GHraisoni COLLEGE
Engineering and Management Pune

G.H.Raisoni College Of Engineering And Management, Pune

(An Empowered Autonomous Institute, Affiliated to SPPU, Pune, Affiliated by NAAC A+ Grade)

Department of Electronics and Telecommunication Engineering

AI Driven Agribot

REVIEW - 2

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Introduction

Agriculture plays a critical role in the economy, particularly in regions where rice is a staple crop. Traditional rice planting methods are labor-intensive and time-consuming, often leading to inefficiencies and increased costs. To address these challenges, the "Agricultural Rice Plantation Robot using AI & IoT" project aims to develop an innovative solution that automates the rice planting process.

This project leverages Artificial Intelligence (AI) and Internet of Things (IoT) technologies to create a smart, autonomous robotic system capable of performing precise and efficient rice planting. The robot is designed to navigate paddy fields, plant rice seedlings accurately, and monitor environmental conditions in real-time. By integrating AI, the robot can make intelligent decisions to optimize planting patterns and adapt to varying field conditions, ensuring uniform seed distribution, and improving crop yield. IoT sensors will provide continuous data on soil moisture, temperature, and other critical parameters, enabling farmers to make informed decisions about crop management.

The introduction of this robotic system aims to revolutionize rice farming by reducing dependency on manual labor, increasing planting accuracy, and enhancing overall productivity. This project represents a significant step towards modernizing agriculture and ensuring food security through technological innovation.

iterature Survey

Paper Name	Name of Publisher	Publishing Year	Methodology	Result
Smart farming for improving agricultural management	Elsevier	2021	Here the cloud based event and data management is done using the cloud system, connecting the different sensors to the cloud and analyse the collected data.	Collection of the data and analyzing it for the future procedure on the crops on the fields according to the quality of the plants.
Application of AI techniques and robotics in agriculture	Elsevier	2023	Normal application of AI in detecting the trees, leaves and other factors like detecting the fruits and quality by using image processing and neural network topology, raspberry Pi and the display	Detecting the objects in the fields using AI and deciding the objects.
Design and development of the agricultural robot for crop seeding	IJAIEM	2014	Here the fully functional agricultural mini robot is made which can drop the seeds automatically into the fields with the help of Arduino, IR sensor, ultrasonic sensor and motors.	The seed of the plant can be sowed without the human requirements with this automated seed planter robot.

.no	Paper Name	Name of Publisher	Publishing Year	Methodology	Result
4	Effect for a Paddy Weeding Robot in Wet Rice Culture	Fuji Technology Press	2018	1. Navigation Algorithm (PWM control as the basic navigation control) 2. Capacitive touch sensors 3. Azimuth sensor	The ground is uneven, and the rows of rice seedlings are not always straight, as is the case in terraced paddies. It is used to detect rice seedlings and Measure the movement direction.
5	Robotics and Automation in Agriculture: Present and Future Applications	ARQII Publication	2020	1. Real-Time Kinematic GPS (RTK-GPS) and IMU 2. Fuji F660EXR Camera 3. Normalized Different Spectral Indices (NDSI)	This new technology is used for position and attitude sensor for navigation system. To monitor the seed falling trajectories which is attached at the Unissem pneumatic planter outlet. It is used in detecting peanut leaf spots.
6	Detection of unhealthy region of plant leaves using Image Processing and Genetic Algorithm	IEEE	2015	1. Artificial neural network (ANN) 2. CIELAB color model 3. Color co-occurrence method with SVM classifier	An ANN based classifier classifies different plant diseases and uses the combination of textures, color and features to recognize those diseases. It is used to remove that noise. The training samples can be increased and shape feature and color feature along with the optimal features can be given as input condition of disease identification.

