AGRO-DOCTOR

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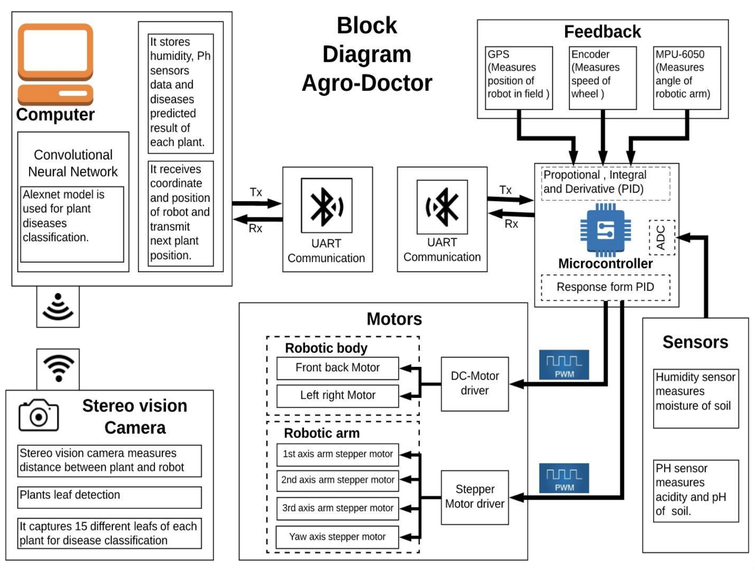
Abstract:
AGRO-DOCTOR is an agricultural robot that monitors our field, recognizes environmental variables and is intelligent enough to diagnose health condition of plants with Artificial intelligence (AI). It identifies the plants with the help of object detection algorithm and automatically navigates to it. The health condition of the plant is identified with images of leaf. The robot has pH and soil humidity sensor which measures acidity and water contain in soil. According to the health condition and soil status, it sprays the fertilizers and pesticides in required amount. It keeps health record of each individual plants and analysis it for better health condition. The data is used by different farmers to grow similar types of crops, which reduces risk in farming.

Objectives:
1. To minimize limitations and problems of traditional farming.
2. To make agriculture smarter, efficient and computerized.

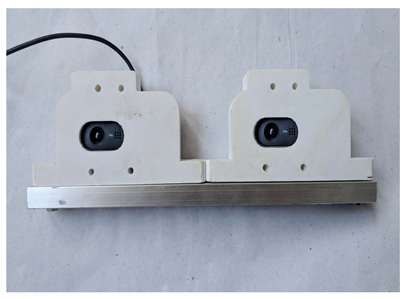
Proposed Model



I. Introduction:
Nepal is an agricultural country. But due to of laborious task, number of farmers are decreasing. Technology has touched every sector till date either it's from building smartphones to satellites so, we came with the same concept-note of technology in Agriculture "AGRO-DOCTOR, an agricultural robot" for making agriculture smarter, efficient and computerized.

II. Theory:

Stereo Camera

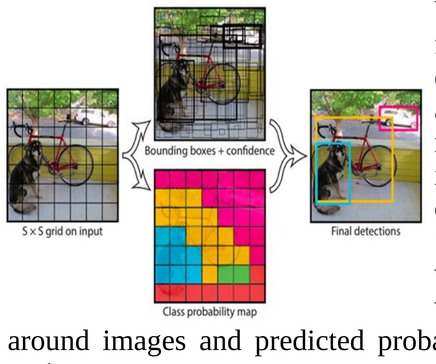


A stereo camera is two cameras of the same type and specification set on a straight line against either the vertical or horizontal plane. The resulting "disparity map" is used to determine the distance of objects from camera.

Alexnet
Alexnet is a CNN architecture designed by Alex Krizhevsky for image classification problem.

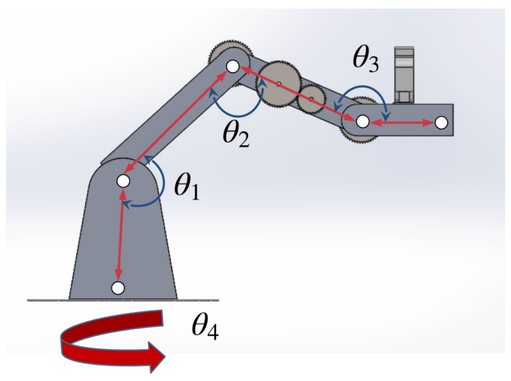
Layer		Feature Map	Size	Kernel Size	Stride	Activation
Input	Image	1	227x227x3	-	-	-
1	Convolution	96	55 x 55 x 96	11x11	4	relu
	Max Pooling	96	27 x 27 x 96	3x3	2	relu
2	Convolution	256	27 x 27 x 256	5x5	1	relu
	Max Pooling	256	13 x 13 x 256	3x3	2	relu
3	Convolution	384	13 x 13 x 384	3x3	1	relu
4	Convolution	384	13 x 13 x 384	3x3	1	relu
5	Convolution	256	13 x 13 x 256	3x3	1	relu
	Max Pooling	256	6 x 6 x 256	3x3	2	relu
6	FC	-	9216	-	-	relu
7	FC	-	4096	-	-	relu
8	FC	-	4096	-	-	relu
Output	FC	-	1000	-	-	Softmax

