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Automatic Weed Detection and Smart Herbicide Spray Robot for Corn Fields

K. Shanmuga Priya[1], Devathai D[2], Keerthana N[3], Ranjitha S[4], Anitha Priyadharshini S[5]

Assistant Professor, Department of ECE, R P Sarathy Institute of Technology, Salem, Tamil Nadu, India[1]

Student, Department of ECE, R P Sarathy Institute of Technology, Salem, Tamil Nadu, India[2]

Student, Department of ECE, R P Sarathy Institute of Technology, Salem, Tamil Nadu, India[3]

Student, Department of ECE, R P Sarathy Institute of Technology, Salem, Tamil Nadu, India[4]

Student, Department of ECE, R P Sarathy Institute of Technology, Salem, Tamil Nadu, India[5]

ABSTRACT: Agriculture is a critical field of economy that needs consistent care and attention. The crops during the growing phase regularly need tending and are prone to pest and weed infestation that severely affects crop productivity. In today's age when sufficient man power is not available in agriculture, machine learning and neural networks can be used to detect the weeds in the crop field. Weeds are a big problem in agriculture because it is major part of agricultural losses. Nowadays, herbicides are sprayed uniformly throughout the field to control the weed. This method is not only expensive but also have bad impacts on environment and human health.

I. INTRODUCTION

In the realm of modern agriculture, the persistent challenge of weed management continues to demand innovative solutions. Weeds not only compete with crops for resources but also serve as hosts for pests and diseases, ultimately jeopardizing agricultural productivity and sustainability. Traditional methods of weed control, often reliant on indiscriminate herbicide spraying, pose significant drawbacks such as environmental contamination, health risks, and economic inefficiencies. In response to these challenges, the integration of advanced technologies, such as machine learning and robotics, into agricultural practices has gained traction. Weed detection systems, empowered by artificial intelligence algorithms, offer the promise of precision agriculture by enabling targeted interventions tailored to specific weed infestations. This paradigm shifts towards precision weed management holds the potential to revolutionize agricultural practices, enhancing both economic viability and environmental sustainability.

II. LITERATURE REVIEW

2.1 CROP MONITORING AND AUTOMATIC WEED DETECTION USING DRONE

Authors: Abdul Hafeez, Vikas Tiwari, Vinod Kumar Verma, Akhtar Saleem Ansari, Mohammed Aslam Husain.
Year: 2021
Description:

Crop monitoring and automatic weed detection using drones involve the utilization of unmanned aerial vehicles (UAVs) equipped with various sensors and imaging technologies to assess the health and status of crops while simultaneously identifying and managing weed infestations.The captured data is then processed using advanced image processing, machine learning, and computer vision algorithms to analyze various parameters related to crop health and weed presence.[1]

2.2 AUTONOMOUS WEEDING ROBOT FOR ORGANIC FARMING FIELDS

Authors: R. Raffik, S Mayukha, J Hemchander, D Abishek, R Tharun,S Deepak Kumar
Year: 2021
Description:

The most significant and effective method to remove weed is by using weecutterobots. The wheeled robots will find their way towards weeds and remove them completely.The Autonomous Weed Cutter Robot for Organic Farming Fields is a sophisticated agricultural device designed to efficiently manage weed growth while adhering to the principles of organic farming. This innovative robot operates autonomously, utilizing advanced technologies to identify and selectively cut weeds without the need for synthetic herbicides or manual labour[2].

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III. PROPOSED SYSTEM

Automatic weed detection and smart herbicide sprayer robot based on image processing is a very useful project in agricultural fields. Since its fully automated, time and money can be saved also a smaller number of labors can be implemented. The user will be updated about field and crop. The weeds can be detected and removed effectively.
Image is converted into gray scale to compute Gray Level Co-occurrence Matrix (GLCM) forfeature extraction. Local binary pattern (LBP) is a type of visual descriptor used for classification in computer vision. Movement of robot is controlled with the help of motor driver and spraying of herbicide is processed using water motor.

At the exhibit, these sorts of plants are being expelled physically, in whatever place conceivable, or herbicides are being splashed consistently everywhere throughout the field to hold them in check. In customary weed control frameworks, herbicides are splashed consistently all over the field. This procedure is incompetent as pretty much 20% of the shower achieves the plant and under 1% of the synthetic really adds to weed control, prompting wastage, sullying of nature and wellbeing issues in individuals.