Objectives

Objective Defined:

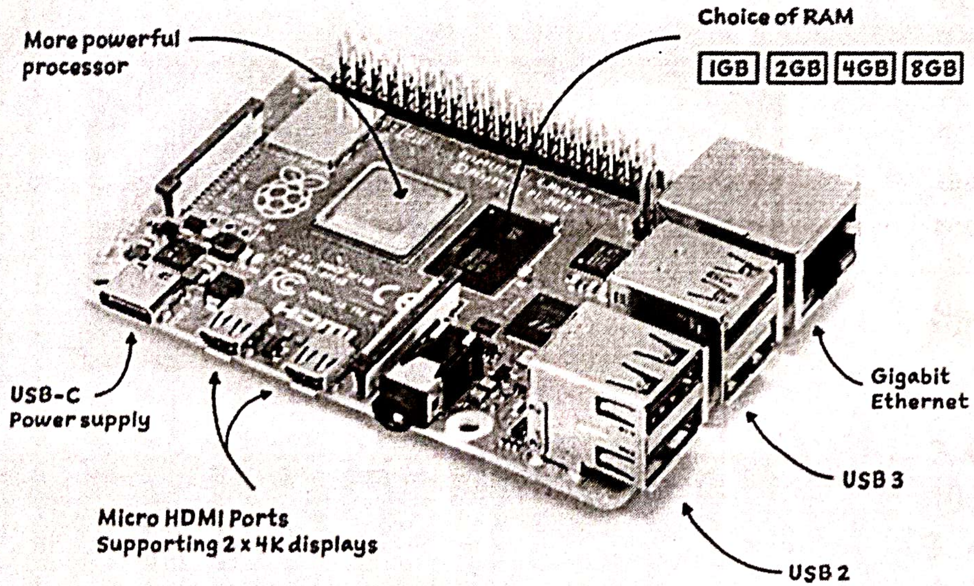
- Integrate AI and machine learning models for crop quality detection and decision-making.
- Implement automation in rice sowing to minimize manual errors and improve efficiency.
- Ensure early identification of potential issues, enabling timely intervention with fertilizers to protect crops.
- Develop an AI-driven Agribot for rice plantation to reduce labor dependency.

Objective Achieved (30-40% Completion):

- Designing the initial system for the Agribot, including Rice planter hardware and software.
- Integrated basic AI and machine learning models for crop quality detection, with further optimization needed.
- Progress made towards identifying crop health issues, but full functionality is still under development.

Detail of the Project

1. Raspberry Pi 4



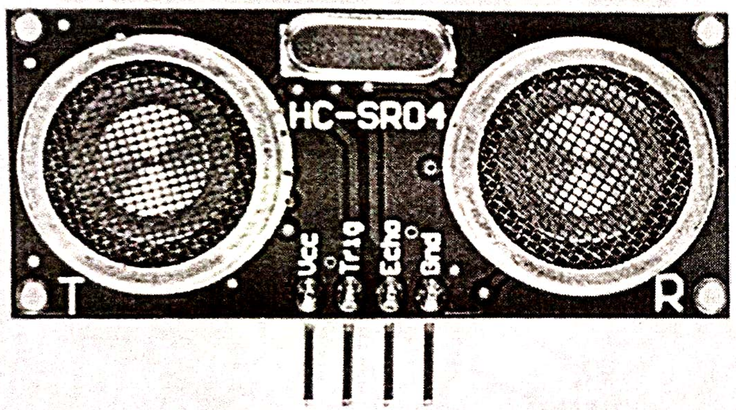
Working Principle

•**Microcomputer**: Functions like a small desktop PC.
•**System on Chip (SoC)**: Broadcom BCM2711 integrates CPU, GPU, memory, and I/O controllers.
•**Operating System**: Typically runs on Raspberry Pi OS (Linux-based).
•**GPIO Pins**: Allows interfacing with other hardware components.

Specifications

•**Processor**: Quad-core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz or 1.8GHz.
•**Memory**: 1GB, 2GB, 4GB, or 8GB LPDDR4-3200 SDRAM.
•**Wireless**: 2.4 GHz and 5.0 GHz IEEE 802.11ac, Bluetooth 5.0, BLE.
•**Ethernet**: Gigabit Ethernet.
•**USB Ports**: 2 USB 3.0 and 2 USB 2.0 ports.
•**Video Output**: 2 × micro-HDMI ports supporting up to 4Kp60.
•**Storage**: Micro-SD card slot.
•**Power Supply**: 5V DC via USB-C connector (minimum 3A).
•**Other Ports**: MIPI DSI display port, MIPI CSI camera port, 4-pole stereo audio and composite video port.

