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CNN for Image Processing to Detect Weeds Using IOT

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Abstract: ***One of the major issues in today's agriculture fields is detecting weed plants in between the crops. Weeds consume more water, nutrients, and light compared to crop plants. Being hardy and vigorous in growth habits, they grow way to faster than crops and consume a huge amount of water and nutrients, results causing heavy losses in yields, the process of removal of weeds manually is a difficult job and it requires more manpower. To date, weed removal can't be automated without manpower. Herbicides play a crucial role in removing the weeds but that leads to soil infertile and later the weeds dominate the field automatically. In solution to reduce the weeds is using herbicide in a higher amount than normal day by day. Usage of herbicides in that amount causes the land infertile. This paper deals with detecting the weeds in the crop using a convolutional neural network, Image processing, and IoT. The weeds in the field and between the crops are detected and removed by using the image processing technique. CNN algorithm is implemented in Matlab software to detect the weed areas in the fields. A robot model is connected to the controller through the motor driver which is also used to carry the camera through the field to detect the weed. The videos and images taken by the camera send to the Matlab and they are trained by using the CNN algorithm and that classifies whether it is a weed or a normal crop. And the necessary instructions send to the Arduino through Zigbee. If the camera detects any weed then the cutter is on 10 seconds to cut the weeds. And the robot model moves further until it finds the next weed. Users can also control the robot model whenever itneeds.***

Keywords: CNN; Weed cutter; Matlab; Zigbee; Image processing.

I. INTRODUCTION

In terms of economic agriculture plays a vital role in India. Farming technologies have been developed during the last two decades to refine the agricultural management practices.

Every field has weeds growing in it throughout the year and in a country like India, the number of such fields is in the hundreds. The weed is a plant that competes with crops for water, nutrients, and space, therefore it reduces crop yield. To date the weed removal can't be automated without manpower due to some effects in crops because of automation and removal of weeds in some types of crops is very difficult.

Usually, herbicides are used for removing the weeds and it also provides a good result at initial but later the weeds dominate the field automatically. Along with the increase in food grain per capital, the need for weed removal also has increased. Usage of large amounts of herbicides leads to polluting the environment and decreasing the quality of food and also soil infertile. Identification and removal of weeds for small scale farms in India come with the difficulty of hiring labor. Acquiring labor for regular crop maintenance has become one of the greatest challenges. The use of IoT, machine learning & image processing to detect the weeds between the crops is highly desirable. Several surveys have been conducted in past research to identify the limitations of the existing weed control systems.

This paper deals with detecting the weeds in the field using convolutional neural networks,Image processing, and IoT. The weeds in the field are detected and removed by the image processing technique.CNN algorithm is implemented in Matlab software to detect the weed areas in the fields. A robot model is connected to the controller through the motor driver which is also used to carry the camera through the field to detect the weed. The videos and images taken by the camera send to the Matlab and they are trained by using the CNN algorithm and that classifies whether it is a weed or a normal crop. And the necessary instructions send to the Arduino through Zigbee.If the camera detects any weed then the cutter is on 10 seconds to cut the weeds. And the robot model moves further until it finds the next weed. Users can also control the robot model whenever it needs. By this way, it can reduce the usage of large amount herbicides and also decreases the soil infertile. And that helps to reduce the manpower. Section I includes the Introduction. Section II focuses on the Literature Survey. Section III highlights the Proposed Methodology while Section IV presents the Architecture. Section V presents the Modules description. Section VI presents the algorithm. Section VII presents Experimental setup and results. Section VIII presents the Conclusion and Section IX presents references.

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II. RELATED WORK

This paper[1] mainly focuses on color segmentation and edge detection. Color segmentation is the method which is used to separate the crop and weeds. This method helps in separating all the visually distinguishable colors from one another. The image after color segmentation consists of green color and the remaining part of the image is black, and then the edge detection process takesplace.

This paper[2] is based on the CNN model deployed in Raspberry-Pi and that is based on a machine learning system. Raspberry-Pi performs image segmentation that is dividing the image into small segments. The Segmentation algorithm used in this model is Watershed Segmentation. Each segment is passed onto a trained CNN model for classifying as weed orcrop.

