DESIGN AND FABRICATION OF MULTIPURPOSE AGRICULTURAL ROBOT

UGC & Govt. Approved
Sonargaon University (SU)
সোনারগাঁও ইউনিভার্সিটি (এসইউ)

A thesis

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of

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DECLARATION

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ABSTRACT

The Agricultural Robot project aims to develop a mechanically driven robot to assist in basic farming tasks, focusing on efficiency, time-saving, and labor reduction. This robot relying on a pre-designed mechanical system and motorized movement to navigate farmland and perform agricultural activities such as planting, watering, and soil tilling. It uses a simple motor-driven wheel system combined with gears, pulleys, and programmable movement paths to ensure coverage of the field in a structured and consistent manner. The robot's design emphasizes reliability, low maintenance, and cost-effectiveness, making it suitable for small to medium-scale farms. By automating repetitive tasks, it minimizes human effort while maintaining productivity and uniformity in crop care. The project demonstrates a practical approach to mechanized agriculture, showing how mechanical and electrical integration can improve farm operations without relying on complex electronics or sensors. This robot represents an accessible solution for farmers seeking to modernize their practices, increase efficiency, and reduce manual labor through simple, robust automation.

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CHAPTER - 1

INTRODUCTION

1.1 Overview

Agriculture is the cultivation of animals, plants, and fungi used to sustain and enhance human life agriculture was the key development in the rise of sedentary human civilization. Agriculture has been around for thousands of years, and its evolution has been shaped by vastly different climates, cultures, and technologies. Modern agronomy, plant breeding, agrochemicals such as pesticides and fertilisers, and technological advances have in many cases dramatically increased crop yields while causing widespread ecological damage. Agricultural food production and water conservation are becoming increasingly global concerns. Mechanized agriculture is the method of using agricultural machinery to mechanise agricultural work, significantly increasing farm worker productivity in modern times, and powered machinery has replaced many farm jobs previously performed by manual labour or by working animals like oxen, goats, and mules Many examples of the use of implements, such as the hoe and plough, can be found in agricultural history. However, the continuing integration of machinery since the industrial revolution has enabled farming to become much less labour intensive. Today's mechanised agriculture entails the use of tractors, trucks, combine harvesters, and a plethora of farm implements, airplanes and helicopters, and other vehicles. Mechanization was a major contributor to rapid urbanization and the development of modern economies. Mechanization, in increase production productivity, allows large-scale production and, in some cases, can enhance the quality of farm produce; however, it can displace unskilled farm labour and affect environmental destruction, especially if used in a short-sighted rather than holistic manner.

Agriculture is the backbone of Bangladesh. The history of agriculture in Bangladesh dates back to ancient times, with rice cultivation being a central part of the country’s economy and culture for centuries. Today, Bangladesh is among the leading countries in farm production in South Asia. Special vehicles and mechanized systems play a major role in

various fields such as industrial, medical, and military applications, and their use in agriculture is gradually increasing productivity. Some of the major problems in Bangladeshi agriculture include rising input costs, shortage of skilled labor, limited water resources, and challenges in crop monitoring. To address these issues, automation and mechanization technologies are being adopted in agriculture, helping farmers improve efficiency, reduce labor dependency, and optimize resource use.

The agricultural census gives vital information on the distribution of land holdings in our country. According to the census majority of the farmers are having the land less than 1 hectare . This is one of the major drawbacks for the mechanization in agricultural sector in India.

The vehicles are being developed for the processes for ploughing, seed sowing, leveling, water spraying. All of these functions have not yet performed using a single vehicle. In this the robots are developed to concentrate in an efficient manner and also it is expected to perform the operations autonomously. The proposed idea implements the vehicle to perform the functions such as ploughing, seed sowing, mud leveling, water spraying.

1.2 Problem Statement

Traditional agricultural practices are labor-intensive, time-consuming, and often inefficient, especially for small and medium-scale farmers who lack access to advanced machinery. Manual farming methods lead to inconsistent results, increased physical strain, and higher operational costs. Additionally, the shortage of skilled labor and rising demand for food production present significant challenges. There is a pressing need for a cost-effective, automated solution that can perform multiple farming tasks with precision and minimal human intervention. The development of a multipurpose agriculture robot addresses these issues by integrating various functions—such as sowing, spraying, and monitoring—into a single, efficient, and sustainable robotic platform.

