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# DESIGN AND DEVELOPMENT OF SEED / GRANULE SPREADER MECHANISM FOR UNMANNED AERIAL VEHICLE (UAV)

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***Abstract:*** There is an increasing demand for effective and independent solutions to deal with urgent global difficulties like fertilizer application, fish aquaculture, deforestation, and winter road management. The goal of this project is to create a Seed/Granule Spreader Mechanism for Unmanned Aerial Vehicles (UAVs) that will enable the application of fertilizer, salt dispersion, and aerial seeding. A hex copter platform, a sowing mechanism, and a tank to hold seeds, fertilizer, or granules are all integrated into the suggested system. The uniform dispersion of seeds over the target area is facilitated by an impeller coupled to a Brushless Direct Current (BLDC) motor, while the flow of seeds is regulated by a servo motor-controlled flap. To guarantee the UAV operates safely and effectively, the design takes aerodynamics, payload capacity, and flying stability into account. Using automated seeding mechanisms and UAV technology, this initiative provides a sustainable, affordable, and eco-friendly way to tackle major difficulties across multiple industries.

***Index Terms* – Drone, Deforestation, Seed Spreader, Agriculture.**

## I. INTRODUCTION

India's ecological landscape is under increasing threat from the rise in forest fires, resulting in substantial forest cover loss and adverse environmental consequences. The Forest Survey of India reports alarming figures, highlighting the vulnerability of over 36% of the country's forest cover to frequent fires. In 2022 alone, India witnessed the loss of 117,000 hectares of natural forest, contributing significantly to the global carbon emissions crisis. The urgency of addressing this environmental challenge is underscored by the fact that, between 2015 and 2020, India ranked second globally in forest cover loss.

In response to this critical issue, our research explores an innovative solution, the Seed Spreading System. This project conceives the development of a seed spreading system that can be seamlessly integrated with drones, providing a technology-driven approach to reforestation efforts. The primary objective is to leverage drone capabilities to efficiently disperse seeds in deforested areas and agricultural lands, thereby promoting the restoration of ecosystems and mitigating the impact of forest fires.

This paper will elaborate on the design, functionality, fabrication and potential impact of the Seed Spreading System, shedding light on its feasibility and relevance in the context of addressing India's pressing environmental concerns. The project imagines a seed spreading system designed for attachment to drones, presenting a novel approach to seed dispersal in deforested areas and agricultural lands.

The Hexacopter is constructed with a multirotor frame onto which the drone's whole structure is fixed. A battery that is attached to a power module, which distributes power to the six output channels, powers this hexacopter. The six motors are connected to four ESCs, each of which receives 24 volts from the output connectors. The main component that receives commands and employs a GPS system for navigation is the Flight Controller JiyiK++V2. The ground station obtains data from the Flight Control Board via a telemetry radio system via the MavLink Protocol. The Hexacopter used is shown in figure 9.

## II. LITERATURE SURVEY

A. U. Dampage, M. Navodana, U. Lakal and A. Warusavitharana(2020). This project aims to create an autonomous agricultural drone capable of seeding paddy fields with precision engineering. To shorten the time needed to sow seeds, a specialized nozzle was created and incorporated into the drone.The drone includes an auto-pilot system and a GPS navigation system that let it be controlled y both human and automatic means while flying.The flying path can be set up in software before take off and modified as necessary. Furthermore, the agricultural drone can be operated manually using a long-range remote controller. The nozzle's settings govern how quickly seeds are sown. In addition to being useful in other paddy fields, the suggested agricultural drone will offer a solution for seeding in soft soil paddy fields. The results of the field tests demonstrated that the suggested procedure is accurate and precise enough to meet the requirements set forth by agricultural experts for paddy production.The proposed technique has the ability to spread seeds in a row at roughly constant spacing and minimize seed waste and dispersion[1].

B. Lysych, Mikhail, Leonid Bukhtoyarov, and Denis Druchinin(2021).This reaserch paper focuses on creating a suite of seeding devices for use with UAVs. For this, the seed distribution and metering systems that were either now being used on UAVs or had the potential to be employed on them were examined. The author analyze the current literature on metering devices that use numerical approaches. Additionally, eight distinct sowing device designs were synthesized in 3D CAD, and their comparative evaluation was finished in terms of mass and a number of technological criteria. Its findings led to the selection of the sowing equipment best suited for a certain technology. One of the sowing device we use in our project is the centrifugal distributor. Fertilizer spreaders and sowing equipment mounted on unmanned aerial vehicles (UAVs) frequently use this device. Its architecture is pretty simple, and seeds can be dispersed up to 20 meters away. Typically, the diameter of the seeds utilized ranges from 0.5 to 5mm.Centrifugal distributor, which greatly expands the sowing strip's width while guaranteeing uniform distribution. An additional motor is installed to rotate the spreader disc, which increases the constructions' weight and energy consumption. Continuous area sowing of small and medium-sized seeds can be accomplished without the need for surface layer penetration by utilizing air flow and centrifugal sowing machines. In agriculture, these kinds of sowing tools are also more popular. The best machines for roller and periodically opening seeding are ideal for large seeds and seeds with notable variations in size and form[3].