2. Ultrasonic Sensor (HC - SR04)



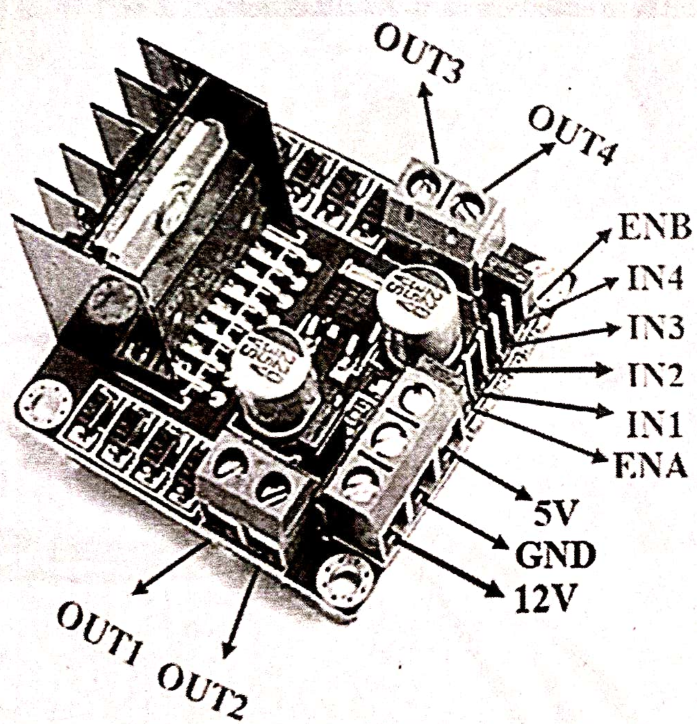
Working Principle:

1. The trigger pin sends a 10 μs pulse to emit ultrasonic waves at 40 kHz.
2. The sensor transmits an 8-cycle burst of ultrasonic sound waves.
3. When these waves hit an object, they reflect back to the sensor.
4. The echo pin receives the reflected waves, and the sensor calculates the distance based on the time difference between sending and receiving the pulse.

Specifications:

1. Operating Voltage: 5V DC, Operating Current:15 mA.
2. Ultrasonic Frequency: 40 kHz, with a measuring range of 2 cm to 400 cm.
3. Accuracy: ±3 mm, with a measuring angle of 15 degrees.
4. Trigger Pulse Duration: 10 μs, Echo Pulse Output proportional to distance measured.

3. DC Motor Driver (L298N)



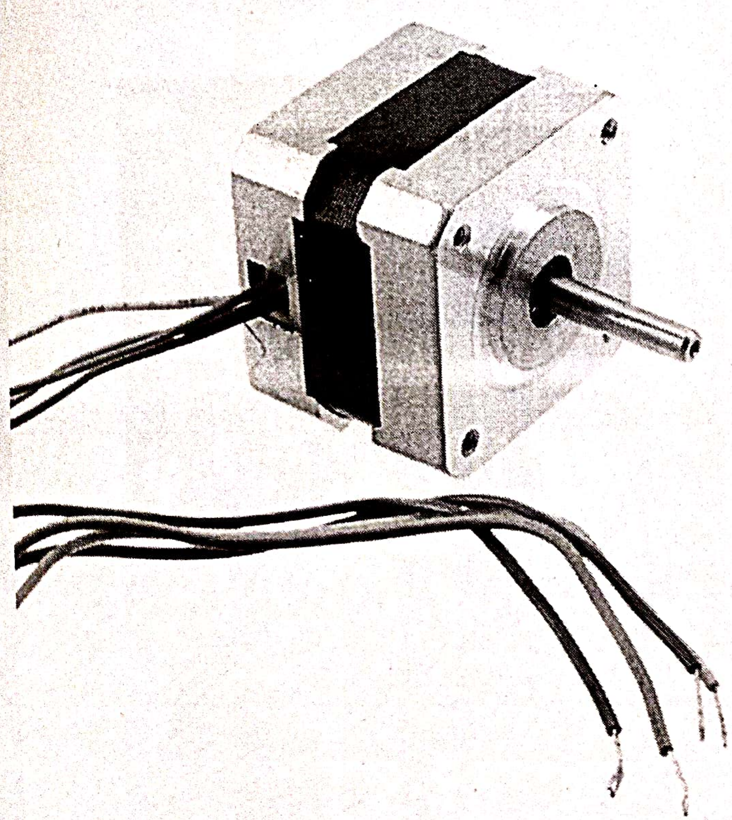
Working Principle:

1. The L298N motor driver controls the direction and speed of DC motors by managing the voltage supplied to them.
2. It operates based on an H-Bridge circuit, which allows the current to flow in both directions, enabling forward and reverse motor motion.
3. By using PWM (Pulse Width Modulation), the speed of the motor can be controlled by adjusting the duty cycle of the voltage.
4. The driver can control two motors independently, allowing for bidirectional movement and speed control in applications like robotics.