1.3 Objectives

The objectives of this project are:

- To design and construct a Multipurpose Agriculture Robot.
- To fabricate a robot vehicle put the seeds and close the mud to spray water.
- To save human energy.

CHAPTER - 2

LITERATURE REVIEW

2.1 Literature Review

Firas B. Ismail et.al this research has the conventional grass cutters have been widely used recently by workers in the gardening and agricultural industries [1]. However, the manual handled grass cutters are consuming a lot of energy and producing air pollution which can directly affect the workers' health. The conventional grass cutters are also creating a high level of noise and vibration which can cause serious health issues such as grip strength, decreased hand sensation and dexterity, finger blanching or 'white fingers' and carpal tunnel [2]. In order to address these issues, a new design of a grass cutter machine has been proposed. This device can be fueled by solar energy and smartly controlled, which has been named as a Smart Solar Grass Cutter that has three main systems which are smart control system, solar system, and the grass cutter. According to the national air space association (NASA), there is a 1.361 kW/m² of solar irradiance received at the top of Earth's atmosphere [3].

T. Koppel et.al the aim of this study was to compare vibration and noise characteristics caused by different types of lawn maintenance machines in association with the risk factors to workers' health [4]. in the present study, the method connecting vibration hazard, health damages and risk levels is presented. Three types of agriculture machines were investigated: all-terrain vehicles (ATV), simple lawn-mowers, ride-on mowers. These machines are used not only in occupational settings, but also by the inhabitants for cutting grass [5]. the gardeners and maintenance workers of the municipal authorities use them daily, sometimes 8 hours a day. The protective equipment against noise is used in occupational settings, but hardly by the public. Noise was evaluated using a Sound Level Meter (TES 1358) following the standard ISO 9612:2009. Vibration was determined as acceleration, velocity and amplitude – measured using a Vibration Dosimeter & Analyser (SV 100) following the standards ISO 2631-4, EVS-EN 5349-2. The risk to the health is assessed by the original flexible risk assessment method worked out in TTU. On the basis

of this flexible model the scheme for connecting the local and whole-body vibration hazards and possible health damages was worked out [6]. the results showed that there are differences in the noise and vibration generated by the ATV, lawn-mowers and ride-on mowers. The safest was ride-on mower (local vibration below 1.15 m (s2) -1). Lawnmowers gave high vibration levels (over 3 m (s2) -1). The personal protective equipment (PPE) has to be worn by all users of the investigated machines. The noise spectral content by these three types of machines is presented and it is different [7]. this enables to choose the right type of ear-muffs by the frequency of noise. The PPE against vibration is also available.

R. V. Sanjana Arunesh et.al grass cutter machines have become very popular today. Most common machines are used for soft grass furnishing. This project aim at developing the Grass cutter operation and construction [8]. The main parts of the Grass cutting machines are DC motor of 75HP capacity, relay switch for controlling motor, Battery for charging it through solar panel. It is placed in a suitable machine structure. The motor have 18000 rpm and it is connected to the electric supply by the use of a roll of wire. The motor rpm increased by the help of gears. Motor controlled by an electric switch for easy operation. The tempered blades are attached in this machine [9]. The raw materials mainly used are GI sheet, motor, switch, wheel, wire, aluminum sheet, square pipe, paint, insulating material and other standard item like nuts, bolts and reverts. The machines required for manufacturing includes welding machine, grinding machine etc. Working principle of the grass cutter is providing a high speed rotation to the blade, which helps to cut the grass. The blade will get kinetic energy while increasing the rpm. The cutting edges are very smooth and accurate. Also Electric Grass Cutting Machines are much easier to be used in garden, lawn and grass fields [10]. In order to enhance the beauty of home- lawns and gardens, Grass cutting machines are the best available option in the industry. With the help of a lawn mower which is a machine with revolving blades to help us cutting lawns at even length, people can easily maintain and beautify their lawns and gardens without any hassle. Now-a-days, there are plenty of options starting from the simplest push along mower to the most advanced electric grass cutting machine. According to world energy report, we get around 80% of our energy from conventional fossil fuels like oil (36%), natural gas (21%) and coal (23%). It is well known that the time is not so far when all

these sources will be completely exhausted. So, alternative sources should be used to avoid energy crisis in the nearby future [11].

