An Autonomous Anti-Collision Flexi-Charge Winged Rover

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Abstract— Based on the current scenario of engineering development, robotics and drones are being mostly used for convenience. Hence, it finds an essential need to design a robot-drone integration which could perform the same task efficiently and could carry the payload to a relevant distance. This document deals with an autonomous ROVER which is meant to travel a path defined by the user and self-charges by using the wind energy which flows in the opposition of the motion of the ROVER. At the same time, it will detect the obstacles and find a conducive way of avoiding or overcoming it either by flying or passing by the object autonomously. Thus it will be able to switch from land to air after detecting any big object. Simultaneously, it will charge a battery system from the air-resistance while extremely being in motion by using the same mechanism as in the wind mill. This will create a technology which will be able to reduce the task of managing two different devices (robot and drone) for a single task and will make sure that a device will be able to perform two different tasks as per our desire.

Keywords— ROVER, self-charges, wind energy, detect, flying, autonomously, wind mill.

I. INTRODUCTION

In the growing era of drones, robotics and automation, the integration of all three domains can be very favorable for advancement in engineering and technology. These three technologies has become an important part of convenience for every other sector and is contributing for simplifying several complex operations. Robotics increases productivity of resources, Drones increases flexibility of resources and automation ensures the perfect allocation of these resources. Thus, the integration of all three technologies can be very beneficial and advantageous for scientific and technological activities.

The project aims on designing and implementing a Rover which detects the obstacles and finds a conducive way of avoiding or overcoming it either by flying or passing by the object and harnessing the resistance force of air by converting it into stored power at the same time. That is, to integrate the power of the productivity, flexibility and allocation of resources we are trying to design a "ROVER" which will traverse on land (same as a robotic vehicle) as well as fly in air (same as a drone) without any human interaction with its own automation ability. It is inferred that, the rover will charge itself while being in motion with the air resistance which will always be in the opposition of the motion of the rover.

"ROVER" is a scientific word for a vehicle which explores the different surfaces with minimum intervention of human beings and their commands and thus performs the activities on its own. Similarly, this project is intended to operate and perform the operations of object avoiding, tackling, charging, traversing and flying on its own with less human interference. Since all the tasks which a basic robot and drone should perform is implied with this single rover, it increases the functionality and availability of the conventional rover technology.

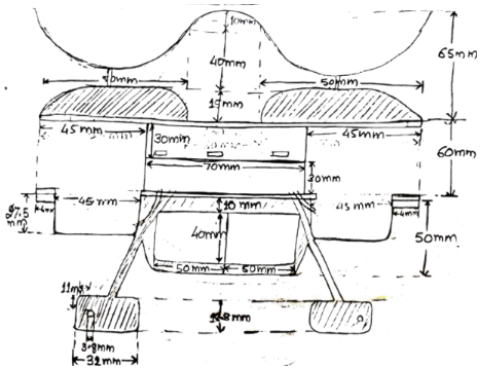

Figure1. General Structure of the ROVER

To explore any kind of the terrain and surfaces, it is important that the rover should be able follow the predefined path and tackle all kind of trenches, potholes and giant obstacles to reach the destination

with the same path. Thus, to tackle such hurdles and not fall for any of them the rover is emphasized to be anti-collision. It will be able to analyze the presence of such kind barriers and determine, whether to overtake them from sideways or by flying over them.

Whenever any unavoidable obstacle will block the path of the rover and moving from the side of it will be impossible, the rover will take a flight to just overcome the obstacle following the same taking off operations as in the drone. Thus, it uses the automation and anti-collision system in order to get into the aerial mode seamlessly without any havoc. Therefore, making the winged rover this seamless operation is achieved.

It cannot be avoided that the drone technology needs a lot of power in order to sustain the long run operations. Thus, in order to reduce the need of the charging the rover frequently, here the minimized version of windmill is used. A mini wind turbine and generator combination is used as same as of it and thus harnesses the air-flow which moves in the opposite direction of the rover to charge the battery. With the abundance amount of air which will rotate the turbine, the secondary battery will be charged abundantly and continuously. This flexi-charge rover will maintain a suitable amount of battery which will be sufficient to power up the rover for its all kind of operations.

With the suitable knowledge of all the three technologies, the combination of them will reduce the need of operating different robots and drones for a single task. Also, it ensures that this system can be used for a long-run task without being concerned about the power consumption of the rover. It includes the monitoring of the rover over the internet and making it an IoT based Robot as well. Thus, while travelling and taking flight, we will be able to monitor it from a distance place without any worry.