Specifications:

1. Operating Voltage: 5V to 35V, Current Rating: 2A per motor.
2. Can control 2 DC motors or 1 stepper motor.
3. Logic Voltage: 5V, with logic current of 36 mA.
4. Dual H-Bridge configuration, allowing for independent control of two motors.

4. Stepper Motor Bipolar 12v



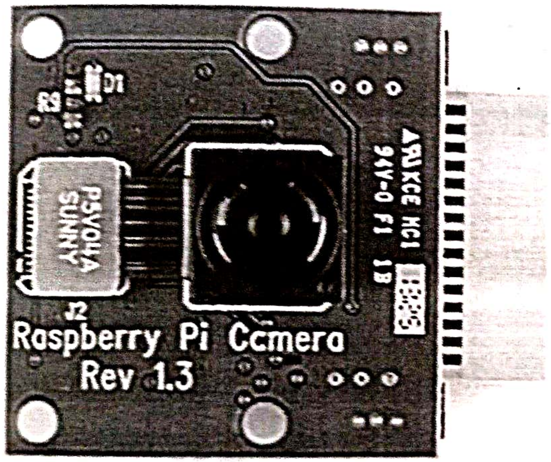
Working Principle:

1. Bipolar stepper motors operate by energizing two coils in a sequence to rotate the motor shaft in precise steps.
2. The direction of the current in the coils is reversed to control the motor's rotation, allowing for full control of the motor's movement.
3. Each pulse moves the shaft by a fixed angle, typically 1.8° per step (200 steps per revolution), ensuring accurate positioning.
4. Bipolar stepper motors require an H-Bridge driver for current switching, as both coils must be controlled for bidirectional movement.

Specifications:

1. Operating Voltage: 12V, Current Rating: 1.2-2A per phase.
2. Step Angle: 1.8° per step (200 steps per revolution).
3. Torque: High holding torque, ideal for precise and strong movements.
4. Wiring: 4-wire configuration (two coils), requiring a bipolar stepper driver for operation.

5. Raspberry Pi 8MP Camera Module



Working Principle:

1. The camera module connects to the Raspberry Pi's CSI (Camera Serial Interface) port, enabling high-quality image and video capture.
2. It utilizes an 8MP sensor for capturing still images and videos, making it ideal for applications like image processing and object detection.
3. The camera feeds data directly to the Raspberry Pi, where it can be processed by software, such as AI or machine learning models, for tasks like crop quality analysis.
4. The module supports video recording in multiple resolutions and still images with a resolution of 3280 x 2464 pixels.

Specifications:

1. Resolution: 8 Megapixels (3280 x 2464 for still images).
2. Video Support: 1080p at 30fps, 720p at 60fps, 640x480p at 90fps.
3. Lens: Fixed-focus, supports a wide range of lighting conditions.
4. Interface: Connects via CSI connector on the Raspberry Pi, using the dedicated camera interface.

Methodology

1

System Design:

- Data Collection and Integration (Sensors, Data Aggregation)
- AI and Analytics Engine (Machine Learning Models, Output Dashboard)

