

Flying Painting Robot (FPR)

TEAM: 20

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Introduction

ELEVATOR PITCH

Industrial and oil & gas sectors face the problem of costly scaffolding and safety risks during high-reach painting tasks. Scaffolding and FOR industries WHO need an efficient and safe alternative, our Flying Painting Robot IS a fully automated painting solution THAT eliminates scaffolding and reduces labor costs. UNLIKE stationary machines limited by height or manually controlled flying drones, The Flying Painting Robot autonomously inspects, plans, and paints.

Background

In sectors like construction, oil, and gas, traditional painting methods present significant challenges:

- I. Labor-Intensive: Painting large surfaces, especially at heights, requires extensive manual labor.
- II. Time-Consuming: Completing painting tasks manually slows down project timelines.
- III. Safety Risks: Workers face hazards such as falls, exposure to toxic chemicals, and accidents while using scaffolding or ladders.
- IV. Inconsistent Results: Manual methods often lead to uneven paint application, requiring rework and increasing material waste.

Constrain

Criteria	Required	Status
Budget	Less than 10,000 SAR	YES,
government regulations	Must be Followed	YES,
Solution	Delivered Oil and Latex Paint	YES,
Dimensions	Equal or less than 100cm	YES, 76 cm
Capable of operating	In 5 KM/hr wind speed or less	YES,

Specification

Criteria	Required	Status
Weight	Less than 10 kg	YES, 8.4 kg
Paint a single color	over 1 m ² in 10 s	Partially we did it, 11.76s
Painting multiple colors	over 1 m ² in 60s	NO,
Operate continuously	For 30 minutes	YES,
Image resolution	12MP	YES,
Maintain communication	up to 100 meters	YES,

Design & Prototype

Meet the needs and Requirements

Lightweight Design: Equipped with six impellers for stable flight up to 8 meters.

Advanced Painting System: Features a Himalaya Airless Paint Sprayer for consistent delivery on complex surfaces.

Reliable Communication: Operates up to 100 meters with a radio telemetry system for real-time monitoring and adjustments.

AI-Powered Navigation: Utilizes the YOLO object detection model for obstacle detection and autonomous navigation.



AI & Computer Vision

Model-name: Drone Object Detection

Trained On: Images took by drone-6412 Images

Model Type: Roboflow 3.0 Object Detection (Fast)

Checkpoint: COCO

Building 64%



Control the movement of the drone through Code

```

1 import collections
2 import collections.abc
3 collections.MutableMapping = collections.abc.MutableMapping
4 from dronekit import connect, VehicleMode
5 from pymavlink import mavutil
6 import time
7 import argparse
8
9 # FUNCTIONS
10 > def connectMyCopter(): ...
11
12 > def arm_and_takeoff(target_altitude): ...
13
14 > def send_ned_velocity(velocity_x, velocity_y, velocity_z, duration): ...
15
16 > def move_drone(direction, distance): ...
17
18 # MAIN EXECUTABLE
19 vehicle = connectMyCopter()
20

```

```

try:
    arm_and_takeoff(5) # Take off to 5 meters altitude
    time.sleep(5)
    # Move the drone
    move_drone("right", 2)
    time.sleep(2)
    move_drone("left", 2)
    time.sleep(2)
    move_drone("up", 1)
    time.sleep(2)
    move_drone("down", 2)
    time.sleep(2)
    move_drone("forward", 2)
    time.sleep(2)
    move_drone("backward", 2)
    time.sleep(2)

```

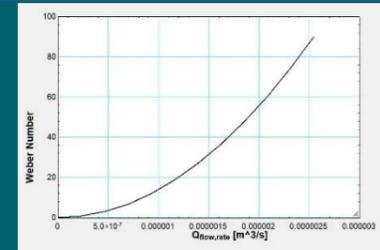
Power

Utilizes a power supply instead of a battery for continuous and reliable operation.

$$P_{total} = 1153.2W$$



Sprayer Selection



Q flow rate	1.82x10 ⁻⁶ [m ³ /s]
Velocity	0.255 [m/s]
Weber Number	29.8

Validation

$$F_d = C_d \rho v^2 A$$

v : velocity of the air
 $\rho = 1.22 \text{ kg/m}^3$
 Drag Coefficient, $C_d = 1$
 Cross Section Area
 $A = 0.044512 \text{ m}^2$



The max Drag force the Drone Can Fly in is 0.607126 N

Conclusion

The FPR revolutionizes painting and inspection by combining AI, precision, and autonomous navigation. It provides a safe, efficient, and innovative solution for hard-to-reach areas, ensuring reliability in diverse environments while reducing costs and human effort.