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Autonomous System in Airport

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Abstract - Cleaning Bot is going to work on an automatize system where the cart is controlled remotely and sensors are placed on the forward part which is going to help to sense any F.O.D(Foreign Object Debris) such as Small Particles & Gravel on the ground. Underground Hanger facility for commercial aircraft is simply located under the Terminal area of airports to park the aircraft for longer hold & line maintenance. Underground Fueling near Aircraft Parking The main use of this service required on our modern airports to minimize Fuel Carts/Trucks, less time required to refuel, proper bonding and grounding done on these systems, less man power required and Ergonomic design.

Key Words: Cleaning Bot, Vacuum Pump, Underground fuelling, Fuel Pump, Underground Hanger, and advance systems.

1. INTRODUCTION

The continuous rise in the air travel consumer base requires expansion of famously of effective and efficient solutions for the problems of present day. Airport developments, that is, limited land for expansion, noise impacts, and operational efficiency. This project then suggests a new strategy of airport structures with the use of an underground aviation hangar investing in infrastructural activities. An automated underground fuelling system, and a specialized cleaning robot. Cleaning the environment around us is one of the important duties of everyone. Bigger the area to be cleaned, greater number of people will be needed. Some places will be so dirty that cleaning such areas cause huge impact on health. Due to dust present in the surroundings, people are prone to allergies, watery eyes, cold, cough, rashes etc [5]. For this reason, moving aircraft maintenance and storage belowground, the best approach of design is made with as little exposed surface area, as little noise, and emissions that affect neighboring citizens and regions, as well as improve overall airport safety. Automated fuelling system will lead to the efficient reduction of the following processes the refuelling process, reduction in fuel splashes, and the improvement operational efficiency. Additionally, specialized cleaning robot is useful clean the underground hangar on their own and narrating fueling infrastructure, safe, and socio-hygiene environment and decrease the demand on labor force. This A key principle of such an integrated system is describes below, and is a shift in airports design thinking creating the ground for far more effective, environmentally-friendly, and shared vision of the green aviation future.

2. METHODOLOGY

This project employs a constellation model combining a best practice state-of-the modern underground hangar like a state-of-the-art commercial and industrial building with an automated cleaning Robot and an underground fuel supply system and of course. The facility design which focuses on security and speed, it has a regular and controlled an entrance/exit system includes a check point, airlock and

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personnel access tunnel connecting to the main storage-maintenance area for aircraft. This area has allocated space for maintenance bays, a state-of-the-art HVAC/ventilation system. Waste management systems, and a Command-and-Control Centre. For reporting, analyzing, and controlling business activities essential for organizational success. Robust surveillance and security systems used for emergency response are coordinated for safety purposes. This small cleaning robot's operation is governed by a complex sensor. and perception system. These are LIDAR and ultrasonic sensors which identify hurdles, and GPS/IMU as geographic and positional information relating to location and orientation of an object. precise navigation. This data is used to avoid objects in the environment. and the path planning, to bring the cleaning work into autonomous operation. All motor control and actuation are through motor controllers. a wheeled or tracked device and a vacuum cleaning mechanism. A user-friendly It covers human-machine interface, such as remote control and an, operator interface (tablet/PC), and they enable scheduling and monitoring of performance. and parameter management. The construction of the underground fuel storage and supply system increases efficiency and safe aircraft refuelling. A fuel tank farm contains all kinds of aviation fuels all of which involves uses pumps and filters to maintain the quality of the fuel. The Hanger is where your aircraft are stored when they are not in use. The highest point of the proposed Hanger, including roof equipment, shall be no higher than the building height of Aircraft a complete finished product is fabricated at site with a basic structural steel framework with attached factory finished cladding and roofing components [8]. The fuel hydrant system provides underground tubes of supply of the fuel to hydrant pits at parking stands for the aircrafts. Fuel dispensers at these pits enable the movement of fuel from the hydrant system to the aircraft. This way of work is the integrated one when using both modern concepts and sophisticated tools. Technology with a safe and effective facility to enable the optimization technology applications for efficient airport operations and safety improvement.

3. IMPLEMENTATION PLAN

Phase 1: The Blueprint

- First, we need a plan. We will decide what we will build precisely: how big the hangar shall be, what type of airplanes it will store, what amount of fuel it will require, and how much cleanup might be needed. Then we shall look for the right place– the one that is small, close to the runway, and where the ground suits.

- Then the structure of the hangar comes in itself: concrete, reinforced, lit structure with access and secret doors. Underground fuel system for storage preparation as well to be protected in the best possible way. And, naturally cleaning robot-the never-tiring mechanical servant keeping up the necessary cleanness in the hangar.