II. OBJECTIVES

The objectives of proposed work are as follows:-

- Making a wireless self-controlled, auto-pilot Rover: - With the use of ESP32 microcontroller and flight controller we can configure it to fly and traverse automatically. It will use such an algorithm that it will be able to switch from land to air and vice-versa all by its own. ESP32 is configured with Bluetooth and Wi-Fi modules, thus, we can manoeuvre it online making it wirelessly operated.
- Perform object recognition using image processing tools: - Using the Open CV library the ESP32 processes and recognizes the object and the distance of the Rover from the object. In this way, Rover will be able to decide whether the object is avoidable or not. It will determine whether the path is free to travel or the object blocks it in such a way that the rover has to flyover it.
- Attempting to automatically fly the rover without any human intervention: - After programming the ESP32 with the sensors and camera, it will be able to switch from land to air without any human controlling it using a device. The microcontroller will also be able to control and manoeuvre the flight controller while being in air. In this way it will operate automatically after getting path from the user.
- Conversion of wind energy to electrical energy via mini wind turbine: - A mini wind turbine and generator combination is used as same as of it is in large-scale wind-mills and thus it harnesses the air-flow which moves in the opposite direction of the rover to charge the battery. With the abundance amount of air which will rotate the turbine while in extreme motion, the secondary battery will be charged abundantly and continuously expanding the usage of the Rover in a single operation.

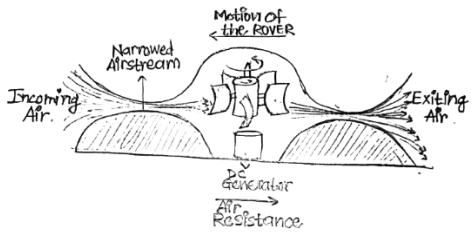

Figure 2. Self-Charging using Air-Resistance

- Making light weight, power efficient and eco-friendly Rover: - Using the wind energy for charging the Rover will not only power up it, but will also reduce the use of heavy weight batteries. This will not only charge-up the battery but also reduce the weight of batteries. Using the resources adequately and renewable form of energy, our rover will contribute in eco-friendly operations.

III. EXPECTED RESULTS

- Avoid small obstacles by diverting the Rover from sideways: - The Rover is will be able to avoid small potholes and barriers which are up to few cm long and does not blocks the path by overtaking it from the sideways. So, for the objects which does not affects the predefined path and can be avoided by

minimum diversion will be avoided from its sideways.

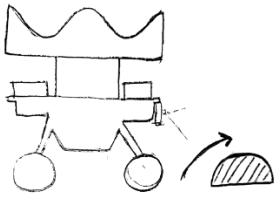

Figure 3. Small Obstacles Avoiding from sideways

- Avoid large obstacles and trenches by flying over them: - For the huge depression of surface or over-massive hurdles which almost blocks the path and causes a lot of change in the path, the rover will automatically switch to aerial mode and the flight controller will take the charge. In this way the same path will be followed by the rover without any diversion and time loss.

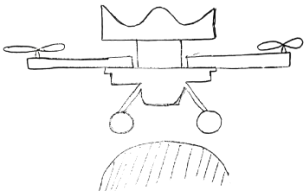

Figure 4. Avoiding large obstacles by flying over them

- A self-controlled, auto-pilot and auto-drive Rover: - Using the ESP32 microcontroller the rover will be able to drive itself on its own once the path is defined by the user. Following the signals from the sensors, it will manipulate the algorithm and according to it maneuver the actuators. If it senses any unavoidable obstacle, it will automatically fly over it so that the path given by user is not disturbed. In the whole process the human interaction will be only restricted to providing a path and not control while the rover is covering it. So, in this way it will be an autonomous, auto-pilot and auto-drive rover.
- The main battery is charged by the secondary storage battery using the wind energy : - Whenever the rover will move, there will be more or less force of air which will cause the stator of the dc generator to rotate. This will generate enough dc voltage which can charge a small secondary battery. This secondary battery will charge the main battery whenever the main battery level will go below 55%. Thus, it won't let the battery get more discharged.

IV. CONCLUSION AND FUTURE SCOPE

The project is a technological work which expects to combine three important technological domains such as Drones, Robotics and Automation. Thus this ROVER will fly like a drone as well as traverse like a robotic vehicle and its autonomous switching operation between these two activities will implement smooth integration of these technologies. It will perform object recognition and distance measurement operations in order to avoid any collision between the Rover and the object and will identify weather the object has to be avoided from side-ways or by taking-off over it. Using wind energy to charge the Rover while being in motion will reduce a tedious task of managing heavy-duty batteries for long run operations. Hence, it will be able to lower the weight of batteries and enhance the weight carrying capacities when a heavy weight operation has to be performed.

There exists a future scope for this project. It can be used for various on-sites applications where the human intervention will be nearby minimum or impossible. We expect the project to be applicable in disaster management, agriculture, military, shipping or extra-terrestrial body exploration. Based on the applications, the project's change in the hardware is totally considerable. Enhancement in all efficient manner can be done to improve the performance of the ROVER.

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