Aybek, A., Kamer et.al approximately one million agricultural tractors are used in Turkey for crop production and about onethird of the population lives in rural areas. The objectives of this study were to determine sound pressure levels, A-weighted sound pressure levels, and the permissible exposure time for tractors without cabins, field-installed cabins, and original cabins at ear level of agricultural tractor operators for following machines: plows, cultivators, top soil cultivators, rotary tillers, tool combinations (harrow þ roller), mechanical drills, pneumatic drills, chemical applicators, fertilizer applicators, drum mowers, balers, and forage harvesters. Variance analyses showed that type of operation, type of cabins, and operation cabin interactions were statistically significant ($P < 0.01$) both for sound pressure levels and equivalent (A-weighted) sound pressure levels [12]. The use of original cabins had a greater effect in decreasing average sound pressures and resulted in more efficient noise insulation, especially at higher center frequencies compared to field installed cabins whereas field-installed cabins proved to be more favorable compared to tractors without cabins. Sound pressure levels at 4000 Hz center frequency was reduced 2–13 dB and 4–18 dB by using a field-installed cabin and an original cabin, respectively [13]. The measured A-weighted equivalent sound pressure levels were compared to the threshold limit level, and was concluded that depending on the cabin types used, the operators could usually work from 4 to 6 h a day without suffering from noise induced inconveniences while 2–3 h is permissible for plowing and forage harvesting on tractors without cabins. Due to timeliness considerations in agricultural machine operations, a farmer would not be willing to interrupt the operation based on permissible exposure time set by the standards [14].

CHAPTER - 3

METHODOLOGY

3.1 Methodology

Our methodologies for the project:

- Creating an idea for design and construction of an **Multipurpose Agriculture Robot**. And designing a block diagram & circuit diagram to know which components we need to construct it.
- Collecting all the components and programming the micro controller to control the whole system.
- Setting up all the components in a PCB board & then soldering. Lastly, assembling all the blocks in a board and to run the system & for checking purposes.

3.2 Work Flow Diagram

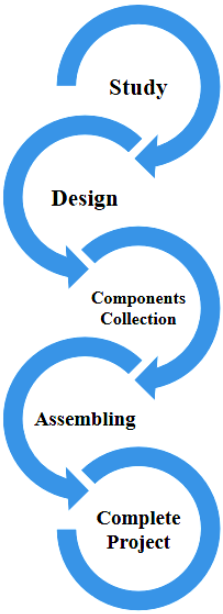


Figure 1.1: Working Flow Diagram

3.3 Working Principle

The multipurpose agricultural robot operates using a DC power supply provided by a rechargeable battery, which can be charged through an AC to DC transformer. Buck converter is used to step down the voltage to safe levels for the on board components. The robot is controlled by a NodeMCU, which acts as the main control unit, managing all movements and farming operations. Four gear motors provide locomotion and are controlled via a motor driver to ensure smooth movement across the field. The plowing function is now operated using a servo motor, allowing precise control over soil tilling. Additional gear motors handle seed sowing, powered through a separate motor driver. Irrigation is carried out by a water pump motor, which is controlled via a relay. The robot is fully remote-controlled using NodeMCU-based transmitter and receiver modules. Commands sent from the transmitter are received and processed by the onboard NodeMCU, which executes the corresponding motion and farming tasks. This system allows efficient seed sowing, plowing, and watering, providing a cost-effective and practical automation solution for small-scale farming.

3.4 Cost Analysis

Table 1: List of Component with Price

Sl. no	Particulars	Specification	Qty.	Unit Price (Taka)	Total Price (Taka)
1	Node MCU	ESP 32	2	700	1400
2	Battery	12V	1	1200	1200
3	Buck Converter	LM2596	2	200	400
4	Gear Motor	37GB	4	1000	4000
5	Gear Motor	25 GB	1	600	600
6	Motor Driver	LM298N	2	250	500
7	Transfomer	220v 50Hz	1	350	350
8	Water Pump	5v	1	250	250
9	Relay		1	150	150
10	Wheel		4	150	600
11	Battery	3.7V	2	100	200
12	Servo Motor	MG995	1	500	500
13	Others				2000
				Total	12,150/=

CHAPTER - 4

HARDWARE & SOFTWARE ANALYSIS

4.1 Components List

Hardware Part

1. Node MCU
2. Battery-12v
3. Buck Converter
4. Transformer
5. Gear Motor
6. Motor Driver
7. Pump Motor
8. Relay
9. Servo Motor

4.2 Node MCU

Node MCU V3 ESP32 ESP-12E is Wi-Fi development board that helps you to prototype your IoT product with few Lua script lines, or through Arduino IDE. The board is based on ESP32 ESP-12E variant, unlike other ESP-12E, you won't need to buy a separate breakout board, usb to serial adapter, or even solder it to a PCB to get started, you will only need a usb cable (Micro USB).