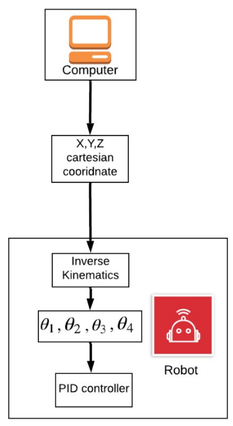
YoLo v2

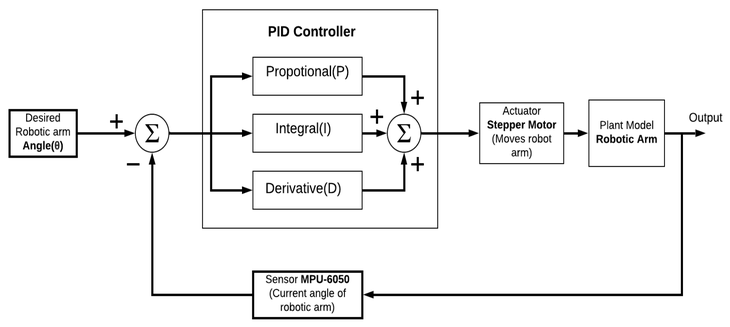


YOLO is an extremely fast real time multi object detection algorithm. The algorithm applies a neural network to an entire image. The network divides the image into an S x S grid and comes up with bounding boxes, which are boxes drawn around images and predicted probabilities for each of these regions.