Phase 2: Construction Stages Started

- Now, the hard work begins. We prepare the soil for these nurseries by clearing off all greenery around it, then making a small pit for them and constructing a hangar to accommodate aircraft. This is going to be a very hectic affair, as concrete is going to be poured in and tunnels are going to be constructed along with all the infrastructure necessary to be laid down. In the general system, we will fit the fuel system to the vehicle and ensure that the pipe and pump are in superb condition.

- Last of all, the cleaning robot will be complete – an epitome of engineering marvel that will create to clean the hangar.

Phase 3: Keeping It Running

- Alternatively, challenges do not end after having constructed a hangar. Everything will require constant supervision-the hangar, the fuel system, and the cleaning robot to make sure they function properly. We will also try to monitor how effectively all these are implemented and will make changes where necessary.

- This must be one of the most trying yet rewarding projects that puts your engineering senses to the

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test. It is the idea of hiding planes in secret places where they get rested and prepared for further use. It is about odds, and you should not be one of those odds.

4. MATERIALS/ DESIGN

Arduino Uno

This is a microcontroller which is used for interfacing hardware and software. To do the same, USB cable is required. Once the board is embedded with the code, it can be operated by a battery supply without using any PC or laptop. Since, the Arduino can be coded to cover specific areas, moving the vacuum cleaner in the desired direction and the time taken for the same can be saved as it is possible through the car carrying it [5].

Batteries

These have positive and negative terminals at the top which supplies 12V to make it run.

Dc motor

To make the machine move, these are required. As the voltage increases, rpm also increases. The least rpm will be at 6V and maximum at 12V.

Motor driver shield

This is used to run different types of motors. The direction and speed of motors depends on the motor shield, as the shield is embedded on the Arduino UNO board and the speed and direction can be controlled by coding in the Arduino IDE.

Ultrasonic sensor

It uses sound waves to calculate the same. There are 4 pins – Echo, Ground, Trigger and VCC [17-19]. External controller is triggered by Trigger pin that sends ultrasonic waves whereas echo pin sends ultrasonic waves and duration it takes to travel decides the distance between the car and obstacle. VCC will take up to 5V and gives the voltage so that the sensor can run.

Vacuum Pump

It creates a pressure difference, generating suction that draws dust, dirt, and debris into the machine. It works by reducing the air pressure inside the vacuum, allowing atmospheric pressure to push particles into the nozzle and filter system Operating at 12Volt DC. This pump is crucial for the vacuum's effectiveness and overall cleaning performance Inflation Time <6 seconds.

*(Above Materials are Only for Cleaning Bot) *

A fuel pump is a electric fuel pump device designed to move aviation fuel from underground tank to aircraft tank. It operates by creating a vacuum that draws fuel up through pipes and digital monitor to show liters of fuels and other basic details.

Our underground hanger has two lane entry for wide-body aircraft (Airbus A380, Boeing 777 and 787 Dreamliner). Operated by hydraulic gate for entry and exit operations, Operating at 10 Volt. This facility has advance system to perform Maintenance Beneath the airport and runway it proper led lighting and proper ventilation.

4.1 DESIGN

It links an underground bard hanger structure with an automated cleaning robot as well as underground fuel pipeline to provide and enhance airport management. From an aesthetic point of view there is a controlled entrance security check, airlock, and a personnel access tunnel to the main section where the various sections consist of maintenance areas, ventilation, waste disposal, and monitoring stations. Security and alarm systems provide safety within every part of the facility. For obstacle detection, path planning, and cleaning, the cleaning robot incorporates ultrasonic sensors, and there is an operator interface for program scheduling and monitoring. We must define a sensor system which is best adapted to its tasks and shape. For a mobile robot navigating in an unknown, cluttered environment, the priority of its sensor system must be its reliability [4]. An efficient refuelling system includes an underground tank containing fuel pumps and filters which feeds through the hydrant pipeline into dispensers located in Aircraft stands to deliver fuel safely and efficiently. In order that aircraft could accept maximum fuel load, the slope of the apron between main wheel groups must not exceed 1 in 200