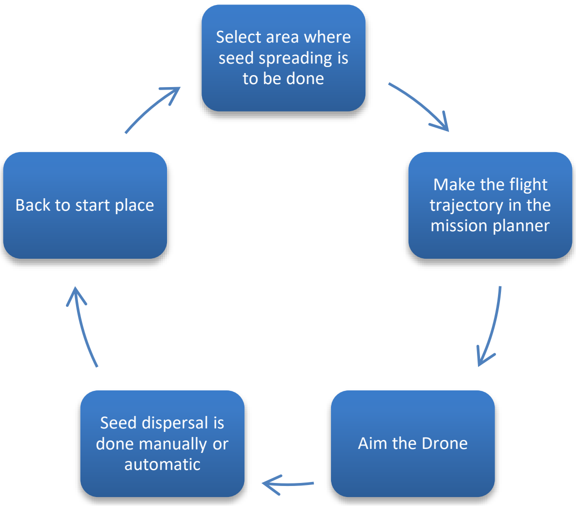
## III. METHODOLOGY

A. Creation and execution of the seed spreading drone

For our project, we have devised an innovative approach for spreading seeds. Our methodology involves utilizing a six-armed hex copter as the primary transportation medium, equipped with a specially designed sowing device known as centrifugal distributor [3] and a driving mechanism. To ensure precise seed dispersal, a container has been strategically fixed underneath the vehicle. The seed spreading mechanism is seamlessly integrated at the bottom of the drone, as illustrated in Figure 4. This configuration allows for controlled and efficient seed dispersal in various agricultural fields, optimizing the overall sowing process.

A soil sensing device is first used to monitor the temperature, moisture content, and pH of the soil. These measurements will be recorded or noted down. The noted numbers will next be cross-checked against the threshold values, which are values that are either larger or less than them. Part of the field will not be included in the mapping process if the values are less than the threshold value, and part of the field will be included in the mapping process if the noted values are larger than the threshold values.

Following this stage, the hexacopter's fly path is calculated using Qground controller, a piece of software that maps the drones in the designated locations. After that, the drone is armed and instructed to begin by arming itself. For ease of use spreading the user directly controls the spreading system. Following the mission's conclusion, the drone Return to Launch mode (RTL mode) is the mode that takes the user back to the starting point. In figure 1, the flowchart is of working of drone is displayed.



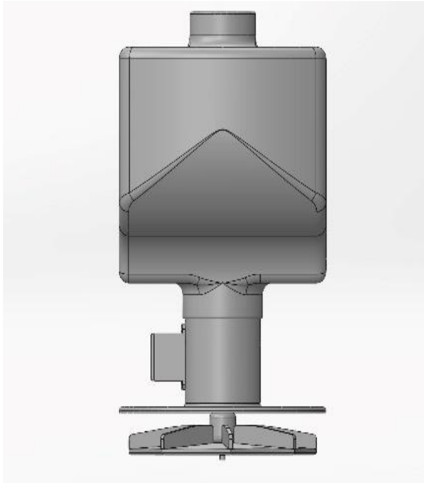
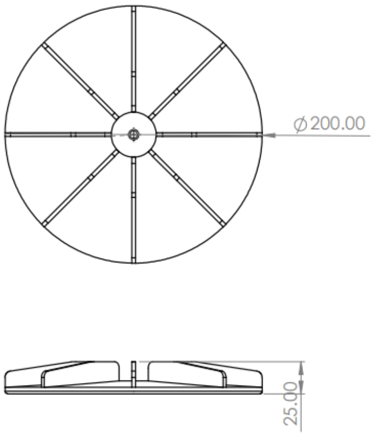



Fig. 1. Working of drone Fig. 2. Front view of tank and mechanism

The impeller shown in figure 3, is 3d printed by using plastic PLA filament.



