CV Garden

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Goals

- Integrate concepts of computer vision and machine learning to help in the maintenance of a home garden. Our robot is inexpensive to buy and runs on parts that can easily be fixed or replaced.

Motivations and Objectives

- Construct a scalable classifier for recognizing images of plants that incorporates convolutional networks and concepts of deep learning to achieve well balanced performance metrics such as accuracy, recall, precision, f1 score, etc.
- Prepare a dataset of 30 thousand images of plants, collected from multiple sources on the internet.
- Mount the Camera Module V2 onto an Elegoo automated car kit, controlled by a Raspberry Pi.

Components

Fig 1. Sample image that was used to train/test network.

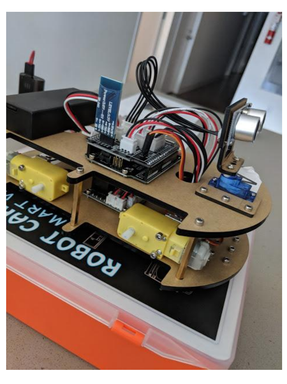

Fig 2. Autonomous Car. Arduino, Shield, and Sensors.

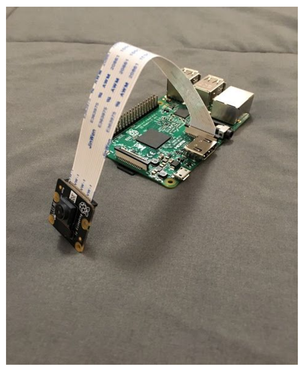

Fig 3. Raspberry Pi with Camera

Methodology

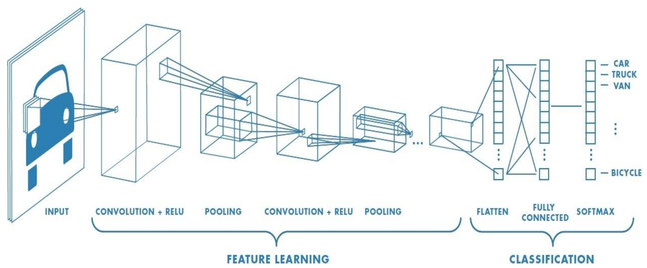

Figure 4. Convolutional Neural Network. The input goes through multiple streams of convolution and pooling during feature learning. The result then goes through the classification process, after which the image is identified as belonging to one of the pools in which the network was trained.

Technology

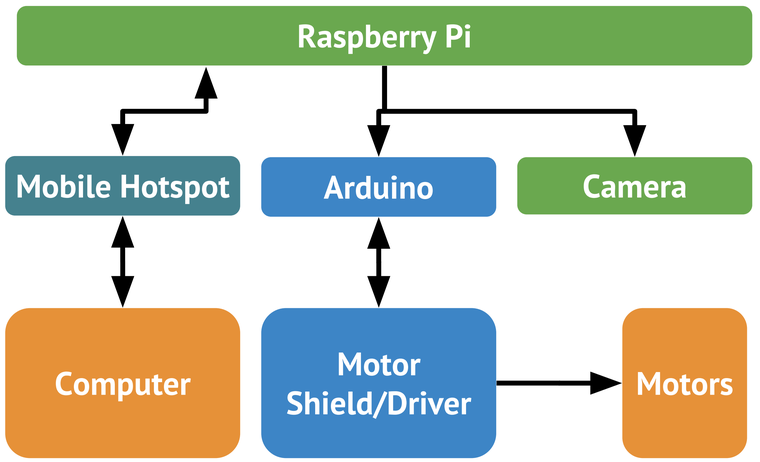

Figure 6. Hardware Interaction Diagram

Logic

Algorithm 1 Master Program

```
procedure MAIN
    arduino ← initialize arduino library
    camera ← initialize camera interface
    network ← load neural network model
    while true do
        arduino.moveCarForward()
        image ← camera.captureImage()
        image ← preprocessImage(image)
        isCrop ← network.ClassifyIsCrop(image)
        if isCrop then
            cropType ← network.ClassifyCropType(image)
            *Report crop type*
            continue
```

Figure 5. Pseudocode to outline the flow of our program. The car moves forward, takes a picture and returns the result.

Machine Learning Performance Metrics

Crop	Precision	Recall	F1-Score	Support
Pansy	0.64	0.71	0.67	173
Rose	0.73	0.69	0.71	180
Daffodil	0.64	0.56	0.60	171
Dandelion	0.78	0.85	0.81	156
Sunflower	0.59	0.59	0.59	173
avg/total	0.67	0.68	0.67	853

Figure 7. Our classification algorithm scores highly in precision, recall and f1 score.

Acknowledgement

We would like to thank Professor Dana for her invaluable support and help throughout the project. We would also like to give a shoutout to Professor Godrich for providing the automated car that served as our robot.

References

[1] C. O. Neal, “Crops vs. weeds.” [Online]. Available: https://www.kaggle.com/limitpointinf0/crop-vs-weeds
[2] “Farmbot: Open source cnc farming.” [Online]. Available: https://farm.bot/
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