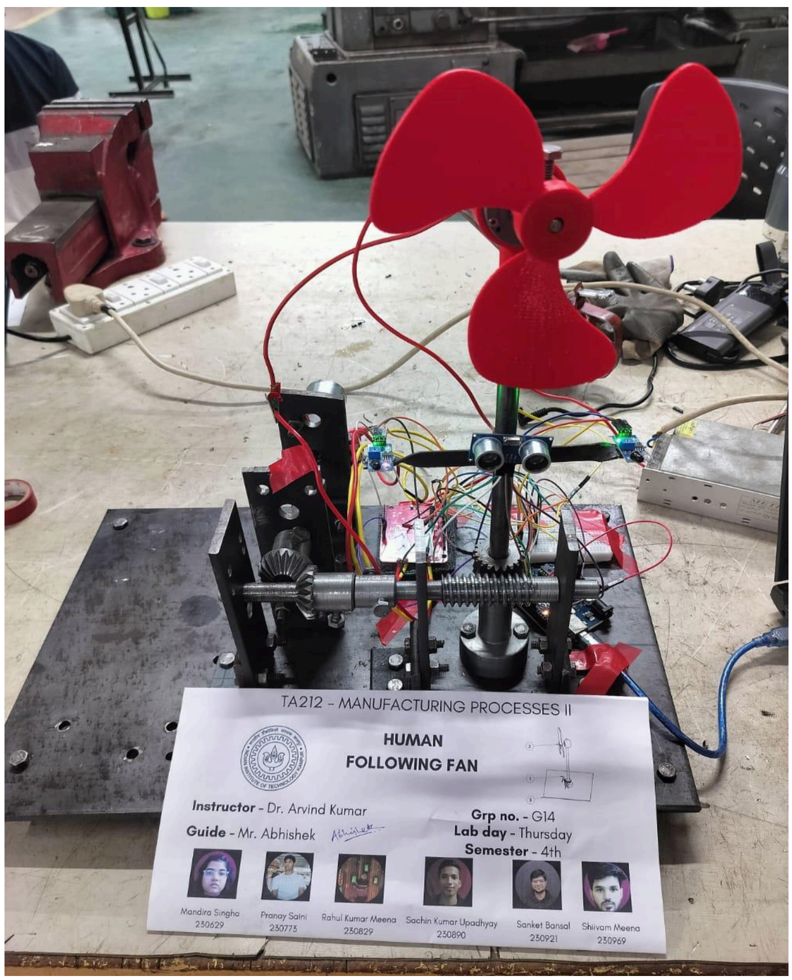
TA212
Manufacturing processes-II

2nd Sem 2024-2025

Group No. 14(THU)

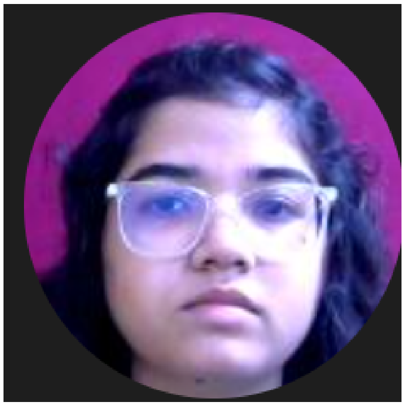
<u>HUMAN FOLLOWING FAN</u>



GUIDE - Mr. Abhishek

Course Instructors- Prof. Arvind Kumar

Mandira Singha 230629

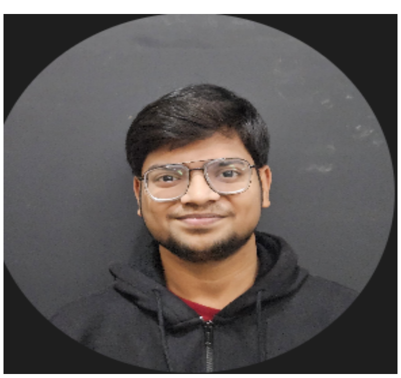


Pranay Saini 230773

Rahul Meena 230829

Sachin Upadhyay 230890

Sanket Bansal 230921



Shivam Meena 230969

INDEX

Introduction

In today’s world, automation and smart systems are revolutionizing daily life by enhancing comfort, convenience, and energy efficiency. One such innovative concept is the development of a "Human Following Fan" — a fan that automatically detects and follows the movement of a human to provide continuous airflow without manual intervention. This project is undertaken as part of the TA 212 – Manufacturing Processes course under the guidance of Prof. Arvind Kumar and project mentorship by Mr. Abhishek.

