Automatic Paddy Drying Robot

Dr. G. Renuka Devi, D. Praveen, B.Bhuvaneswari, M. Hariharan and N.Nithya Sre

Department of Robotics and Automation,
Manakula Vinayagar Institute of Technology, Puducherry, India
renukadeviayyappan@gmail.com

Abstract *- The process of drying rice paddies holds immense significance in rice production, profoundly influencing the quality of the final yield by ensuring the ideal moisture content. Among the conventional techniques for managing the solar drying process, manual tedding stands out – a labor-intensive procedure that entails the physical task of flipping and evenly dispersing the grains. This method remains widely practiced by Filipino farmers due to its cost-efficiency and minimal environmental impact. Nevertheless, there is an increasing demand for modernizing this process to enhance efficiency and elevate the quality of rice output. The focal point of this research is to engineer an automated tedding mechanism for sun-drying rice grains. Several forward-thinking designs were explored, encompassing a tossing mechanism, a plow-based configuration, a vacuum-assisted system, and a cutting-edge sweeper wheel concept. Following meticulous evaluation, a specific mechanism was chosen for production and subjected to rigorous testing. The findings unequivocally demonstrate the effectiveness of the chosen model in efficiently collecting and redistributing grains on the drying surface, achieving an impressively low margin of error, falling below 5%. This breakthrough holds the promise of streamlining the rice drying process, yielding time and resource savings, and ultimately elevating the overall quality of the rice harvest.*

Index Terms— Collecting, Sun Drying, solar drying process, tossing, Tedding,

I. Introduction

Rice is a cornerstone of agricultural and economic stability in India, serving as a linchpin for food security within the nation. Despite substantial advancements in rice paddy production over the past decade, the overall yield has declined due to the prevalent inefficiencies in post-harvest practices, most notably in paddy drying. The drying stage is an absolutely critical facet of rice production, wielding substantial influence over the quality of the final output by ensuring the precise moisture content. Deviating from the recommended moisture threshold, which typically hovers around 14% as prescribed by institutions such as the International Rice Research Institute (IRRI), can lead to issues like breakage, discoloration, and spoilage. This underscores the pressing need for vigilant monitoring and management of the grain's temperature, consequently fueling the development of contemporary mechanical drying solutions. Yet, the high costs, rigorous maintenance demands, and technical complexity associated with these mechanical drying technologies have led to the continued popularity of the traditional practice of sun drying on pavements. This method prevails due to its cost-effectiveness and minimal environmental footprint, a testament to its practicality in the Indian context. According to IRRI, the recommendation is to ted the grains every half-hour during this process to ensure even drying.

Mechanization also holds great importance in streamlining the collection of paddy spread out on the expansive pavements. This challenge is exacerbated by the dearth of suitable technology for this task and the demand for expeditious handling, particularly when the monsoon season looms. Points out that manual collection can take over an hour, contingent on the field's dimensions, and necessitates a considerable workforce due to the prevailing method of grain sweeping. The pressing requirement is for an automated solution that not only streamlines the collection process but also outpaces the manual procedure in terms of speed and efficiency. Such an innovation promises to be of immense assistance to post-harvest operations in India, addressing the unique needs of the Indian agricultural landscape and benefiting local communities.

II. Objective

The primary aim of this research is to identify the most efficient mechanical design for grain turnover on pavements. This design will be tailored to meet the specific requirements of farmers and millers, while also aligning with the established tedding standards of the International Rice Research Institute (IRRI).A pivotal objective is to scrutinize multiple design options based on criteria such as accessibility, design intricacy, power demands, and adaptability/flexibility in real-world applications. The goal is to select a design that excels in these key aspects. The study intends to subject the chosen design to rigorous testing, with a primary focus on its effectiveness in tedding the grains and its ability to comprehensively sweep the grains. This thorough evaluation ensures that the selected design not only fulfills theoretical standards but also excels in practical, real-world scenarios.