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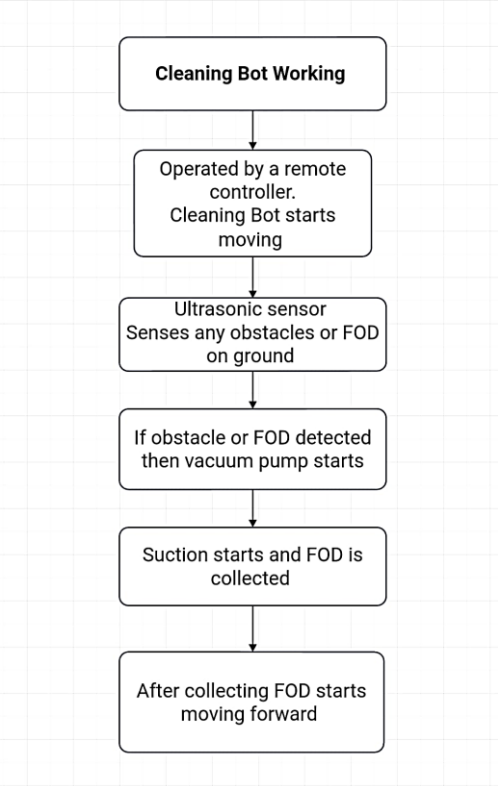
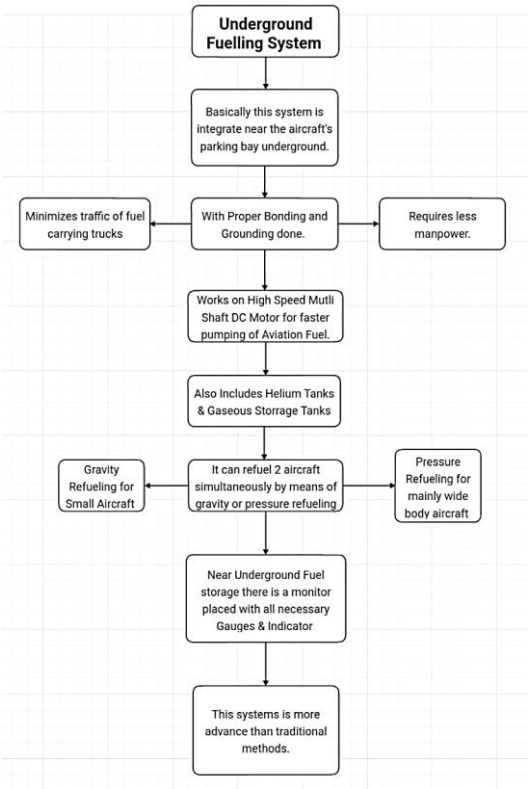
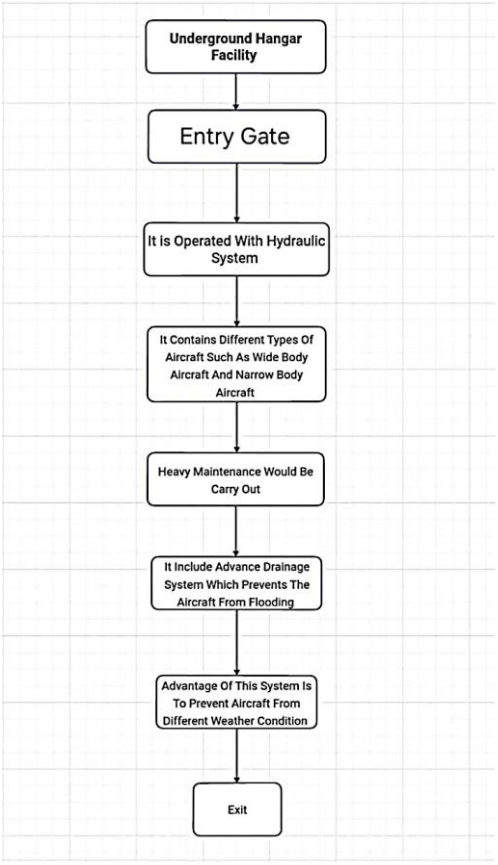
[6], the underground fuelling system bypasses this limitation. On the operational side, it helps to optimize processes in the airport on the one hand, and improves safety conditions on the other.

4.2 FLOW CHARTS







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5. CONCLUSION

In conclusion, the development of an integrated system comprising an underground aircraft hangar, automated underground fuelling system, and a specialized cleaning robot presents a compelling solution to address the evolving challenges faced by modern airports. This innovative approach offers a pathway towards more sustainable, efficient, and secure airport operations. By relocating aircraft maintenance and fuelling activities underground, we can significantly reduce noise and air pollution, optimize land utilization, and enhance safety protocols. The integration of automated systems further streamline operations, minimizes human error, and reduces operational costs. This project not only addresses immediate concerns related to airport capacity, environmental impact, and operational efficiency but also paves the way for a paradigm shift in airport design and development.

The successful implementation of this integrated system will serve as a compelling demonstration of the feasibility and benefits of incorporating advanced technologies into airport infrastructure. It has the potential to inspire future airport projects, contributing to a more sustainable and resilient aviation industry that prioritizes environmental responsibility, operational efficiency, and passenger safety. The future of airport design lies in embracing innovative solutions like this, ensuring the continued growth and development of air travel while minimizing its impact on the environment and surrounding communities.

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