This project aims to integrate fundamental manufacturing techniques along with basic electronics and control systems to design and fabricate a prototype of a Human Following Fan. The project involves the application of various manufacturing processes, sensor integration, motor control, and structural design to achieve the desired functionality.

Acknowledgement

We would like to express our sincere gratitude to Prof. Arvind Kumar for providing us with the opportunity to work on this innovative project as a part of the TA 212 – Manufacturing Processes course. His valuable insights and guidance throughout the project were instrumental in shaping our approach and understanding.

We would also like to extend our heartfelt thanks to our project guide, Mr. Abhishek, for his constant support, motivation, and technical assistance. His expert guidance helped us overcome challenges and implement practical solutions during the course of this project.

Lastly, we thank our classmates, laboratory staff, and everyone who directly or indirectly supported us in the successful completion of this project.

Motivation

The primary motivation behind this project is the increasing demand for smart appliances that can enhance user comfort while optimizing energy usage. Conventional fans require manual adjustment or remote controls, which may not always provide optimal comfort.

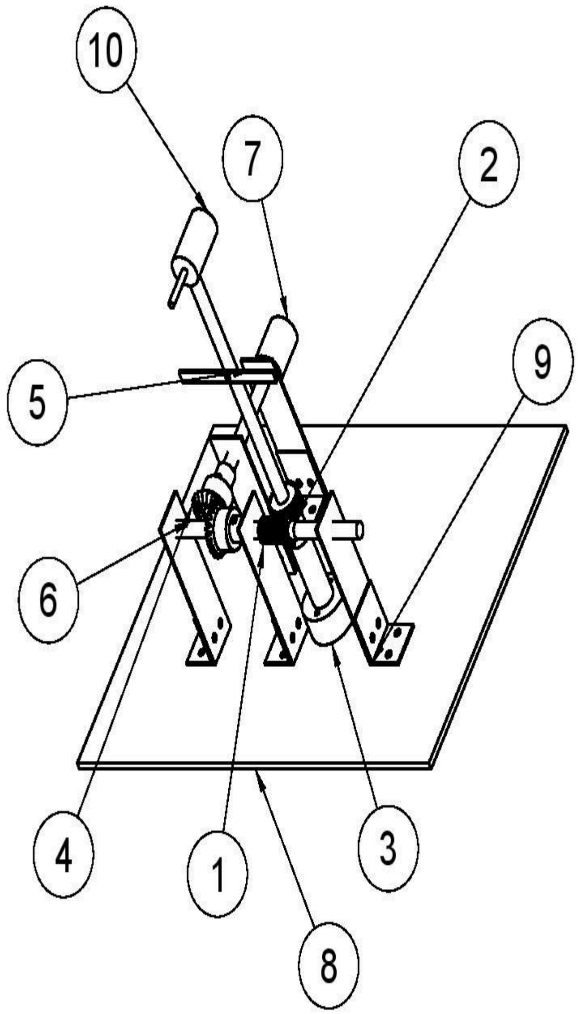
A Human Following Fan system provides an automated solution where the fan can detect the location of a person within a room and adjust its orientation accordingly. This innovation has practical applications in homes, offices, and public spaces where energy efficiency and user comfort are priorities. Additionally, this project allows us to practically apply our knowledge of manufacturing processes in a real-world product design scenario.