To maintain a strategic distance from these outcomes, a keen weed control framework ought to be utilized. These frameworks must be equipped for finding weeds in the field achieves the plant and under 1% of the synthetic really adds to weed control, prompting wastage, sullying of nature and wellbeing issues in individuals. An imaging detector is a main part of any weed location and arrangement framework. Singular plant characterization has been effectively shown with either otherworldly or shading imaging.

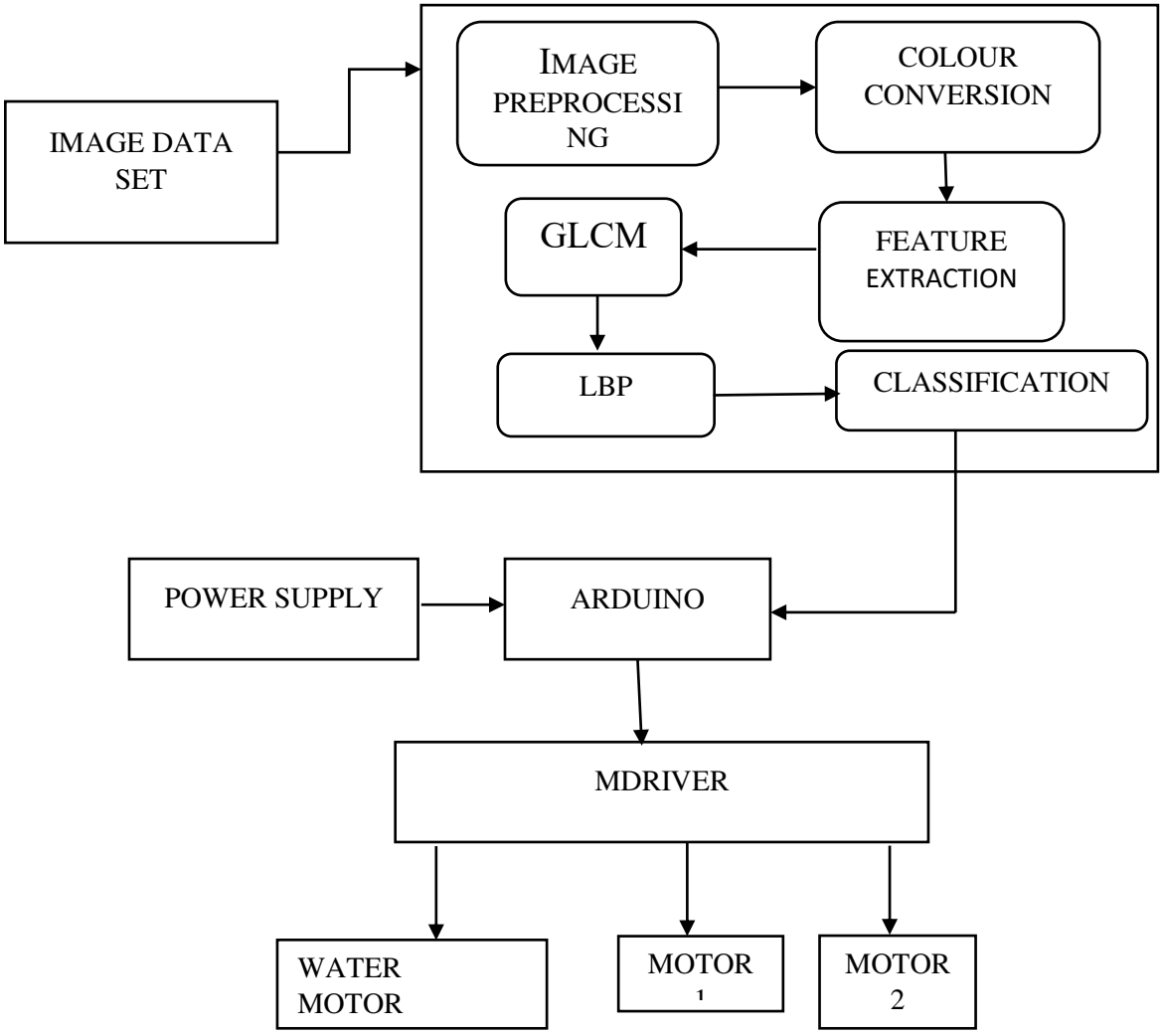

FIGURE.NO.3.1. PROPOSED SYSTEM BLOCK DIAGRAM

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IV. WORKING

The accompanying advance is the preparing of the caught picture. The picture is enslaved to morphological thresholding, erosion and dilation to decide the nearness of yields in the Region of Interest recognizing whether it is a weed or the plant.The definitive advance is the straightway splash of the weeds in the ROI.The image is then converted to grayscale using cv2.cvtColor() of OpenCV. Then we mask image to green colour by giving masking range of (36, 0, 0) (86, 255, 255) in cv2.inRange() function. After doing this we only get green part of the image.