This paper[3] proposes an algorithm predominantly uses an Erosion and Dilation approach to detect weeds. The color image is converted to binary by extracting the green parts of the image. The number of white pixels present in the particular region is determined and white pixels with higher count in the region are considered to be weeds. The herbicide is stored in an exceedingly container fitted with pump motors attached to spray nozzles. Once the weeds are identified, the signal is distributed from Raspberry-Pi to the motor driver controlling the pump motors to spray the chemicals over theweeds.

This paper[4] introduces the system implementation of an image processing technique for weed detection.It involves a straightforward simple edge detection technique using various filters like such as Gaussian and Laplacian. It finally concludes with the feature extraction results that implement the ORB algorithm. An RGB image is taken as a sample to demonstrate the difference between a weed and therefore the crop. This RGB image is processed for detecting the particular weeds. After certain steps, we get an output where the weeds are separated from the crop and that is the sampleimage.

This paper[5] presents a machine vision system for weed detection in vegetable crops using outdoor images, avoiding lighting and sharpness problems during the initial step. This development will be a module for a weed removal mobile robot with camera (Latin for “dark room”) for lighting conditions. The aim of this paper is to develop an algorithm to detect weeds, using image filtering to extract color features and area, then a process to label each object implemented in that particular area.

III. PROPOSED WORK

This paper proposes the ideology of automatic detection and removal of weed. This help both the farming and gardening cultures most easily and efficiently based on efforts that put up to maintain the crop or field, time that is taken to detect and remove the weed. One can maintain his garden or crop anywhere within the range of 10mts - 100mts. This is done by investigating the crop using the live cam that is connected to a moving bot that has cutting equipment and detecting whether its a weed or not using an image processing algorithm. And when it is detected the cutting equipment is instructed to cut that particular weed and after removing that particular weed the bot that has the live cam is made to move to the next frame and repeat the process of detecting and removing the weeds. And the user can control the bot from his pc using a graphical user interface so that he can move the bot to whatever corner in the crop he wants to. And the data set to detect the weed that to be taken as a reference is trained through CNN in Matlab[10] and using that data set the image processing algorithm process the images or videos that have been captured using the live cam and detect whether its weed ornot.

IV. ARCHITECTURE

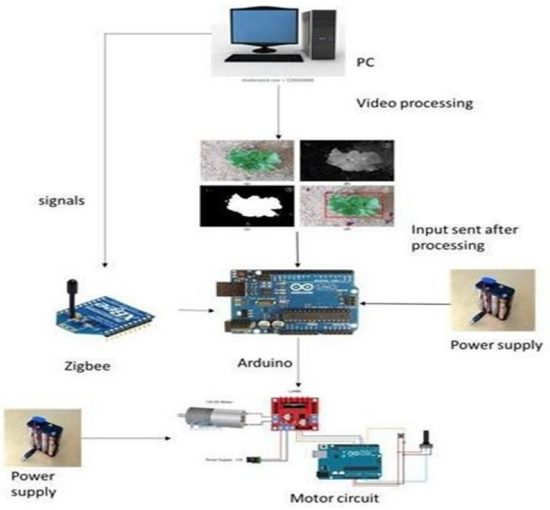

Figure 1: Flow chart

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The implemented system consists of a camera on the bot, which is used to take pictures and videos. Later it sends them to PC using the CNN algorithm in image processing it detects whether it is a weed or not. So then it gives necessary instructions to the weed cutter. Arduino board is connected to the motor circuit and the ZigBee receiver, where the motor circuit is instructed where and when to function and for the functioning of cutting equipment. And the ZigBee transmitter drive installed in the pc and can be operated through the pc using the graphical user interface.

V. MODULES DESCRIPTION

A. Arduino

Figure 2: Arduino

Arduino is a microcontroller. Where in this project Arduino connects to the Motor driver circuit[12] and motors. Arduino boards manage the motors rotation and the weed cutter. Where ZigBee module is connected to the Arduino to receive the requests from the API from the ZigBee module that connected to the system.

B. L298N Motor Driver

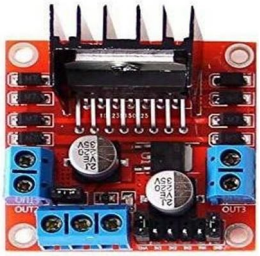

Figure 3: L298N Motor Driver

L298N is a motor driver which is used to control the two motors attached to both the wheels. It is used when there is a high voltage required for the motors to run. It has an H- bridge drivers are used for inductive loads that require forward and backward functions with control, for example, dc motors. This motor receives the instructions from theArduino.