Abstract

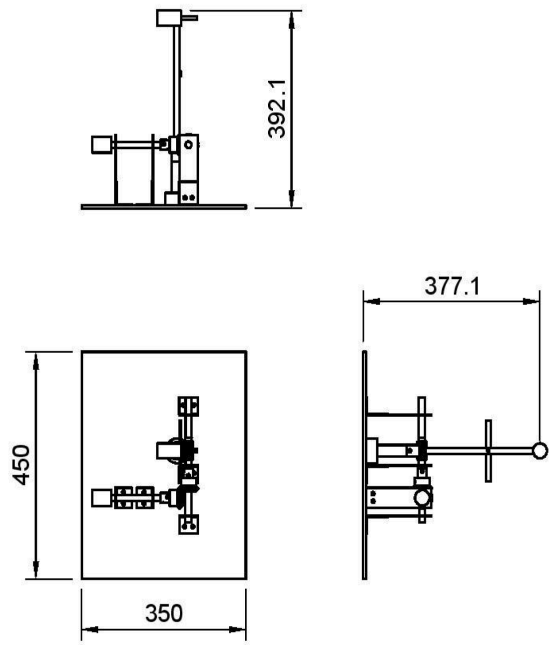
This project focuses on the design and fabrication of a "Human Following Fan" as part of the TA 212 – Manufacturing Processes course. The objective of the project is to create a fan capable of detecting human presence and automatically aligning itself to direct airflow towards the user, thereby increasing comfort and reducing energy wastage.

The system employs sensors (such as PIR or ultrasonic sensors) to detect human presence and position. A microcontroller processes this information and controls the rotation of the fan using a motor-driven mechanism. The fan structure is fabricated using conventional manufacturing processes like cutting, drilling, welding, and assembly techniques.

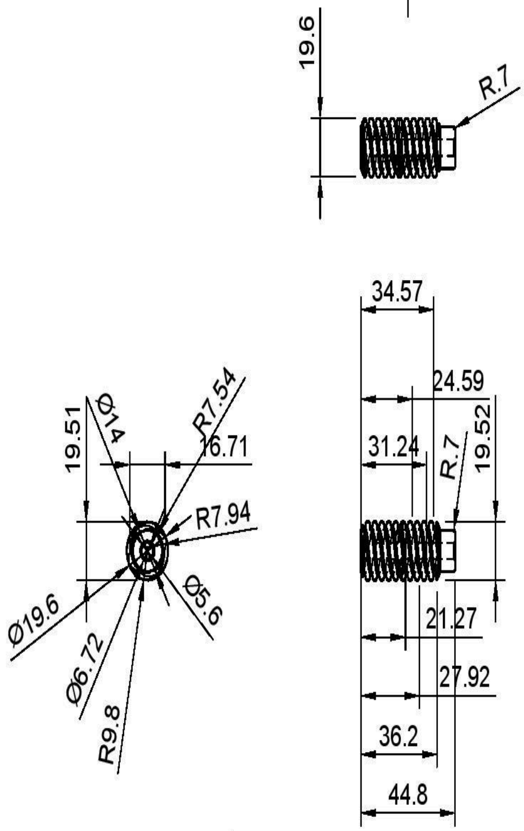
The successful completion of this project demonstrates the integration of mechanical design, electronics, and manufacturing processes to develop a smart product prototype suitable for practical applications.



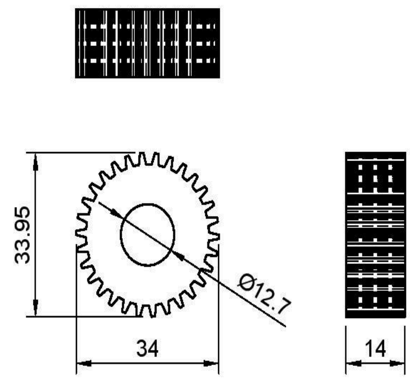
Parts List			
Item	Qty	Part Number	Material
1	1	57545K632_Steel Worm	Steel
2	1	Component2	Steel
3	1	Component3	Steel
4	2	2600N1_Metal Miter Gear	Steel
5	1	Component5	Steel
6	1	Component6	Steel
7	1	Component7	Steel
8	1	Component8	Steel
9	1	Component9	Steel
10	1	Component10	Steel