2

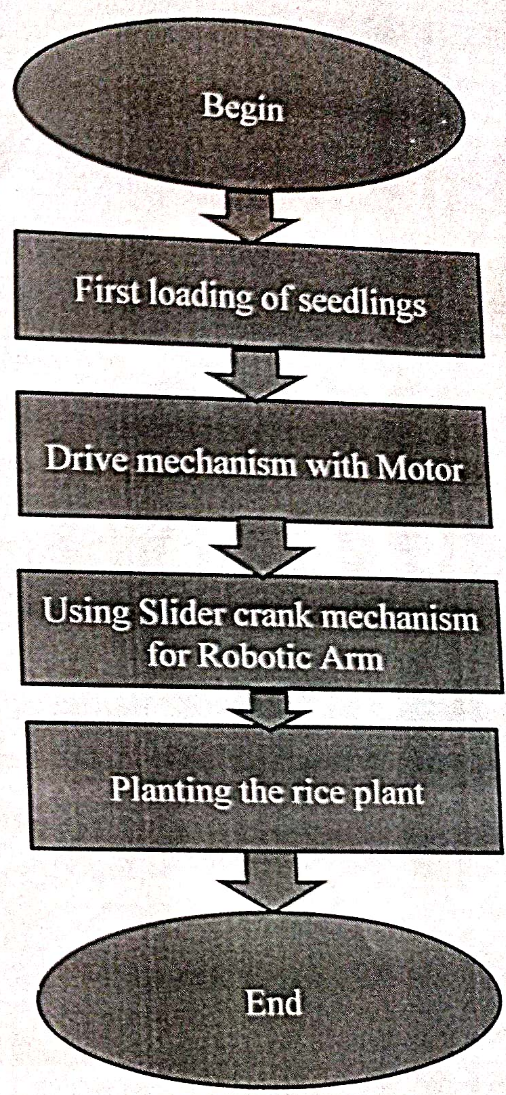
Components:

- Hardware
- Software
- Data Collection
- Data Processing and Storage
- AI and Analytics Engine

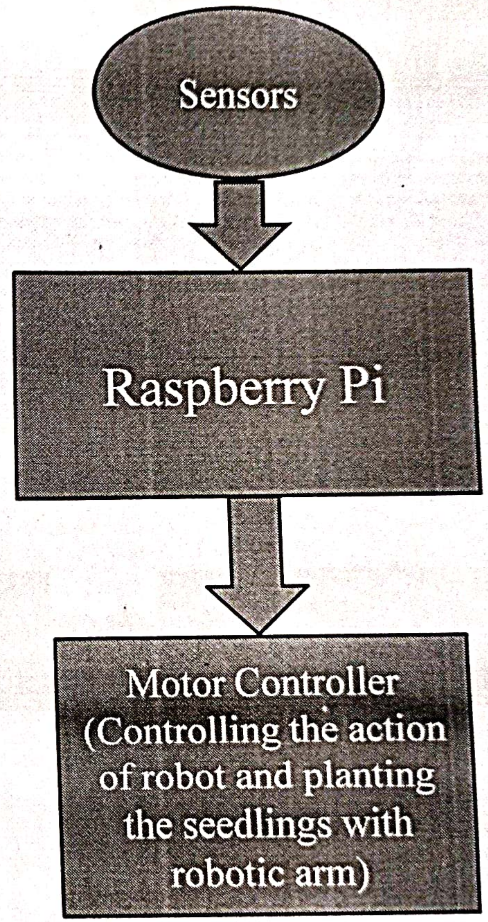
3

Hardware Architecture:

Here is the architecture of the hardware which the rice planter will work and the different actions will be taken by the machine.