C. Zigbee

Figure 4: Zigbee

Zigbee is primarily used for two way communication. It has a short range of connectivity up to 100 meters[11]. In this model, we used two ZigBee modules one is for the receiver and Another one is for the sender. The signals are sent from the pc [8]through the graphical user interface(GUI) to the receiver in thebot.

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VI. ALGORITHM

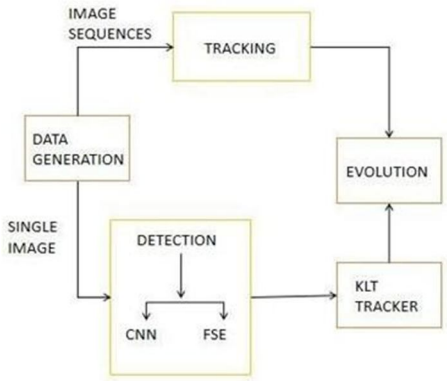

Figure 5: Work flow of algorithm

In data generation, the image sequences and single images are serving as input to the detection module and tracking module [7]. The two approaches CNN+KLT tracker and a convolutional LSTM are applied and evaluated. Data module generates the annotated data, which we split into training and test sets. In the detection phase, the CNN learn a model from which we can detect eddy cores. And the KLT tracker tracks the eddies using a sparse optical flow and evaluation is done. In Fig[5] FSE means Feature Space Extension.

VII. EXPERIMENTAL SETUP ANDRESULTS

First, we have taken the video on the farm using the camera. In Matlab software, the video will be converted into any number of small frames and each frame labels the weeds using image extraction and labeling methods. The weed detection process consists of two sub-processes, one is Image extraction with labeling the input and the other one is building the network architecture. The image extraction process divides each training image into sub-images where the collections of these sub-images are sent to the Convolutional Neural Network models[6] to predict the potential weed regions in the test images. And the necessary instructions send to the Arduino through ZigBee. Arduino controls the weed cutter and it is on for 10 seconds to cut the weeds. And the robot model moves further until it finds the next weed. Users can also control the robot model whenever it needs through a graphical userinterface(GUI).

Figure 6: Detection of weed plants in the field

After the image was taken by the camera. It sent to the Matlab software and labels the weeds using image extraction and labeling [9] methods. And the fig[6] shows how the output looks like after the process wasdone.

Figure 7: GUI to control bot

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The Graphical User Interface is used to track the weed in the given video by clicking the track button. And also the user can control bot to the forward, left and right directions through the graphical user interface and also the user can stop the moving bot by clicking the stop button.

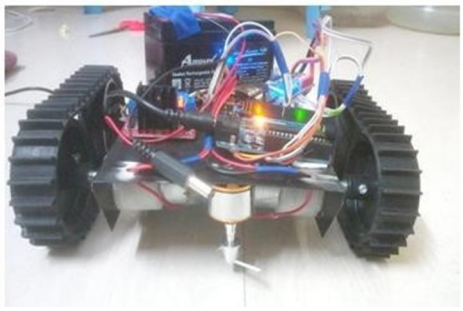

Figure 8: weed cutter

The fig[8] represents the complete implementation of the bot model which contains the weed cutter in the front and the cutter will move with high speed.

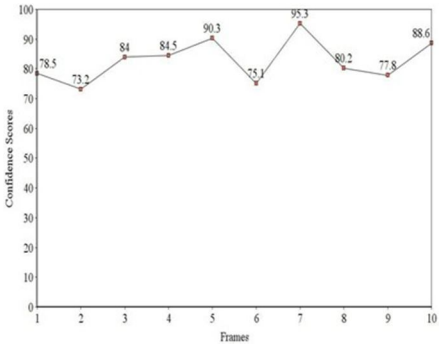

Figure 9: Graph for Confidence scores

Fig[9] shows the confidence level scores for weed detection in each frame. In the above graph, the x-axis represents the no of frames divided into the video and the y-axis represents the confidence level scores.