III. Block Diagram

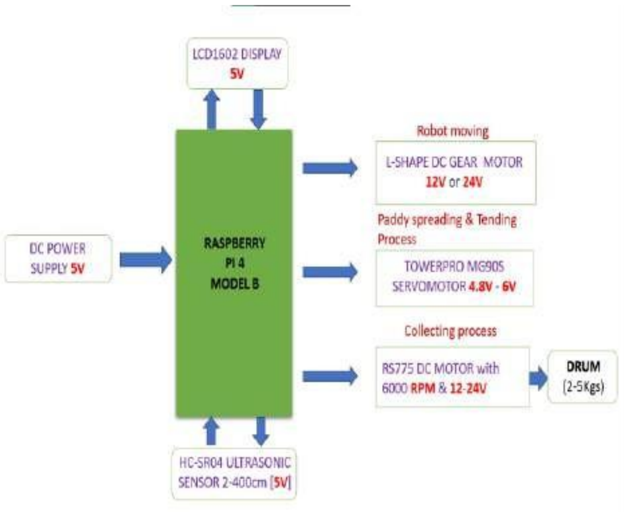

Fig:1-Block Diagram of Automatic Paddy Drying Robot

IV COMPONENTS

- Raspberry Pi 4 Model B
- Permanent Magnet DC Gear Motor, Magnetic Hall Encoder
- TowerPro MG90S Mini Digital Servo Motor
- LCD1602 Parallel LCD Display with Blue Backlight
- IIC/12C Serial Interface Adapter Module
- 4x4 Matrix 16 Keypad Keyboard Module 16 Button MCU
- MPU6500 Gyroscope/Accelerometer/Digital Motion Processor
- RS775 12V 6000RPM High Speed DC Motor
- HC-SR04-Ultrasonic Range Finder
- B3950 10K NTC Thermistor Temperature Sensor

V Design Considerations

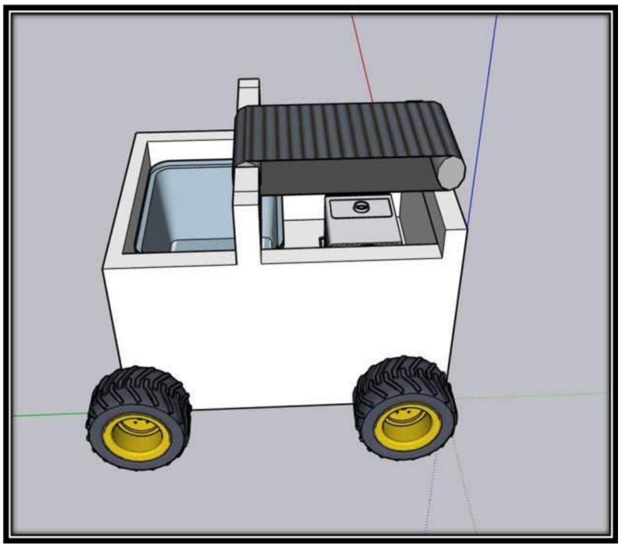

Fig:2-SideView of Robot Model

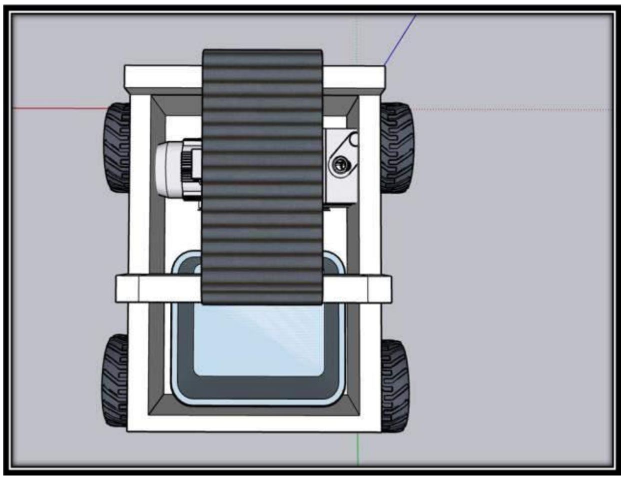

Fig:3-Top View of Robot Model

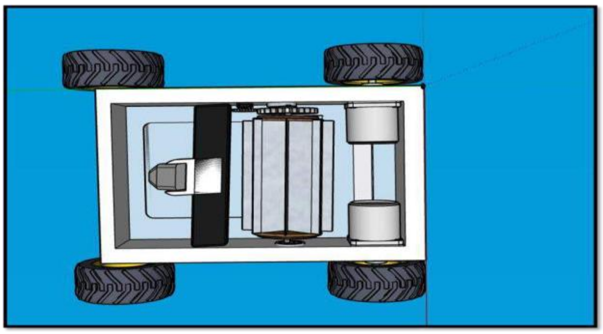

Fig:4-DownView Of Robot Model

VI Methodology

Starting the Robot and Paddy Drop:

At the beginning of the project, we set up the robot's workspaceusing a display. Users choose where the robot will work by entering numbers for how far it should go left and right (x-axis) and forward and backward (y-axis). Once we've done this, the robot begins its work. It starts moving from a certain point and puts out Paddy as it moves. This way, we make sure that the Paddy is spread evenly along the path. This even spread is important for the next step, which is tedding.

