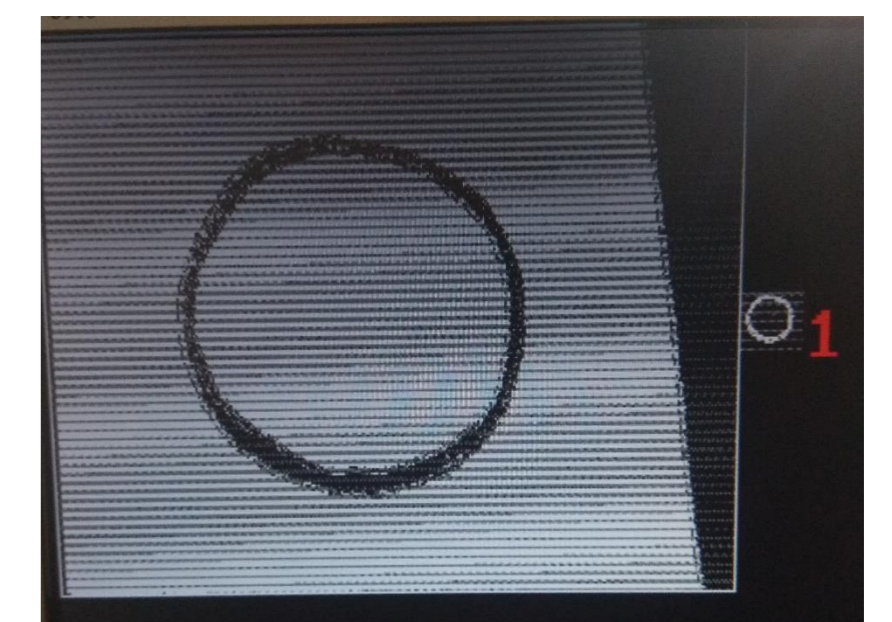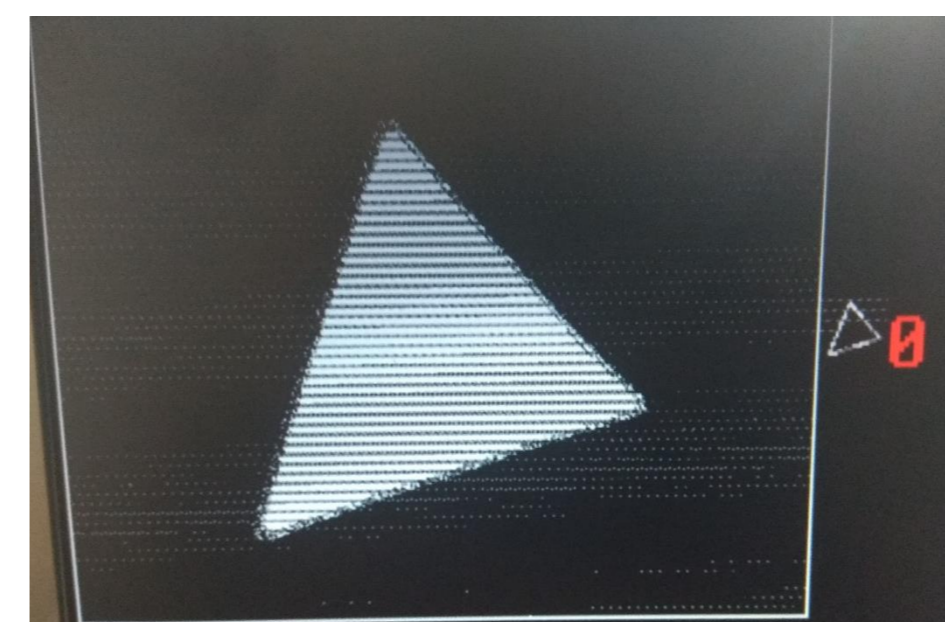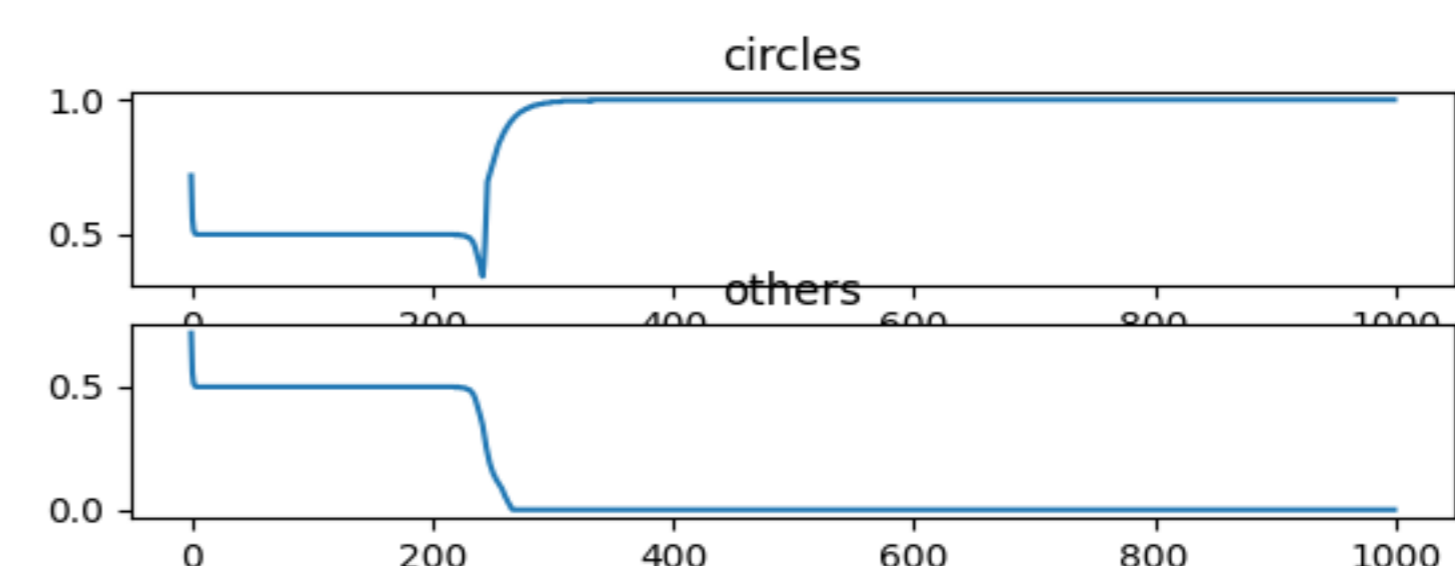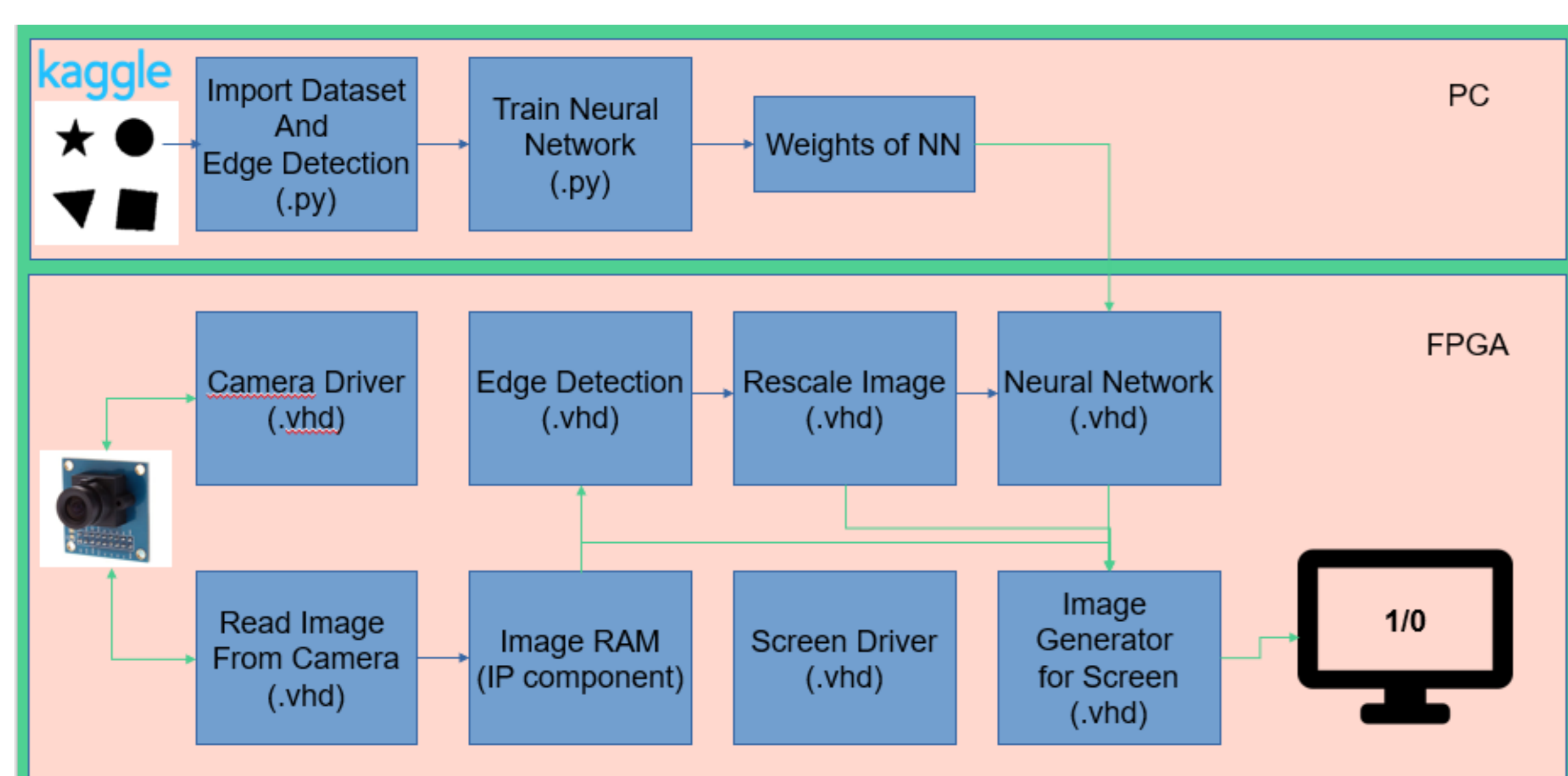In other field of usage is alerting visually impared people from dangers.

Results and Discussion

❖ Project basically perform requirements. As a result, input image filtered and a neural network predict object by this filtered image.

❖ Neural network has 28x28 bit array input ,9 bit output and 1 hidden layer has 2 neuron.
❖ In neural network code used fixed point type as 1 bit sign,6 bit integer side and 8 bit floating side.
❖ Half of pattern dataset used for testing. When training patterns on python script, performed full accuracy on test set.

❖ By the limitation of my FPGA, It is capable of train only basic patterns and can detect one type pattern.
❖ .But, in a strongest FPGA, it can usable for more complex patterns.

References

• Four Shape Dataset, https://www.kaggle.com/smeschke/four-shapes/metadata
• A. R. Omondi, J. C. Rajapakse, FPGA Implementation of Neural Networks, Springer, 2006.

Acknowledgements