Figure : Node MCU

4.3 Battery

A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12.6 volts. A battery cell consists of two lead plates a positive plate covered with a paste of lead dioxide and a negative made of sponge lead, with an insulating material (separator) in between.



Figure : 12V Battery

Quick Details

- Nominal Capacity: 200AH
- rechargeable 12v dc battery pack: 1PCS/CTN(according to the actual situation)
- Production Capacity: rechargeable 12v dc battery pack:50000PCS/Month
- Maintenance Type: Free
- Voltage: 12V

4.4 Buck Converter

A buck converter (step-down converter) is a DC-to-DC power converter which steps down voltage (while drawing less average current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) typically containing at least two semiconductors (a diode and a transistor, although modern buck converters frequently replace the diode with a second transistor used for synchronous rectification) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side

filter). It is called a buck converter because the voltage across the inductor “bucks” or opposes the supply voltage.



Figure : DC -DC Buck Converter

4.5 Transformer

A transformer is an electrical device used to change the value of an alternating voltage. Transformers are widely used in electrical work. They are encountered daily, in industrial, commercial and domestic situations. They vary in size from miniature units used in electronics to huge units used in power stations. The efficient transmission and distribution of electricity throughout the country would be impossible without the use of power transformers. Center Tapped Step Down Transformer is a general purpose chassis mounting mains transformer. Transformer has 230V primary winding and center tapped secondary winding. The transformer has flying colored insulated connecting leads (Approx 100 mm long). The Transformer act as step down transformer reducing AC - 230V to AC - 12V. The Transformer gives outputs of 12V, 12V and 0V.



Figure : Transformer

4.6 Gear Motor

A DC motor is any motor within a class of electrical machines whereby direct current electrical power is converted into mechanical power. A 12v DC motor is small and inexpensive, yet powerful enough to be used for many applications.



Figure : DC Gear Motor

Specification

- Voltage: 12V DC
- Gear ratio: 1/31
- No-load speed: 200 RPM
- Rated Speed: 65 RPM
- Rated torque: 10 kg.cm
- Rated current: 2.5 Amp
- Length of Motor(including spindle): 106 mm/4.17″
- Diameter: 37 mm/1.45″
- Shaft length: 21 mm/0.82″
- Shaft diameter: 6 mm/0.24″

4.7 Relay

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

4.8 Pump Motor

This is a low cost, small size Submersible Pump Motor which can be operated from a 2.5 ~ 6V power supply. It can take up to 120 litters per hour with very low current consumption of 220mA. Just connect tube pipe to the motor outlet, submerge it in water and power it. Make sure that the water level is always higher than the motor. Dry run may damage the motor due to heating and it will also produce noise.



Figure : Pump Motor

Feature

- Operating Current: 130 ~ 220mA
- Flow Rate: 80 ~ 120 L/H
- Maximum Lift: 40 ~ 110 mm
- Continuous Working Life: 500 hours
- Driving Mode: DC, Magnetic Driving
- Material: Engineering Plastic
- Outlet Outside Diameter: 7.5 mm
- Outlet Inside Diameter: 5 mm

4.9 Motor Driver

The LM298N is a popular 16-Pin Motor Driver IC. As the name suggests it is mainly used to drive motors. A single LM298N IC is capable of running two DC motors at the same time; also the direction of these two motors can be controlled independently.

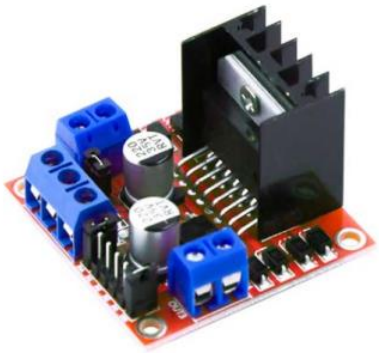


Figure : Motor driver IC LM298N

4.10 Servo Motor

A servo motor is an electrical device that can push or rotate an object with great precision. If you want to rotate and object at certain angles or distances, you use servo motors. It is made by a simple motor which is driven by a servo mechanism. If the motor is DC driven then it is called DC servo motor and if it is AC driven motor then it is called AC servo motor. We can get a very high torque servo motor in a small and light weight packages. These are being used in various applications like toy cars, RC helicopters and planes, robotics, machines etc.



