DESIGN AND FABRICATION OF POLLINATION DRONE

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ABSTRACT

One of the primary issues regarding current agricultural production is crop pollination. Roughly $74 Billion per years' worth of crops depends on pollination by various pollinators. However, the recent weakening of honey bees has significantly vulnerable output. Failures of additional natural pollinators, such as changed insect types and animals, have also been described. Such downfall of pollinators has considerably amplified the price of agriculturalists and hiring them for cross-pollination amenities. From mutually food sustainability and economical opinion, there is a crucial need to pursue substitute pollination systems. Globally, pollinators mark 35% of farming land and perform a main part in "food production". Accordingly, intensive care is convenient to know the influence insects make on "crop pollination". Outdated selection approaches used in insect nursing have several problems, as well as that they are labor-intensive and potentially unreliable. Some of these disadvantages can be overcome using air vehicles, computer vision, and deep learning-based methods to automate pollination. To overcome this problem this project presents an automated drone for pollination which uses deep-learning and machine-learning procedures to approximation of the flower place, size, location, and state to guide the drone to arrest and interrelate with florae for pollination. In this concept, we use drone and artificial intelligence methods to carry pre-composed pollen and inject them into flowers for pollination to increase productivity. Drone pollination avoids numerous existing issues with ordinary pollinators in farming, such as 'honeybee' colony collapse disorder, pollinator fleas and viruses, killers, pesticide spray, opposing weather, and the obtainability of pollinators in an opportune manner. Second, machinelike pollinators will recover value and creation. With the declining number of bees, artificial pollination is more in trend. Artificial pollination is beneficial and can increase plant productivity. The effective completion of this scheme will suggestively influence the arena of non-natural pollination in agriculture.

Keyword - *Pollination, Bees, Agriculture, Pollinators, **E**fficientNet, Torch, DJITello.*

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1. INTRODUCTION

"Pollination" is an aware term to almost everybody. We know that flowers must be pollinated, usually by different types of insects, for the plant to generate fruits and seeds. We have seen many captions declarative that insect pollinator populaces are decreasing, threatening those important procedures. It's well known that pollen is the yellow dust that completely covers our cars at the time of spring, and we tend to blame it for the periodic aversions. For several people, that's completely as far it gets. But taking some amount of time to look into it can lead to astonishing discoveries. Individual plants and flowers have advanced their individual-focused constructions and pollination methods over billions of years. Plant-pollinator mutuality has advanced to become the central facilitator of both plant replica and pollinator nourishment. Pollination is the imitation system used by blossoming plants. Precisely, it is the performance of transporting pollen from the male-anther to the female-stigma of one flower that makes the seeds and allows reproduction. Pollen is fine dust-like particles or powder that grow inside the stamen and gather on its surface. Pollen grains are unique in their figure and the sculpturing of their hard outside surfaces. For positive pollination, the pollen should be transmitted into a stigma of the same plant type at the perfect time. When pollen parks on an amenable stigma, one of the pollen grain's two core cells 'germinate' and produces a pollen tube, basically a subway over the stigma and panache, creating a track to an ovule private the flower's ovary. The subsequent cell inside the pollen grain splits into two sperm cells which portable down the pollen tube to the ovule. One sperm cell bond with egg, creating an embryo, and ultimately it creates a seed. The other bonds with a cell in the ovule to produce endosperm, which offers nutrition for the embryo. Ovaries might have one or several ovules. Only pollinated ovules advance to the seeds. If all ovules aren't inseminated by discrete pollen grains, less seeds grow and the subsequent fruit is probable to be shaped oddly. The understanding of the sowed fruit and vegetables we consume are in fact herbal ovaries may be somewhat disgusting. Cross-pollination is predominant. There are benefits to variation in helping plants adapt to a changing environment. Flowers stop unintentional self-pollination in numerous ways, with changing the timing of pollen issue and stigma receptiveness, the longitudinal planning of anthers and stigmas, and extrication of male and female flowers on similar plants. Amazingly, plants that usually have self-pollination fences in the dwelling can alternate their structure and its chemistry to admit their individual pollen if cross-pollination does not occur in a timely way owing to weather or absence of pollinator activity.