Tedding the Paddy:

After waiting for about half an hour, the robot goes back to where it started. It follows the same path where it dropped the Paddy. This special method helps to make the Paddy better. It helps toseparate the grains and make them airy, which is important for drying.We do this several times, around 4 to 5 times, with each time taking about 30 minutes. This way, we make sure that all the Paddy gets treated well.

Collecting the Paddy:

Once we're done with tedding, the robot goes back to where it started again. This time, it uses a vacuum to collect all the Paddy. It puts the collected Paddy into a small storage drum designed for this purpose. This is a good way to save Paddy and make use of the space efficiently**.**

VII Coding and Testing

```python
import RPi.GPIO as GPIO
import time

# Define the GPIO pins for the keypad rows and columns
rows = [17, 18, 27, 22]  # Replace with the actual GPIO pin numbers
cols = [23, 24, 25]      # Replace with the actual GPIO pin numbers

# Define the keypad layout
keys = [
    ['1', '2', '3'],
    ['4', '5', '6'],
    ['7', '8', '9'],
    ['*', '0', '#']
]

# Setup GPIO mode and pins
GPIO.setmode(GPIO.BCM)

# Initialize the rows as input and enable internal pull-up resistors
for row in rows:
    GPIO.setup(row, GPIO.IN, pull_up_down=GPIO.PUD_UP)

# Initialize the columns as output and set them high
for col in cols:
    GPIO.setup(col, GPIO.OUT)
    GPIO.output(col, 1)

# Function to read the keypad
def read_keypad():
    key = None
    for col in range(len(cols)):
        GPIO.output(cols[col], 0)
        for row in range(len(rows)):
            if GPIO.input(rows[row]) == 0:
                key = keys[row][col]
                while GPIO.input(rows[row]) == 0:
                    pass
        GPIO.output(cols[col], 1)
    return key

try:
    while True:
        key = read_keypad()
        if key:
            print("Key pressed: " + key)
except KeyboardInterrupt:
    GPIO.cleanup()  # Clean up the GPIO pins on Ctrl+C
```

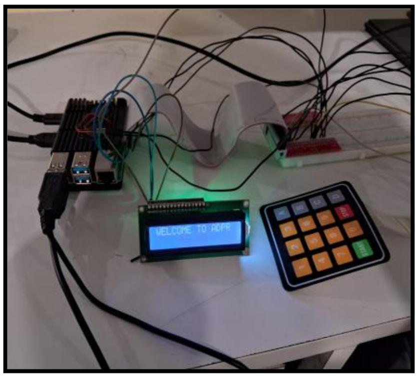

Fig:6-Interfacing with Raspberry pi

VIII RESULT

Fig:7-Display Output

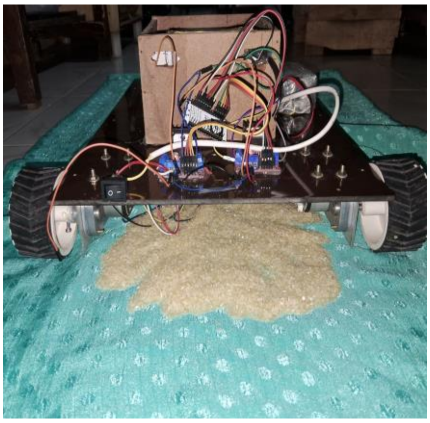

Fig:8-Field Testing Output

Sl. NO	PRODUCT	INPUT FOR DRUM IN KG	DROPING TIME IN MINUTES	TEDDING TIME IN MINS	REPEATING TEDDING IN MINS	TEMPERATURE FOR PADDY IN PERCENTAGE	COLLECTION SPEED IN AW	COLLECTION TIME IN MINS
1.	WHEAT	5KG	3MINS	3MINS	30MINS	14%	100AW	4MINS
2.	WHEAT	10KG	6MINS	6MINS	30MINS	14%	100AW	8MINS
3.	WHEAT	15KG	9MINS	9MINS	30MINS	14%	100AW	12MINS