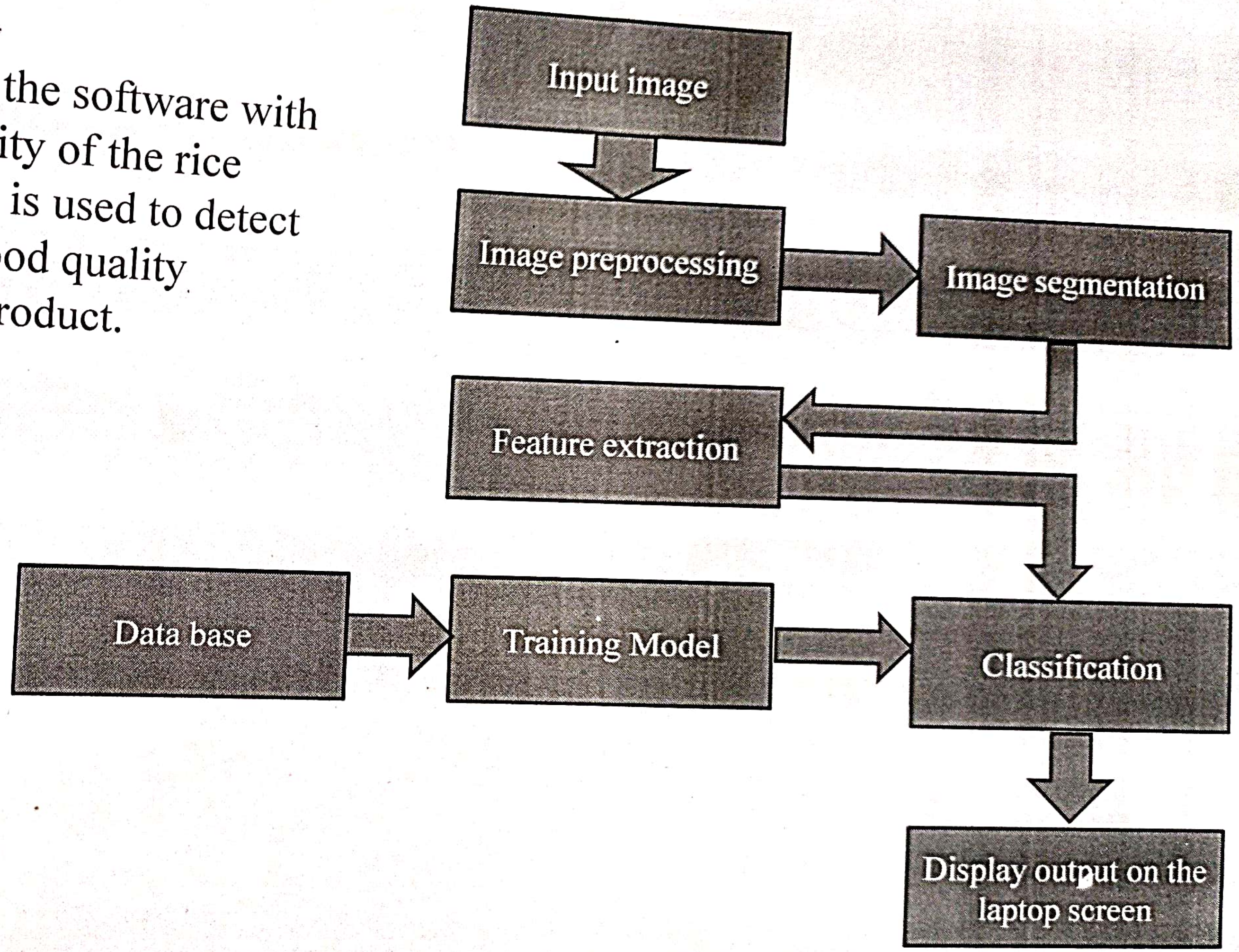
- Block diagram of the Hardware Circuit.



Software Architecture:

3

Here is the block diagram of the software with which we can detect the quality of the rice plant. The Machine Learning is used to detect the difference between the good quality product and the bad quality product.



Components Used

- Raspberry pi 4 Model B
- chassis and rice planter
- Raspberry Pi Camera Module V2 (8 Megapixel)
- Battery unit (Lead Acid)
- Stepper Motor (DC 12v)
- Motor controller (L289N 2A)
- Ultrasonic Sensor (HC-SR04)
- Jumper Wires

Project Work Completed Upto Date:

- Developing machine learning models for crop quality detection.
- Progress made towards identifying crop health issues, but full functionality is still under development.
- Created the schematic for motors integrated with motor driver and raspberry pi.
- Generated the Code for the controlling motors with Motor controller with raspberry Pi.

jected Work Completed:

```
import cv2
import os
import numpy as np
from sklearn.svm import SVC    Import "sklearn.svm" could not be resolved from source
from sklearn.model_selection import train_test_split    Import "sklearn.model_selection" could not be resolved from source
import joblib    Import "joblib" could not be resolved

# Function to load and preprocess images from a folder
def load_images(folder):
    images = []
    labels = []
    for label in os.listdir(folder (parameter) folder: Any  oad, 1 = average, 2 = good)
        label_path = os.path.join(folder, label)
        for file in os.listdir(label_path):
            img_path = os.path.join(label_path, file)
            img = cv2.imread(img_path)    "imread": Unknown word.
            img_resized = cv2.resize(img, (64, 64))
            img_gray = cv2.cvtColor(img_resized, cv2.COLOR_BGR2GRAY)
            images.append(img_gray.flatten())  # Flatten the image
            labels.append(int(label))  # Use folder name as label
    return np.array(images), np.array(labels)

# Load and preprocess the dataset
X, y = load_images('path_to_crop_images')  # Dataset path

# Split dataset into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)

# Train the SVM model
model = SVC(kernel='linear')
model.fit(X_train, y_train)

# Save the trained model
joblib.dump(model, 'svm_crop_model.pkl')    "joblib": Unknown word.
```