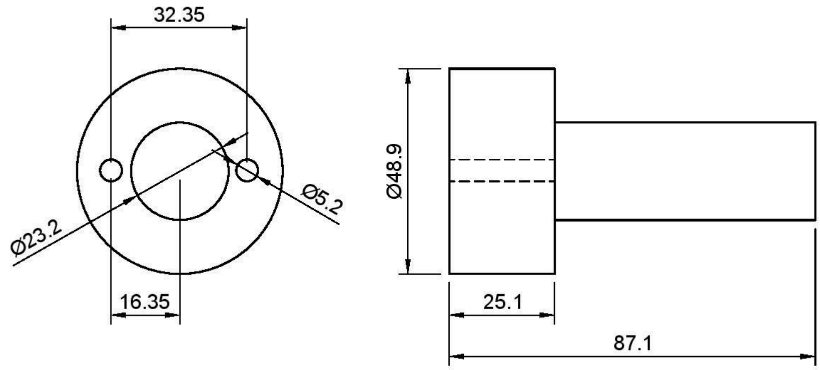
Dept.	Technical reference	Created by	Approved by		
		Shivam Meena 16-04-2025			
		Document type	Document status		
		Title	DWG No.		
		TA212			
			Rev.	Date of issue	Sheet
					2/15



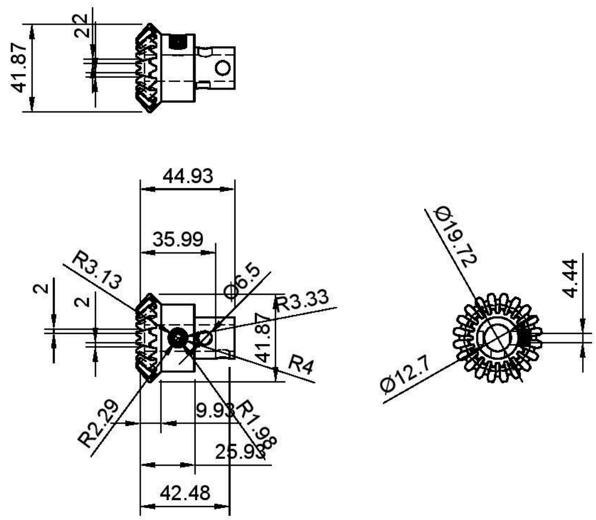
Dept.	Technical reference	Created by	Approved by
		Shivam Meena 16-04-2025	
		Document type	Document status
		Title TA212	DWG No.
			Rev. / Date of issue / Sheet 3/15



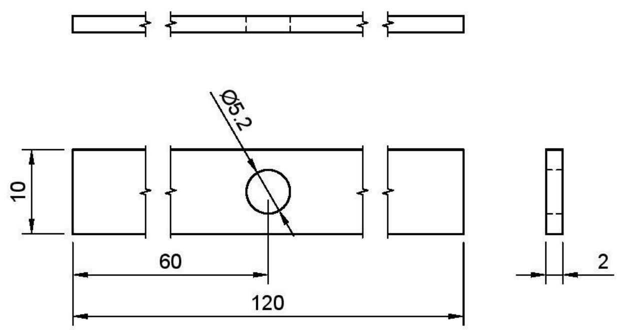
Dept.	Technical reference	Created by Shivam Meena 16-04-2025	Approved by
		Document type	Document status
		Title TA212	DWG No.
			Rev. / Date of issue / Sheet 4/15