The photos thusly captured are processed, and a decision is gone up against the premise of a computation of white pixels in the photo and the herbicide is showered. The showering is master by the usage of water shower motors pipe concentrating clearly on the plants. These portions are mounted on a land robot that movements through the ground, catching pictures at predefined between times and taking care ofeach photo taken, and in this way sprinkling the herbicide.

A motor driver L293D IC is utilized for interfacing the wheel motors and pump motors .The wheels of the robot are connected to equipped 30 rpm engines initiated by a 9V battery. The robot holds one little pump motor kept in holder accused of herbicide, joined to a pipe for splashing.

V. HARDWARE REQUIREMENTS

- Arduino Uno
- L293D Motor Driver IC
- BO Motor
- Water Motor

5.1 ARDUINO UNO

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward.

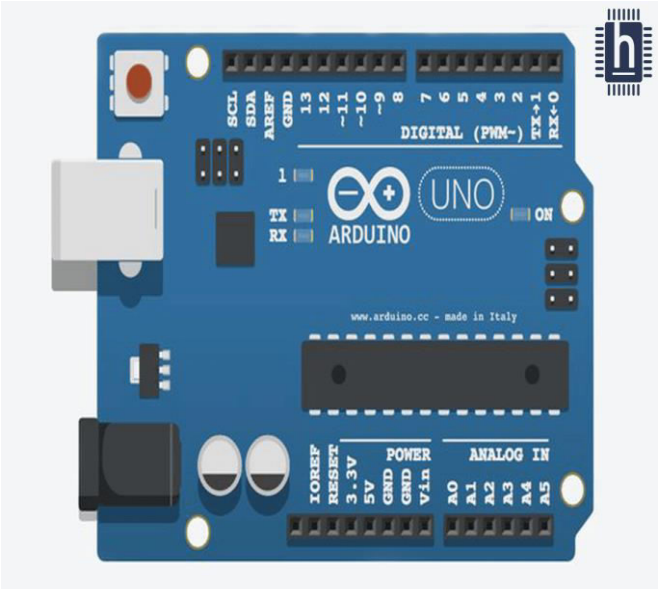

FIGURE.NO.5.2. ARDUINO UNO

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5.2 L293D MOTOR DRIVER IC

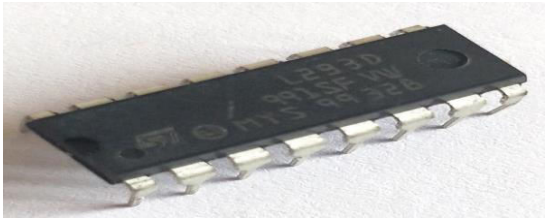

FIGURE.NO.5.3. L293D MOTOR DRIVER IC

L293D H-bridge driver is the most commonly used driver for Bidirectional motor driving applications. This L293D IC allows DC motor to drive on either direction. L293D is a 16-pin which can control a set of two DC motors simultaneously in any direction.

5.3 BO MOTOR

FIGURE.NO.5.4. BO MOTOR

The BO Series160RPMDC Motor Plastic Gear Motor– BO series straight motor gives good torque and rpm at lower operating voltages, which is the biggest advantage of these motors. Small shaft with matching wheels gives an optimized design for your application or robot. Mounting hole son the body & light weight makes it suitable for in-circuit placement.

5.4 WATER MOTOR

The motor drives the impeller to rotate, sucks water into the pump body, and then discharges water through the outlet. Small water pump has a wide range of applications, and can be used in household, agricultural, industrial and other fields.

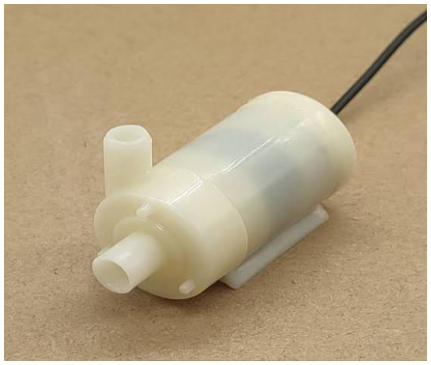

FIGURE.NO.5.5. WATER MOTOR

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VI. SOFTWARE REQUIREMENTS

6.1 MATLAB

MATLAB is a high-level language and interactive environment for numerical computation, visualization, and programming. The language, tools, and built-in math functions enable you to explore multiple approaches and reach a solution faster than with spreadsheets or traditional programming languages, such as C/C++ or Java You can use MATLAB for a range of applications, including signal processing and communications, image and video processing, control systems, test and measurement, computational finance, and computational biology.