2. LITERATURE REVIEW

Malika Nisal Ratnayake, Adrian G, Dyer, Alan Dorin have developed a model "Towards Computer Vision and Deep learning Facilitated Pollination Monitoring for Agriculture" which is useful for CV based pollination observing. They proposed a novel algorithm, polytrack, which several insects at a similar time in complex agricultural atmospheres. This program algorithm uses deep learning techniques and segmentation to spot and imprint insects. Polytrack contains flowers recognizing module to automate the process of collecting insect-flower interface data, and a small-resolution handling mode that shrinks computational demands engaged in the processor to adapt the software towards the necessities of low-powered observing hardware.

YI CHEN, Yun LI Dongguan industry has proposed a paper "Intelligent Autonomous Pollination for Future Farming" this paper advances a theoretical-practical roadmap of independent fertilization for upcoming farming using machinelike micro air vehicle pollinators. The research offers new visions into independent design and production and into possible ways to grow the production effectiveness which curtails the time from lab to market. The independent MPs are being realized by Artificial Intelligence and humanoid expertise in the loop for the keen agricultural industry.

Ming-Liang Gao, Yuan-Ru Zang, Jin Shen, Yu-Chen Zhang, De-shui Yu has created an algorithm "Visual tracking based on Flower Pollination Algorithm" In this study, computer visual tracking is regarded as a method of ideal reproduction of blossoming plants. An FPA-based tracing architecture is anticipated and its tracing accuracy and velocity are compared with particle filter and mean shift.

Jung Uk Kim and Yong Man Ro have created an object detection model "Attentive Layer Separation for Object Classification and Object Localization in Object Detection" object sorting emphasizes the utmost discriminative object part of the feature chart. Whereas, object localizing needs a feature chart that is dedicated to the whole zone of the object. Comprehensive investigational observations based on the "PASCAL VOC dataset" and "MS COCO dataset" exhibited that this object detection system outperformed the "state-of-the-art" methods.

Weisen Shi, Junling Li, Nan Cheng, Feng Lyu, Shan Zhang, Haibo Zhou and Xuemin shen created a model "Multi-Drone 3D Trajectory Planning and Scheduling in Drone Assisted Radio Access Networks" The 3D path disparities in horizontal and vertical directions, and the DBS-related network models, are studied in the formulation. To report the non-protrusion and" NP-hardness" of the "MINLP" problem, decouple it into several "Integer Linear Programming" (ILP) and "quasi-convex" sub-problems in which "AoI" association, D2U communication planning, horizontal trails, and flying altitude of DBSs are correspondingly enhanced. Then, the Multi-DBS 3D path planning and scheduling procedure to resolve the sub-problems centered on the BCD method.

3. EXISTING ALGORITHM

Worldwide, pollinators have a major contribution to 35% of agronomic land and food production. Therefore, observing is useful to recognize insects' involvement in crop pollination. Traditional sampler practices used in insect monitoring have some downsides, including that they are labor demanding and potentially unpredictable. Some of these downsides might be diminished using air vehicles, computer vision, and deep learning-based practices to automate pollination. A pipeline for computer vision-based pollination monitoring and put forward a unique algorithm, Polytrack that tracks several insects simultaneously in difficult farming surroundings. The algorithm uses deep learning and foreground/ background segmentation to spot and track insects has attained precision and recall at a good rate.Respectively when observing honeybees foraging in test sites within the polytunnels of a strawberry farm. Polytrack includes a flower detection module to automate the collection of insect-flower interface data, and a low-resolution dispensation mode that lowers computational configuration demand placed on the processor to work the software towards the requirements of low-powered monitoring hardware.