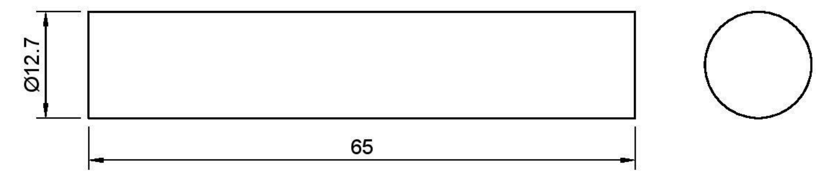
Dept.	Technical reference	Created by Shivam Meena 16-04-2025	Approved by		
		Document type	Document status		
		Title TA212	DWG No.		
			Rev.	Date of issue	Sheet 5/15



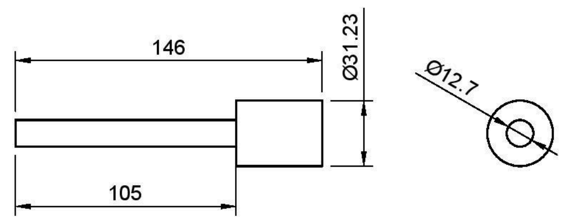
Dept.	Technical reference	Created by Shivam Meena 16-04-2025	Approved by		
		Document type	Document status		
		Title TA212	DWG No.		
			Rev.	Date of issue	Sheet 6/15



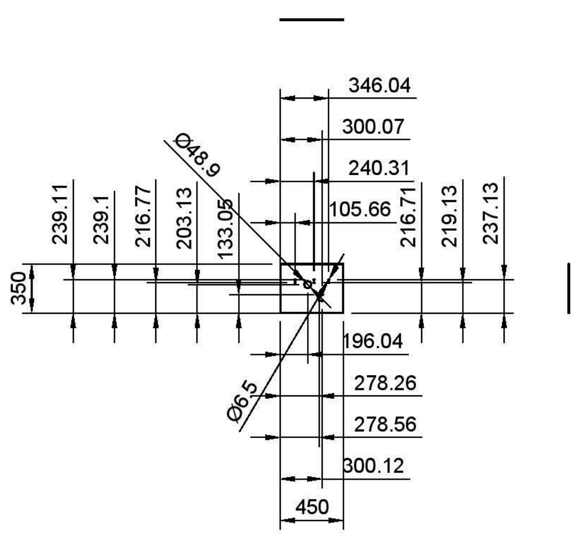
Dept.	Technical reference	Created by Shivam Meena 16-04-2025	Approved by		
		Document type	Document status		
		Title TA212	DWG No.		
			Rev.	Date of issue	Sheet 7/15



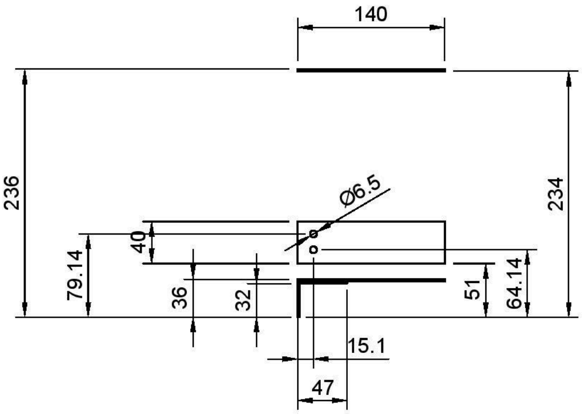
Dept.	Technical reference	Created by	Approved by		
		Shivam Meena 16-04-2025			
		Document type	Document status		
		Title	DWG No.		
		TA212			
			Rev.	Date of issue	Sheet
					8/15



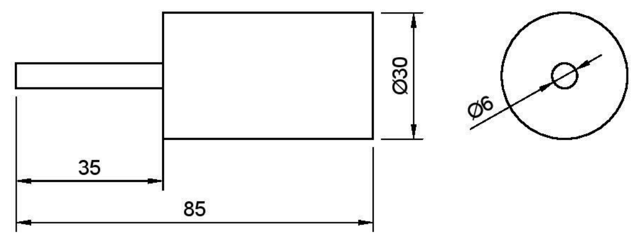
Dept.	Technical reference	Created by	Approved by		
		Shivam Meena 16-04-2025			
		Document type	Document status		
		Title	DWG No.		
		TA212			
			Rev.	Date of issue	Sheet
					9/15