Working of Robotic Arm

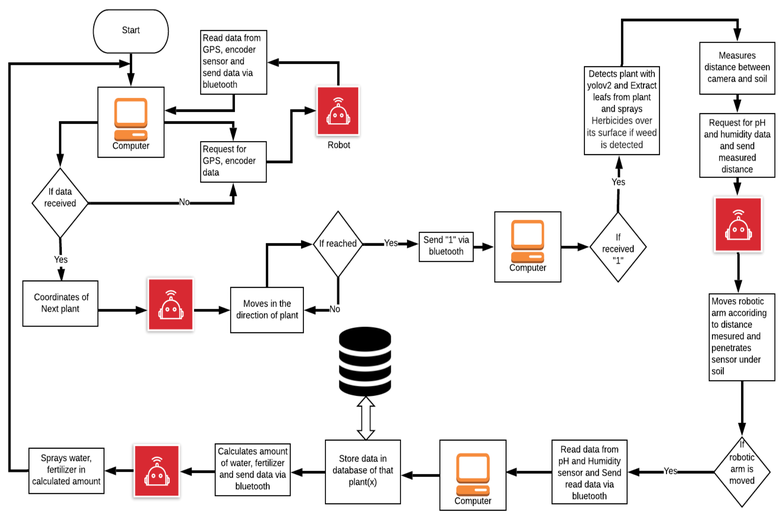


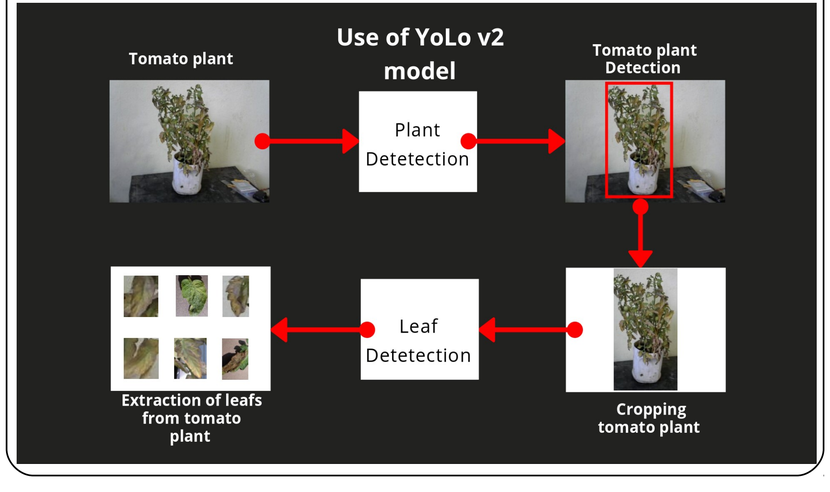


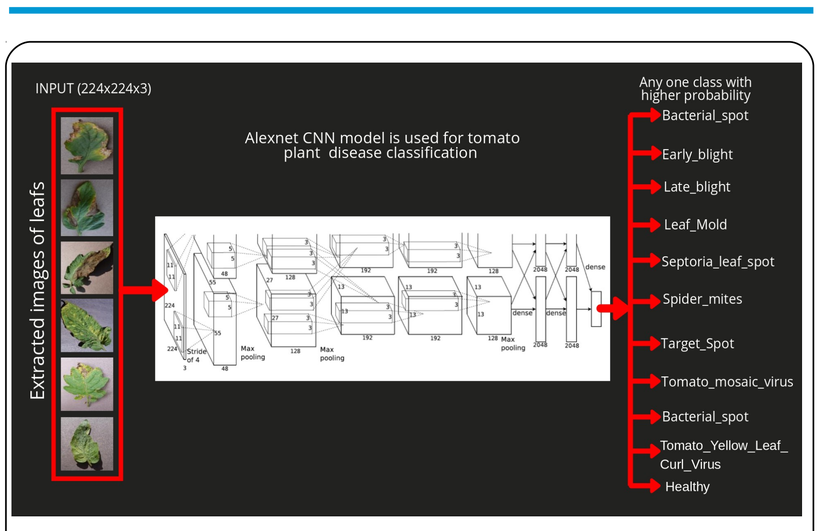


Block Diagram of PID Controller

III. Methodology & System Setup





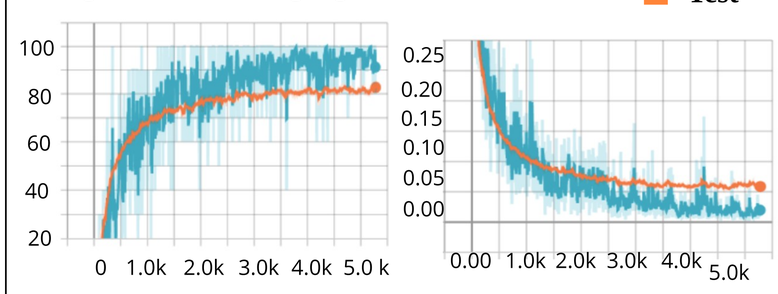


Stereo vision camera is used to measure distance between robot and plant. After measurement YoLov2 model is used to detect tomato plants. Leaves are extracted from image of tomato plant and finally Alexnet CNN model is used for tomato plant disease classification.

IV. Results and Analysis:

Alexnet model training

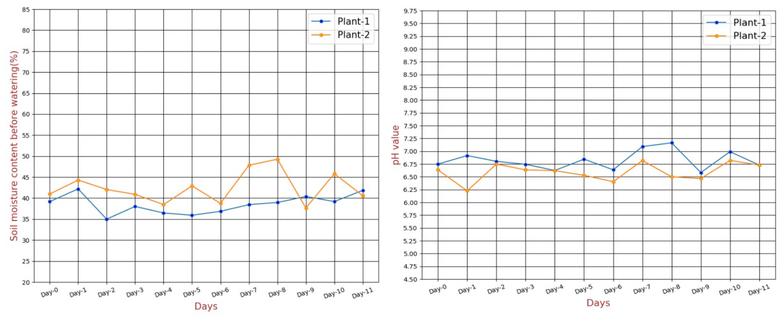
Tensorflow library is used to create Alexnet model. Alexnet model is trained on 60,000 images for 8hours in google colab



Accuracy **Cross_entropy**

Train accuracy = 91.20% Test accuracy = 83.45%

Output (Data Visualization)



Soil moisture content vs Days **Soil pH vs Days**

Watering amount vs Days **Predicted results of tomato plant**

V. References:
[1] Adi, K. & Widodo, C. E. (2017). DISTANCE MEASUREMENT WITH A STEREO CAMERA. International Journal of Innovative Research in Advanced Engineering, Volume IV, 24-27. 10.26562/IJIRAE.207.NVAE10087

[2] S. R. Park and J. W. Lee, "A Fully Convolutional Neural Network for Speech Enhancement," Interspeech 2017, 2017.

[3] unnat, A. M. (2019, April). *An introduction to implementing the YOLO algorithm for multi object detection in images*.Retrieved from Towards Data science: https://towardsdatascience.com/an-introduction-to-implementing-the-yolo-algorithm-for-multi-object-detection-in-images-99cf240539.