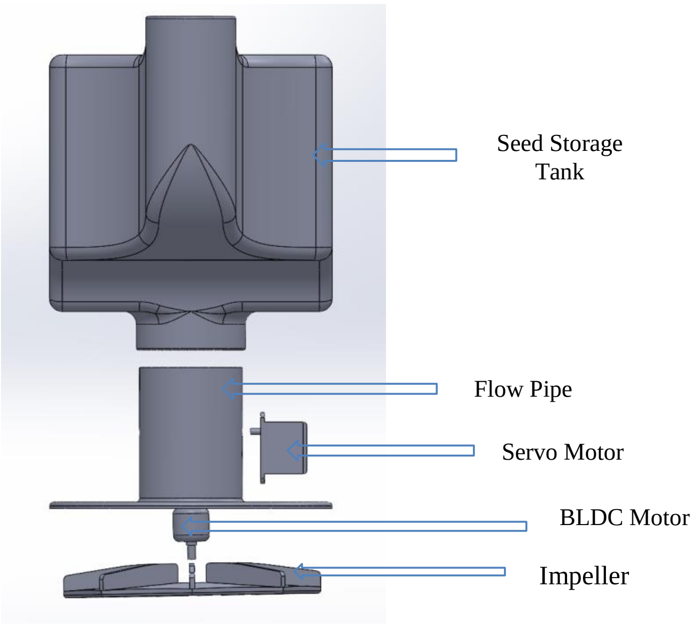




Fig.3. Impeller Fig.4. Assembly of the Spreader mechanism

The main hardware components required to put this hexacopter together are as follows: -

1. Flight controller JiyiK++V2
2. Battery 12cell 22000mah
3. Hobby wing x8 motor
4. Flight controller JiyiK++V2
5. Transmitter Skydroid H12
6. Propellers: 2911inch

*A. Motor*

We have used Xrotor pro x8 brushless motor which has built-in esc in it. These are mulit phased motors operated by using ESC(Electronic Speed Controller).Here the PMSM algorithm, based on Field Oriented Control, optimizes the cooperative performance of the ESC, motor, and propeller, resulting in a high-stability, reliable, and efficient propulsion system.To maintain the motor's rotation, the ESC produces three distinct, adjustable phases of high frequency signals. Because the motors can draw a lot of current, we need high capacity ESCs.The ESC used here has continuous current of 80A. The ESC is coupled with the motor after being directly connected to the control channels of the receiver.

*B. Flight controller JiyiK++V2*

A tiny circuit board with enormous complexity is known as a flight controller (FC). Its job is to respond to input by rotating the motor and maintaining each motor's RPM. A pilot's instruction instructing the multirotor to advance is sent to the flight controller—we use the industrial grade JIyiK ++V2 in our instance. Strong industrial-grade sensors and algorithm optimization are advantages of K++V2. The flight controller system only requires one calibration after installation. Recalibration is not necessary, even in the event that the working environment changes. Incredibly simple to use.

*C. Transmitter Skydroid H12*

An FPV transmitter specifically made for industrial RC machines, especially agricultural drones, is the Skydroid H12. Here are a few of the Skydroid H12's main characteristics: Long Range: The H12 has an amazing range of up to 30 kilometers, or nearly 18.6 miles. Compatibility: The R12 receiver and the Skydroid H12 can connect together. It is also compatible with a number of FPV cameras.

### B. The Seed Spraying Mechanism Control

The primary function of the seed spreader mechanism is to disperse the seeds at the chosen location. A 5V volt power source, an ESP 32, and a BLDC motor drive the seed-releasing course. Seeds are deposited onto a rotating disk that is coupled to a BLDC motor; the servo motor, which is managed by a Mobile app, opens and closes the latch. Instead of using transmitter we are using a dedicated mobile app to control seed spreader mechanism. The figure 5 illustrates the circuit employed in the drone for motor control. The web application (shown in fig. 6) based on esp32 has two controls. The first one(Servo 1) controls servo motor from 0° to 180° position but we only need 0° to 90° for controlling the position of flap. The second control (BLDC) controls the speed of bldc motor from minimum to maximum.