Figure : Servo Motor

CHAPTER - 5

RESULT ANALYSIS

5.1 Data calculation

Design Calculation for Ploughing Tool

- **Depth of cut** = 5 cm
- **Speed of the tool** = 12 m/s = speed of the vehicle
- **Number of teeth** = 5
- **Speed (N)** = 65 rpm (of the motor)
- **Feed rate =** speed of the tool÷speed of the motion

Feed rate, FR=(12×60) ÷65

=11.07 m/rev

Design Calculation for Seed Sower

- **Speed of the motor** = 65 rpm
- **Row spacing** = 2 cm
- **Seed sowing time** = 2 sec/per seed
- **Number of openings** = 9 per row
    - 3×9=27 openings

Seed dropping per minute:

= (65×27) ÷54

=32seeds

5.2 Project Outcomes

After finally completing this project, we ran it & we observed the output of this project. We can see that it is working well as expected. After making our project we observe it very careful. It works as we desire. Our project give output perfectly and all equipment are work perfectly. We check how much it works and we get perfect output from this project.

- The robot successfully performs three key farming tasks: seed sowing, plowing, and watering.
- Servo motor control for plowing offered precise soil tilling compared to traditional gear motor use.
- The water pump motor with relay switching delivered consistent irrigation output.
- The robot reduced manual labor effort, offering a cost-effective alternative for repetitive farming operations.
- Remote Control Functionality works effectively within the tested range, enabling smooth operation of movement and farming tasks.

5.3 Complete Project Prototype



Figure 5.4 : Our Final project

5.4 Advantage

There are many advantages of the project. Some of these are given below:

- No need of human effort in the agricultural field.
- 3 operation is done at single time, hence increases production and saves time.
- Using battery hence no chance of pollution.
- Farmar can operate this robot through remote by sitting at one side.

5.6 Applications

This project has applications in many fields due its necessity. We have selected a few of them and they are given below:

- Used for automatic Digging, Sowing, mud elasing and water sprinkling purpose.
- Also use for pesticide sprinkling.
- Automatic flow of seed (controllable).
- Also used for soil inspection
- Suitable for rural areas and urban areas.

CHAPTER - 6

CONCLUSION

6.1 Conclusion

The multipurpose agricultural robot project successfully highlights the potential of simple automation in modern farming. Designed with Node MCU as the central controller, the system integrates gear motors for mobility and seed sowing, a servo motor for plowing, and a water pump motor for irrigation. This configuration ensures reliable operation while reducing the need for complex sensors or costly technologies. The use of a Node MCU-based transmitter and receiver allows smooth wireless control, enabling farmers to manage operations from a distance with ease. The prototype effectively demonstrates how seed sowing, plowing, and watering can be performed in an efficient, time-saving, and cost-effective manner. By reducing dependency on manual labor, the robot offers a practical solution to challenges faced in small-scale farming, such as rising labor costs and time management. Overall, this project contributes toward promoting agricultural mechanization, improving productivity, and showing how low-cost automation can play a vital role in sustainable farming practices.

6.2 Future Recommendation

As we have already discussed about the advantages, applications of our project so definitely there’s room for improvement. Some of these are listed below:

- In future development this project can be develop by more sensor & alarm system.
- In Future we will add extra power system.
- In future develop Control on IoT System
- In the future, add a GSM module to send an SMS alert system

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APPENDIX

Programming Code:

//**Transmitter** //

```
#include <WiFi.h>
#include <HTTPClient.h>

// Button pin configuration
const int btnUp =21 ;
//const int btnDown =4 ;
const int btnLeft = 18;
const int btnRight = 19;
const int ledPin = 2;       // WiFi status LED
#define btnDown 4          // Fan Relay

const int btnu =34 ;
const int btnd =32 ;
const int btnp =35;
const int btnr =39 ;

// Add these global variables at the top of your code
int pState = 0;          // Current toggle state (0 or 1)
int lastPButton = 0;     // Previous raw button read
bool pChanged = false;   // To detect new press

// Add these global variables at the top of your code
int rState = 0;          // Current toggle state (0 or 1)
int lastrButton = 0;     // Previous raw button read
bool rChanged = false;   // To detect new press

// WiFi target
String targetSSID = "ESP_SERVER";
String targetIP = "192.168.4.1";

// Function to connect to server
void connectToESPServer() {
  Serial.println("Scanning for ESP_SERVER...");
  int n = WiFi.scanNetworks();
  bool found = false;

  for (int i = 0; i < n; ++i) {
    if (WiFi.SSID(i) == targetSSID) {
      Serial.println("ESP_SERVER found. Connecting...");
      WiFi.begin(WiFi.SSID(i).c_str());
```

```
      unsigned long startTime = millis();
      while (WiFi.status() != WL_CONNECTED && millis() - startTime < 10000) {
        delay(500);
        Serial.print(".");
      }

      if (WiFi.status() == WL_CONNECTED) {
        Serial.println("\nConnected!");
        found = true;
      }
      break;
    }
  }

  if (!found) Serial.println("ESP_SERVER not found!");
}

void setup() {
  Serial.begin(115200);
  WiFi.mode(WIFI_STA);

  // Setup buttons
  pinMode(btnUp, INPUT_PULLUP);
  pinMode(btnDown, INPUT_PULLUP);
  pinMode(btnLeft, INPUT_PULLUP);
  pinMode(btnRight, INPUT_PULLUP);
  pinMode(ledPin, OUTPUT);
  pinMode(btnu, INPUT_PULLUP);
  pinMode(btnd, INPUT_PULLUP);
  pinMode(btnp, INPUT_PULLUP);
  pinMode(btnr, INPUT_PULLUP);
  connectToESPServer();
}

void loop() {
  // Read buttons (RAW values)
  int up = digitalRead(btnUp) == LOW ? 1 : 0;
  int down = digitalRead(btnDown) == LOW ? 1 : 0;
  int left = digitalRead(btnLeft) == LOW ? 1 : 0;
  int right = digitalRead(btnRight) == LOW ? 1 : 0;
  int u = digitalRead(btnu) == LOW ? 1 : 0;
  int d = digitalRead(btnd) == LOW ? 1 : 0;

  // ===== TOGGLE for p =====
  int pRaw = digitalRead(btnp) == LOW ? 1 : 0; // raw press detection
  if (pRaw == 1 && lastPButton == 0) {         // button just pressed
    pState = !pState;                          // toggle state
    pChanged = true;                           // mark change
```

```
  }
  lastPButton = pRaw; // store last read

  // Use pState instead of pRaw for sending
  int p = pState;


 // ===== TOGGLE for r =====
  int rRaw = digitalRead(btnr) == LOW ? 1 : 0; // raw press detection
  if (rRaw == 1 && lastrButton == 0) {         // button just pressed
    rState = !rState;                        // toggle state
    rChanged = true;                           // mark change
  }
  lastrButton = rRaw; // store last read

  // Use pState instead of pRaw for sending
  int r = rState;
 //  int r = digitalRead(btnr) == LOW ? 1 : 0;

  // Show on Serial
  Serial.printf("Up:%d Down:%d Left:%d Right:%d u:%d d:%d p:%d r:%d\n",
                up, down, left, right, u, d, p, r);

  if (WiFi.status() == WL_CONNECTED) {
    // Prepare JSON
    String payload = "{\"up\":" + String(up) + ",\"down\":" + String(down) +
                     ",\"left\":" + String(left) + ",\"right\":" + String(right) +
                     ",\"u\":" + String(u) + ",\"d\":" + String(d) +
                     ",\"p\":" + String(p) + ",\"r\":" + String(r) + "}";

    // HTTP POST
    HTTPClient http;
    http.begin("http://" + targetIP + "/data");
    http.addHeader("Content-Type", "application/json");
    int httpCode = http.POST(payload);

    if (httpCode > 0) {
      String response = http.getString();
      Serial.println("Response: " + response);
      digitalWrite(ledPin, HIGH);
    } else {
      Serial.println("POST failed");
      digitalWrite(ledPin, LOW);
    }
    http.end();
  } else {
    Serial.println("WiFi disconnected. Reconnecting...");
    digitalWrite(ledPin, LOW);
    connectToESPServer();
```

```
  }

  delay(10); // Shorter delay for better button response
}
```