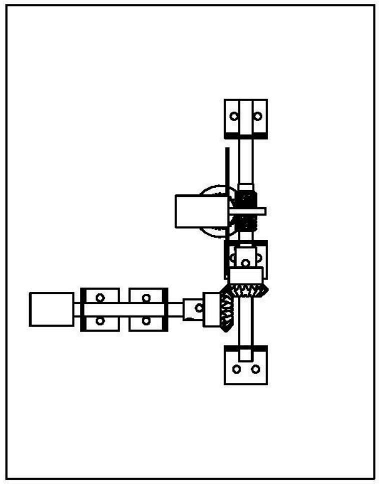
Dept.	Technical reference	Created by	Approved by		
		Shivam Meena 16-04-2025			
		Document type	Document status		
		Title	DWG No.		
		TA212			
			Rev.	Date of issue	Sheet
					10/15



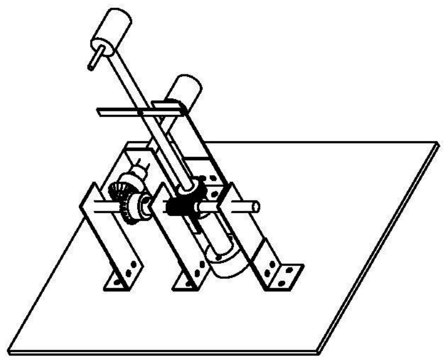
Dept.	Technical reference	Created by Shivam Meena 16-04-2025	Approved by		
		Document type	Document status		
		Title TA212	DWG No.		
			Rev.	Date of issue	Sheet 11/15



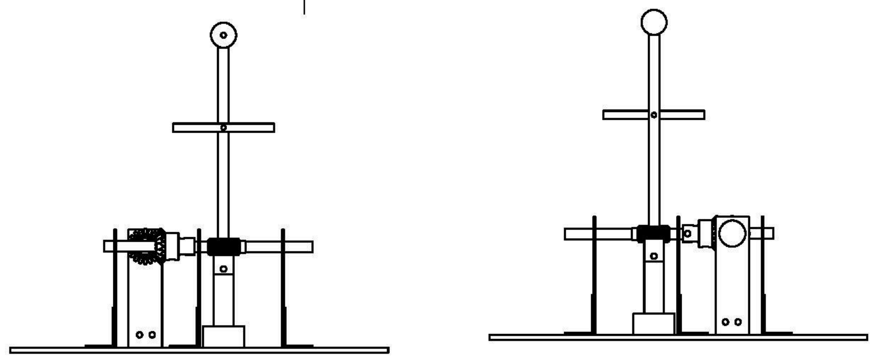
Dept.	Technical reference	Created by Shivam Meena 16-04-2025	Approved by
		Document type	Document status
		Title TA212	DWG No.
			Rev. / Date of issue / Sheet 12/15



Dept.	Technical reference	Created by	Approved by
		Shivam Meena 16-04-2025	
		Document type	Document status
		Title	DWG No.
		TA212	
			Rev. / Date of issue / Sheet
			13/15



Dept.	Technical reference	Created by Shivam Meena 16-04-2025	Approved by		
		Document type	Document status		
		Title TA212	DWG No.		
			Rev.	Date of issue	Sheet 14/15