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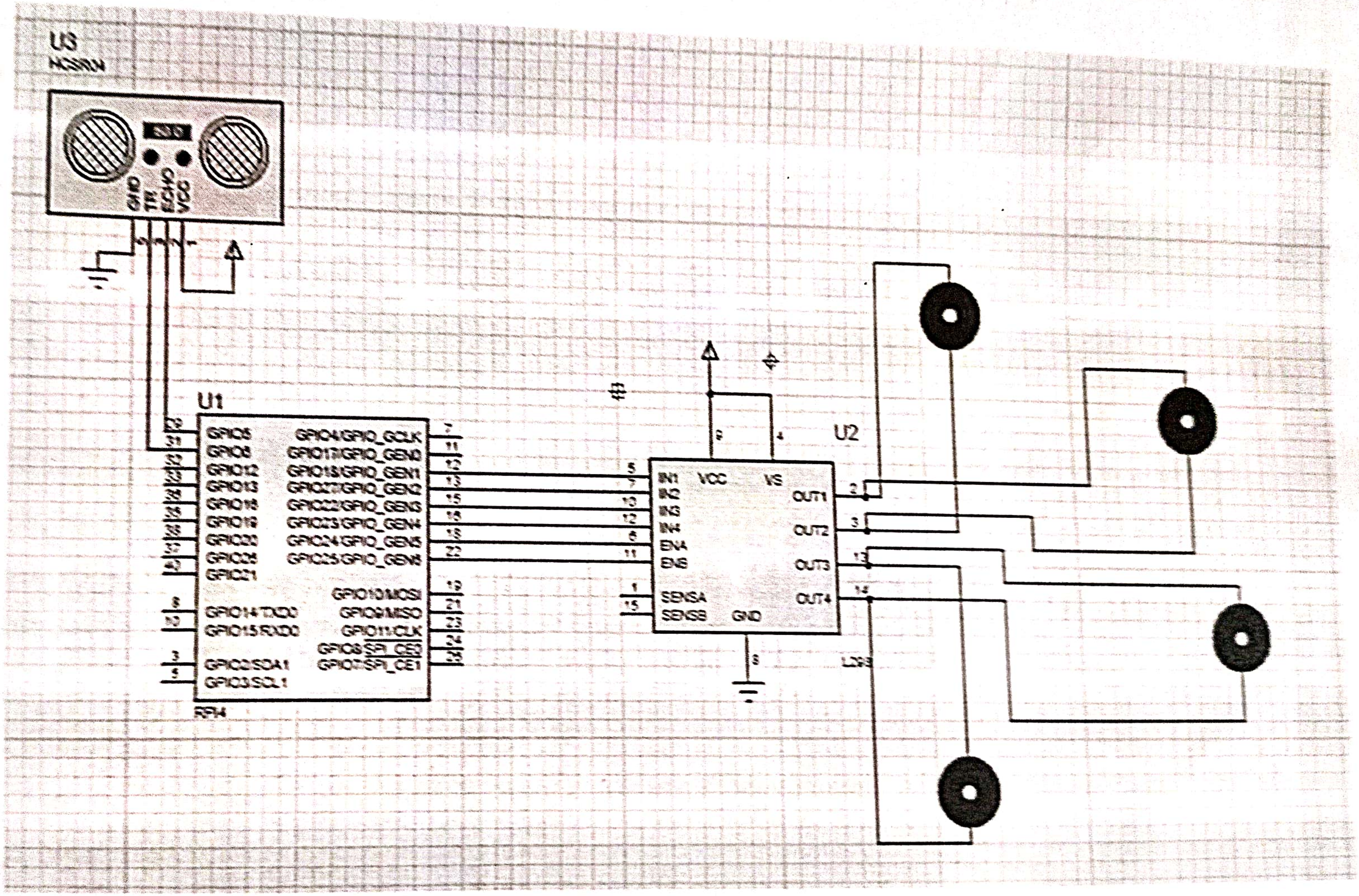
Run Testcases ⊗0 ⚠9 ⓘ33 ⚡0 | Ln 21, Col 46 Spaces: 4 UTF-8 CRLF {} Python 3.12.5 64-bit (Microsoft Store) ⚠3 Spell Prettier

Result Obtained:



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Thank You

Thank You