//**Reciver** //

```
#include <WiFi.h>
#include <WebServer.h>
#include <ArduinoJson.h>
#include <ESP32Servo.h>  // Servo library

// ===== Motor Pins =====
const int IN1 = 12;
const int IN2 = 13;
const int IN3 = 14;
const int IN4 = 27;

// ===== Rotor Pins =====
const int r_IN3 = 25;
const int r_IN4 = 33;

// ===== Servo for Plow =====
Servo plowServo;
const int plowPin = 18;
int plowAngle = 60;  // initial position
const int plowMin = 0;
const int plowMax = 90;
const int plowStep = 5;

// ===== Pump Pin =====
const int pumpPin = 26;  // Choose any free GPIO pin for pump control

// ===== WiFi =====
const char* ssid = "ESP_SERVER";
WebServer server(80);

// ===== rotor Control Functions =====
void moverotorStop() {
  digitalWrite(r_IN3, LOW); digitalWrite(r_IN4, LOW);
}
void moverotorStart() {
  digitalWrite(r_IN3, HIGH); digitalWrite(r_IN4, LOW);
}

// ===== Motor Control Functions =====
void moveStop() {
  digitalWrite(IN1, LOW); digitalWrite(IN2, LOW);
```

```
  digitalWrite(IN3, LOW); digitalWrite(IN4, LOW);
}
void moveForward() {
  digitalWrite(IN1, HIGH); digitalWrite(IN2, LOW);
  digitalWrite(IN3, HIGH); digitalWrite(IN4, LOW);
}
void moveBackward() {
  digitalWrite(IN1, LOW); digitalWrite(IN2, HIGH);
  digitalWrite(IN3, LOW); digitalWrite(IN4, HIGH);
}
void moveLeft() {
  digitalWrite(IN1, LOW); digitalWrite(IN2, HIGH);
  digitalWrite(IN3, HIGH); digitalWrite(IN4, LOW);
}
void moveRight() {
  digitalWrite(IN1, HIGH); digitalWrite(IN2, LOW);
  digitalWrite(IN3, LOW); digitalWrite(IN4, HIGH);
}

// ===== Web Request Handler =====
void handleButtonControl() {
  if (!server.hasArg("plain")) {
    server.send(400, "text/plain", "Bad Request");
    return;
  }

  String body = server.arg("plain");
  StaticJsonDocument<200> doc;
  DeserializationError err = deserializeJson(doc, body);
  if (err) {
    server.send(400, "text/plain", "JSON Error");
    return;
  }

  int up = doc["up"];
  int down = doc["down"];
  int left = doc["left"];
  int right = doc["right"];
  int u = doc["u"];
  int d = doc["d"];
  int p = doc["p"];
  int r = doc["r"];

  Serial.printf("Up: %d | Down: %d | Left: %d | Right: %d | U: %d | D: %d | P: %d | R: %d
\n",
                up, down, left, right, u, d, p, r);

  // Motor control
  if (up == 0) moveForward();
```

```
  else if (down == 0) moveBackward();
  else if (left == 0) moveLeft();
  else if (right == 0) moveRight();
  else moveStop();

  // Pump control
  if (p == 0) digitalWrite(pumpPin, HIGH);
  else digitalWrite(pumpPin, LOW);

  // Rotor control
  if (r == 0) moverotorStart();
  else moverotorStop();

  // Servo control → increase / decrease angle
  if (u == 0) {
    plowAngle += plowStep;
    if (plowAngle > plowMax) plowAngle = plowMax;
    plowServo.write(plowAngle);
  }
  else if (d == 0) {
    plowAngle -= plowStep;
    if (plowAngle < plowMin) plowAngle = plowMin;
    plowServo.write(plowAngle);
  }

  server.send(200, "text/plain", "OK");
}

// ===== Setup =====
void setup() {
  Serial.begin(115200);
  WiFi.softAP(ssid);
  Serial.print("ESP32 AP IP: ");
  Serial.println(WiFi.softAPIP());

  // Motor pins
  pinMode(IN1, OUTPUT); pinMode(IN2, OUTPUT);
  pinMode(IN3, OUTPUT); pinMode(IN4, OUTPUT);
  moveStop();

  // Rotor pins
  pinMode(r_IN3, OUTPUT); pinMode(r_IN4, OUTPUT);
  moverotorStop();

  // Servo pin
  plowServo.attach(plowPin);
  plowServo.write(plowAngle);  // initial position

  // Pump pin
```

```
  pinMode(pumpPin, OUTPUT);
  digitalWrite(pumpPin, LOW);  // Default Pump OFF

  // Web server
  server.on("/data", HTTP_POST, handleButtonControl);
  server.begin();
}

// ===== Loop =====
void loop() {
  server.handleClient();
}
```