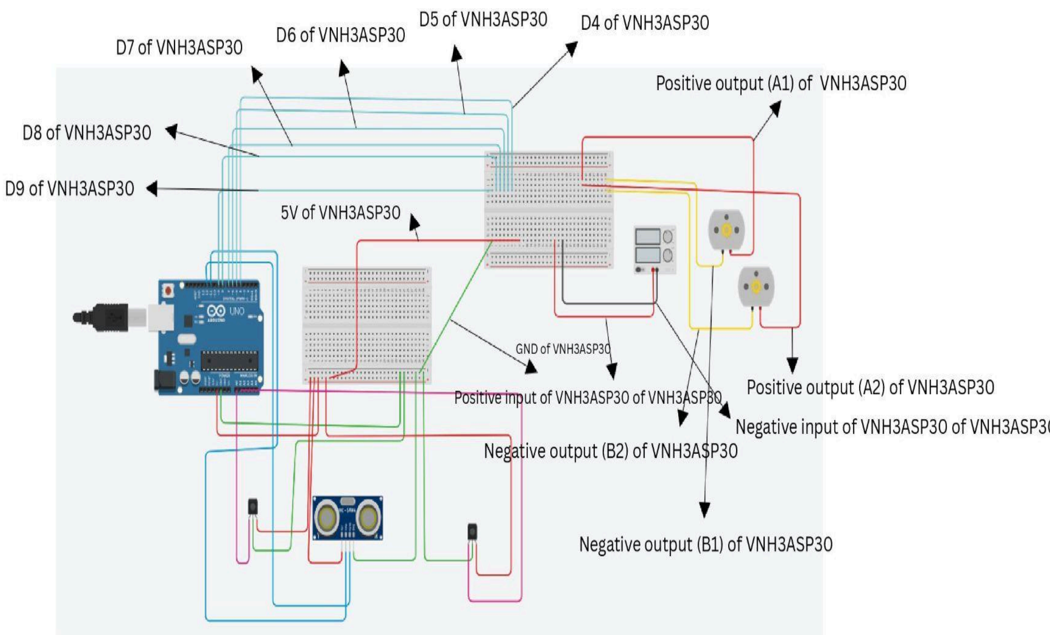
Dept.	Technical reference	Created by	Approved by
		Shivam Meena 16-04-2025	
		Document type	Document status
		Title	DWG No.
		TA212	
			Rev. / Date of issue / Sheet
			15/15

```
// IR Sensor Pins (Analog)
#define IR_LEFT A0
#define IR_RIGHT A1

// Ultrasonic Sensor Pins
#define TRIG_PIN 11
#define ECHO_PIN 12  // Digital pin for echo

// L298N Motor Driver Pins
#define BASE_MOTOR_IN1 7
#define BASE_MOTOR_IN2 8
#define BASE_MOTOR_EN 5 // PWM speed control for base motor

#define FAN_MOTOR_IN1 9
#define FAN_MOTOR_IN2 4
#define FAN_MOTOR_EN 6 // PWM speed control for fan blade motor

void setup() {
  Serial.begin(9600); // Start Serial Monitor

  // IR Sensors
  pinMode(IR_LEFT, INPUT);
  pinMode(IR_RIGHT, INPUT);

  // Ultrasonic Sensor
  pinMode(TRIG_PIN, OUTPUT);
  pinMode(ECHO_PIN, INPUT);

  // Motor Driver
  pinMode(BASE_MOTOR_IN1, OUTPUT);
  pinMode(BASE_MOTOR_IN2, OUTPUT);
  pinMode(BASE_MOTOR_EN, OUTPUT);

  pinMode(FAN_MOTOR_IN1, OUTPUT);
  pinMode(FAN_MOTOR_IN2, OUTPUT);
  pinMode(FAN_MOTOR_EN, OUTPUT);

  // Initially stop motors
  stopBaseMotor();
  stopFanMotor();
}

// Function to get distance using the ultrasonic sensor
long getDistance() {
```

```
  digitalWrite(TRIG_PIN, LOW);
  delayMicroseconds(2);
  digitalWrite(TRIG_PIN, HIGH);
  delayMicroseconds(10);
  digitalWrite(TRIG_PIN, LOW);

  long duration = pulseIn(ECHO_PIN, HIGH);
  long distance = duration * 0.034 / 2; // Convert time to distance in cm

  return distance;
}

// Rotate Base Left
void rotateBaseLeft() {
  digitalWrite(BASE_MOTOR_IN1, HIGH);
  digitalWrite(BASE_MOTOR_IN2, LOW);
  analogWrite(BASE_MOTOR_EN, 150);
}

// Rotate Base Right
void rotateBaseRight() {
  digitalWrite(BASE_MOTOR_IN1, LOW);
  digitalWrite(BASE_MOTOR_IN2, HIGH);
  analogWrite(BASE_MOTOR_EN, 150);
}

// Stop Base Rotation
void stopBaseMotor() {
  digitalWrite(BASE_MOTOR_IN1, LOW);
  digitalWrite(BASE_MOTOR_IN2, LOW);
  analogWrite(BASE_MOTOR_EN, 0);
}

// Start Fan Motor
void startFanMotor() {
  digitalWrite(FAN_MOTOR_IN1, HIGH);
  digitalWrite(FAN_MOTOR_IN2, LOW);
  analogWrite(FAN_MOTOR_EN, 255); // Full speed
}

// Stop Fan Motor
void stopFanMotor() {
  digitalWrite(FAN_MOTOR_IN1, LOW);
  digitalWrite(FAN_MOTOR_IN2, LOW);
```

```
  analogWrite(FAN_MOTOR_EN, 0);
}

void loop() {
  int left = analogRead(IR_LEFT);
  int right = analogRead(IR_RIGHT);
  long distance = getDistance();

  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");

  Serial.print("Left IR: ");
  Serial.print(left);
  Serial.print(" Right IR: ");
  Serial.println(right);

  int irThreshold = 100; // IR sensor threshold (adjust if needed)

  // --- Base Motor Control (Rotates only based on IR Sensors) ---
  if (left < irThreshold && right < irThreshold) {
    stopBaseMotor();  // If both IR sensors detect, stop movement
  } else if (left < irThreshold) {
    rotateBaseLeft(); // If only left IR detects, rotate left
  } else if (right < irThreshold) {
    rotateBaseRight(); // If only right IR detects, rotate right
  } else {
    stopBaseMotor(); // Default to stopping
  }

  // --- Fan Blade Motor Control (Runs only on Ultrasonic Sensor) ---
  if (distance >= 10 && distance <= 100) {
    startFanMotor(); // Runs continuously in this range
  } else {
    stopFanMotor(); // Stops if out of range
  }

  delay(200); // Small delay to prevent rapid switching
}
```