VII. IMAGE PROCESSING

Image pre-processing is an essential step of detection in order to remove noises and enhance the quality of original image. It required to be applied to limit the search of abnormalities in the background influence on the result. The main purpose of this step is to improve the quality of image by removing unrelated and surplus parts in the background of image for further processin

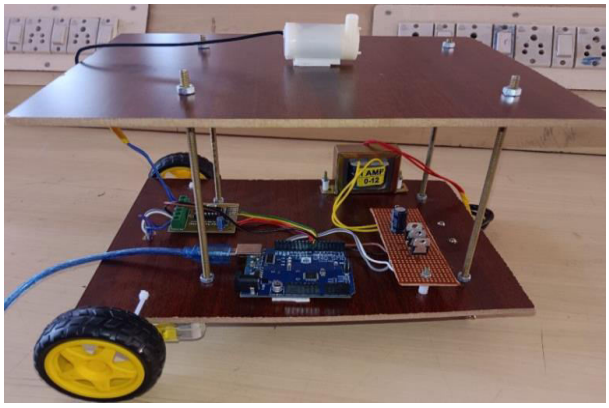

FIGURE.NO.7.1. PRE-PROCESSING IMAGE

VIII. RESULT

The results from weed detection coupled with smart herbicide spray robots for corn fields have shown promising outcomes. By using advanced technologies such as computer vision and machine learning, weed detection accuracy has improved significantly, leading to more precise and targeted application of herbicides. This approach minimizes herbicide usage, reduces environmental impact, and increases crop yield by effectively managing weed competition.

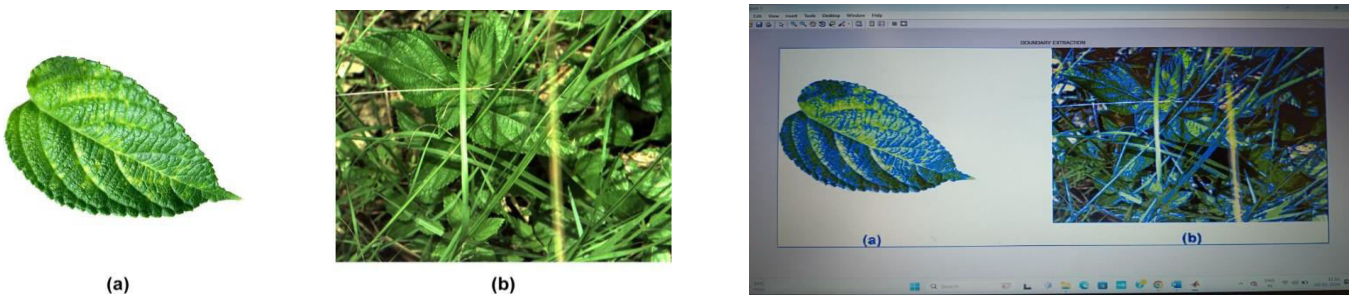

FIGURE.NO.8.1. RESULT

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8.2 SIMULATION RESULT

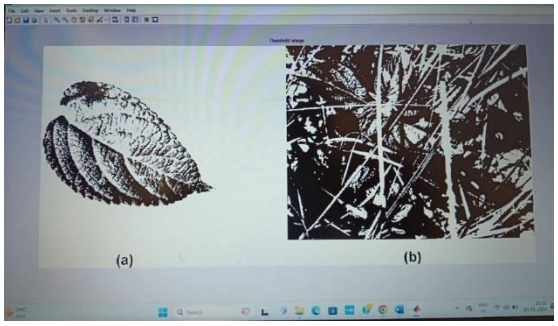

FIGURE.NO.8.2. SIMULATION RESULT

IX. CONCLUSION

In conclusion, the integration of machine learning, robotics, and advanced sensing technologies holds immense promise for revolutionizing weed management in agriculture. By leveraging these innovations, we can transition towards precision weed control practices that are not only effective and economical but also environmentally sustainable. The development of automated weed detection systems and robotic platforms empowers farmers with real-time monitoring capabilities and data-driven insights, enabling them to make informed decisions and optimize resource allocation. Furthermore, by reducing the reliance on indiscriminate herbicide spraying and minimizing environmental contamination, these technologies contribute to the preservation of ecosystems and the protection of human health. As we navigate the challenges of feeding a growing global population while confronting climate change and diminishing natural resources, the adoption of sustainable weed management practices becomes imperative.

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