VIII. CONCLUSION

The proposed system, IOT Based Weed detection, and Image processing use Convolutional Neural network for detecting weeds. Farmers can monitor the growth of crops and plants when they are not in the field. It is not easy for farmers to visit the field every day. This proposed system detects the weed automatically and weed cutter which is attached to the robot model cuts the weeds. So we can also reuse the weed affected area and also decreases the usage of herbicides for the removal ofweeds.

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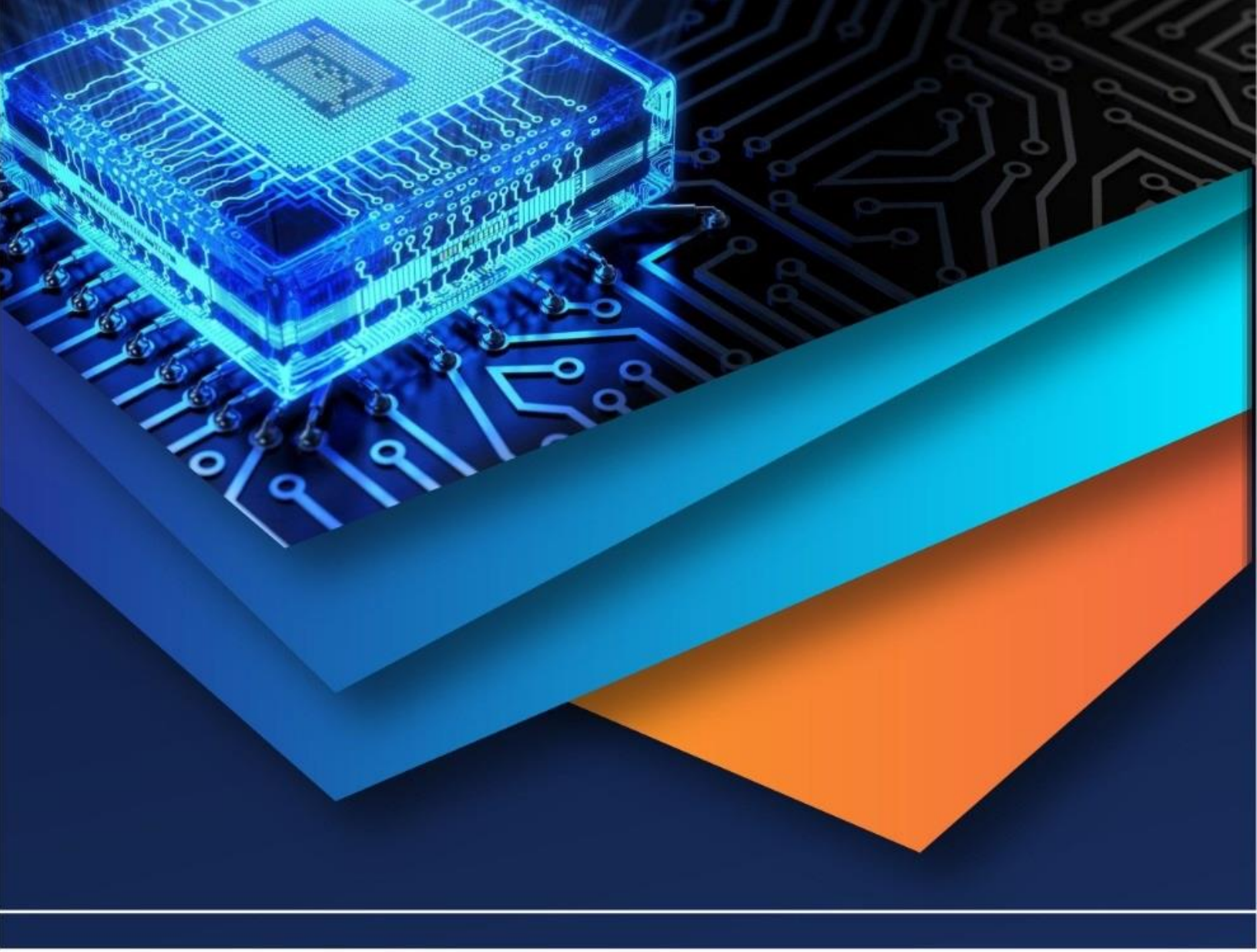

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