Fig:9-Achieved Output

IX Conclusion

In conclusion, the examination of design considerations for a grain tedding mechanism aimed at sun drying has led to significant insights. The process involved the construction and testing of a functional prototype, guided by a commitment to practicality and the effectiveness of the chosen design. After evaluating four distinct designs, the sweeper wheel concept emerged as the most promising, thus warranting further analysis and testing. The preference for the sweeper wheel design stemmed from its remarkable resilience to grain breakage during operational use, surpassing alternative designs such as the Vacuum Design and Sweep and Catch Design. Notably, this design proved to be more practical in terms of the number of components required for manufacturing and the energy demands of the entire system. Extensive testing revealed that the selected design excelled in grain sweeping, with a minimal collection loss of only 2.88%. Nevertheless, there remains room for improvement in terms ofthe tedding efficiency, given that the mobile robot equipped with a vacuum had to traverse the grains thrice for optimal results. Nonetheless, these outcomes can be regarded as satisfactory, especially when applied in real-world grain sun drying operations, provided that they are accompanied by diligent monitoring and consistently timely tedding. This system has the capacity to perform partial tedding every 30 minutes and complete tedding every 1.5 hours, storing in drum up to 2-5kg using vacuum, contributing significantly to the overall grain drying process.

X References

[1] Jeremiah Lorenzo D. Frejas, Donnell Ace M. Lumanlan, Danica Mitch M. Pacis*, Edwin D.C. Subido Jr., and Nilo T. Bugtai, “Design and Implementation of an Automated Stirring Robot for Rice Paddy Sun Drying”, Manufacturing Engineering and Management Department, De La Salle University.

[2] Jr.*, Danica Mitch M. Pacis, Nilo T. Bugtai “Design Implementation of a Tedding Mechanism for Grain Sun Drying Edwin DC. Subido” Manufacturing Engineering and Management Department, De La Salle University *

[3] Prof. Meenakshi Patil, Mohammad, Mirza Sarfaraz Baig, Mohammed Amir Shaikh, Mohammed Asif Anoori Darzi “SOLAR POWER AUTOMATIC GRAIN DRYER”Dept Of Electronics And Communication, PDA College Of Engineering, Kalaburagi, India

[4] Anoy Morejón Mesa , Toshiyuki Tsujimoto and Tadashi Watahiki “Fabrication and evaluation of a Solar Grain Dryer”

[5] Pyseth Meas, Anthony H. J. Paterson, Donald J. Cleland, John E. Bronlund, A. John Mawson, Allan Hardacre, and Joseph F. Rickman “Effects of Different Solar Drying Methods on Drying Time and Rice Grain Quality”

[6] Nay Win Sein “Design and Analysis of Solar Paddy Dryer by Natural Convection”Department of Mechanical Engineering, Technological University (Mandalay), Myanmar

[7] Dandy Z. Sjechlad, J Jamari , and SA Widyanto Doctoral Program of Mechanical Engineering, Diponegoro University, Semarang - Indonesia Engineering Business Unit Division, PT Pura Barutama, Kudus - Indonesia “Auto-Stirring Grains Bed Dryer as an Innovative Efficiency Solution” Department of Mechanical Engineering, Faculty of Engineering, Diponegoro University, Semarang – Indonesia

[8] P. Bunyawanichakul; G.J. Walker; J.E. Sargison; P.E. Doe School of Engineering, University of Tasmania, Hobart, TAS, Australia; “Modelling and Simulation of Paddy Grain (Rice) Drying in a Simple Pneumatic Dryer”Received 21 June 2005; accepted in revised form 20 November 2006; published online 25 January

2007)

[9] A Review Vikrant kumar, Jaivir singh, Neelash Chauhan, Suresh Chandra, Vivak Kumar and MK Yadav “Process of paddy parboiling and their effects on rice”

[10] Z. Mehdizadeh and A. Zomorodian “A Study of the Effect of Solar Drying System on Rice Quality”.

[11] Ertie Abana, Meljiflor Pacion, Roxanne Sordilla, Daniel Montaner, Dennis Agpaoa, Rryma Mae Allam Interior “Rakebot: a robotic rake for mixing paddy in sun drying” Design and Information Technology Education, University of Saint Louis, Philippines

[12] Vallaya Alongkorn Rajabhat University Moo Tambol Klongnueng Amphoe Klongluang PathumThani, Thailand , Faculty of Science and Technology Vallaya Alongkorn Rajabhat University Moo Tambol Klongnueng Amphoe Klongluang PathumThani, Thailand “Rice Grain Physical and Chemical analysis from Paddy Drying by Using a Solar Tunnel Dryer” at Prathum Tani], Thailand Krissadang Sookramoon and Mananya Khamwachirapithak Faculty of Industrial Technology

[13] Prof. Meenakshi Patil, Mohammad, Mirza Sarfaraz Baig, Mohammed Amir Shaikh, Mohammed Asif Anoori Darzi Dept Of Electronics And Communication, “SOLAR POWER AUTOMATIC GRAIN DRYER” PDA College Of Engineering, Kalaburagi, India.