Circuit Diagram



- The breadboard represents the VNH3ASP30 DC Motor Driver.

Worm Gear Calculations

m_n (Normal module) = 1.5

α_n (Normal pressure angle) = 20 degrees

Z_w (No. of threads) = 5

Z_2 (No. of teeth) = 30

d_1 (Pitch diameter of worm) = 18 mm

Y (Lead angle (Gashing angle)) = $\sin^{-1}((m_n * Z_w)/ d_1)$ = 24.62 degrees

d_2 (Pitch diameter of worm gear) = $(Z_2 * m_n)/\cos(Y)$ = 34 mm

x_{n2} = - 0.1414

α_x (Center distance) = $((d_1 + d_2)/2) + (x_{n2} * m_n)$ = 25.78

$h_{\alpha 1}$ (Addendum) = $1.00 * m_n$ = 1.5

$h_{\alpha 2}$ (Addendum) = $(1.00 + x_{n2}) * m_n$ = 1.29

h (Whole depth) = $2.25 * m_n$ = 3.38

$d_{\alpha 1}$ (Outside diameter) = $d_1 + 2 * h_{\alpha 1}$ = 21

$d_{\alpha 2}$ (Outside diameter) = $d_1 + 2 * h_{\alpha 2} + m_n$ = 38.08

d_{th} (Throat diameter) = $d_2 + 2 * h_{\alpha 2}$ = 36.58

r_i (Throat surface radius) = $(d_1/2) - h_{\alpha 1}$ = 7.5

d_{f1} (Root diameter) = $d_{\alpha 1} - (2 * h)$ = 14.24

d_{f2} (Root diameter) = $d_{th} - (2 * h)$ = 29.82