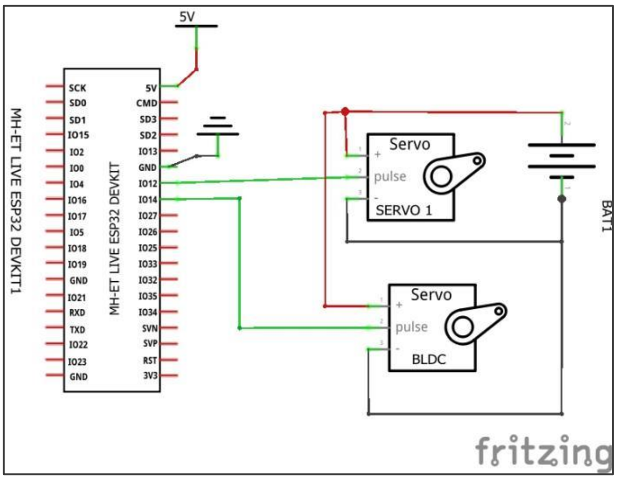



Fig.5. Implemented Circuit

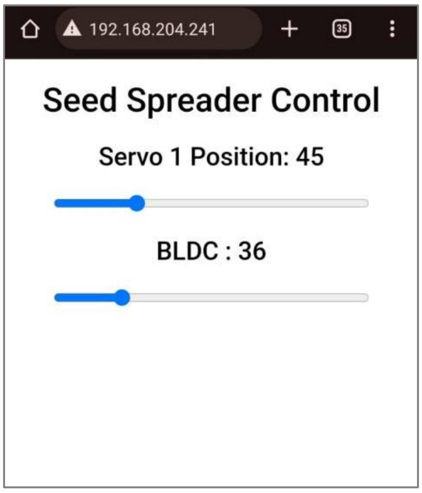



Fig.6. Web app used to control motor

## IV. RESULTS AND DISCUSSION

The below figures 7 and 8 shows the overall mechanism of the seed spreading drone. The results of seed spreading are shown in the figure 9. It shows the data of seed spreading when 1kg of bajra(Pearl millet) seeds are present in it. If the flap is 20% open then the all seeds(1kg) will come out in 1min 15sec.

Fig.7. Mechanism integrated with drone

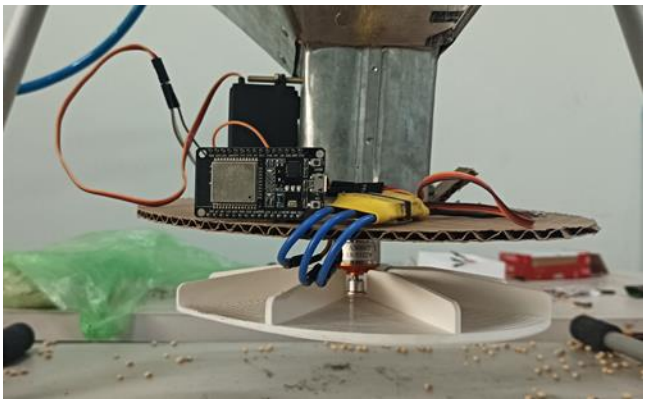


Fig.8. Seed Sprayer Mechanism

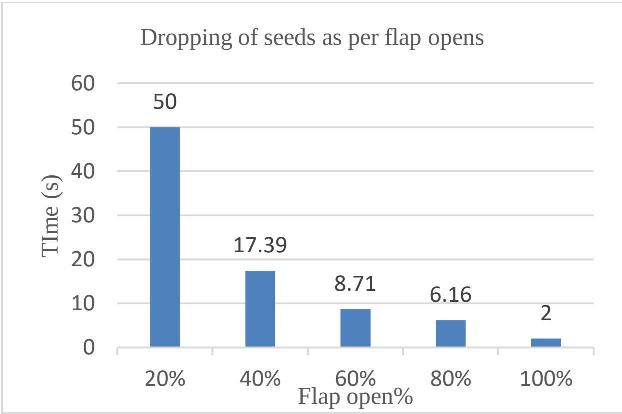



Fig.9. Time consumed in spreading 1kg seeds of bajra

**Variability of Material:**

Different types of material is tested through the tank like seed of different sizes, powder material, and fertilizer, salt and thick liquid. Among all these babul seeds flow rate can be controlled precisely and powder material spreading was nearly good. But for thick liquid and salt proper mechanism is required and changes are needed.

## V. CONCLUSION

The design and development of a seed/granule spreader mechanism for Unmanned Aerial Vehicles (UAVs) represents a significant stride in precision agriculture, offering potential to revolutionize sowing practices and enhance crop yields sustainably. Through a blend of aerospace engineering, robotics, and agricultural science, this research has yielded a robust mechanism capable of precise and uniform distribution of seeds and granules over vast agricultural landscapes. Validated through computational modeling and extensive field trials, this technology promises cost-effective, efficient solutions, mitigating labor costs and environmental impact. The seed spreader mechanism has proven to be used in a variety of situations due to its adaptability. The technology can spread seeds over wide regions in the event of deforestation, aiding in reforestation and biodiversity preservation. It can help with the regulated discharge of fish feed pellets into aquaculture ponds in fish farming applications, which would improve fish development and production. The device can be used to spread de-icing or salt on snowy roads throughout the winter to increase traction and safety. Moreover, the system can be modified for the accurate administration of granular materials such as fertilizers in agricultural settings. As we move forward, ongoing research and interdisciplinary collaboration will be vital in refining and scaling UAV-based spreading technologies to meet the evolving needs of global agriculture, ensuring food security while safeguarding our planet's resources.

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