4. PROPOSED ALGORITHM

Monitoring is beneficial to appreciate the influence insects make on crop pollination. Traditional sampling methods used in insect monitoring have some disadvantages, as well as they are labor concentrated and hypothetically undependable. Some of these disadvantages may be solved using air vehicles, computer vision, and deep learning-based methods to mechanize pollination. To overcome this problem this project offers a computerized drone for pollination which uses deep learning and machine learning algorithms to approximate the flower location, dimensions, alignment, and corporeal condition to guide the drone to seizure and cooperate with floras for pollination. In this concept, we use drone and artificial intelligence methods to carry pre-collected pollen and inject them into flowers for pollination to increase productivity. Drone pollination bypasses many present issues with normal pollinators in farming, such as “honeybee colony collapse disorder”, pollinator fleas and diseases, killers, pesticide spray, opposing weather, and the obtainability of pollinators in an appropriate manner. Additionally, robotic pollinators will recover fruit value and production. With the lessening number of bees, fake pollination is more in movement. If we take the instance of “China”, 100% of plants are fertilized insincerely. So, we can see that artificial pollination is beneficial and can increase plant productivity. The positive achievement of this plan will suggestively influence the field of artificial pollination in farming.

5. ARCHITECTURAL DIAGRAM

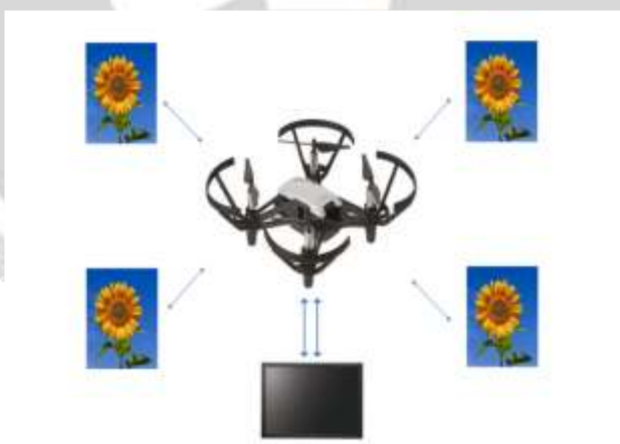

Fig -1: System Architecture

6. METHODOLOGY

The drone we used is DJI Tello. The drone consists of four BLDC motors fixed on each flying arm. The transmitter gives the command to the receiver board fixed on the drone. As the drone receives the command it acts accordingly to fly in a particular direction. Once the take-off command is received, the drone which carries the pre-collected pollens begins its take-off from the ground and flies to a certain altitude, and waits for the “stream on” command. When the stream on command is passed, a camera that is mounted on the drone turns on and starts streaming the visuals captured by the drone to the monitor. These visuals can be used to monitor the movement of the drone and through which we can analyze the drone's performance and update if needed. Then the drone starts searching for the flower nearby for pollination. When any flower is detected by the drone forward command is automatically generated to move the drone towards the flower to initiate pollination. Once the pollination is done backward command is automatically generated to move the drone back to its original searching position. And the clockwise command is automatically generated to rotate the drone in the clockwise direction so that it can detect another flower and repeat its process. Through which artificial pollination is achieved successfully. The drone flies according to the speed given to the motors fixed on each arm of it. When the speed given to all the motors are increased from lower pwm voltage to higher pwm voltage, then the drone moves upwards, whereas when the pwm voltage is decreased from higher voltage to lower voltage, the drone comes down to the ground. In order to move left and right, the left motors should be slowed down whereas the right motors should be increased in speed and the same goes for the right side, such that motors in the right should be slowed down and the left motors should be given more speed.

6.1 Algorithm Used

EfficientNet is a convolutional neural network construction and the ascending way that consistently balances all sizes of depth, breadth, and resolution using a complex constant. Unlike conventional repetition that random scales these issues, the EfficientNet scaling method consistently scales net breadth, depth, and resolution with a set of static scaling constants. The efficiency of prototypical scaling also depends on the starting point of the network. So, to additional improvement of its performance, they have also advanced a new baseline network by executing a neuronic construction search using the "AutoML MNAS" basis, which enhances both correctness and effectiveness. The resultant planning uses portable overturned holdup convolution, parallel to 'MobileNetV2' & 'MnasNet', but is to some extent larger due to an enlarged 'FLOP' economical. They, then scale up the baseline network to obtain a family of models, called "EfficientNets". They have compared their "EfficientNets" with other current CNNs on "ImageNet". In general, the EfficientNet representations attain both sophisticated correctness and improved competence done present CNNs, dropping limit size and FLOPS by instruction of scale. However, EfficientNets complete fine on "ImageNet", to be utmost valuable, they should also transmission to additional datasets.

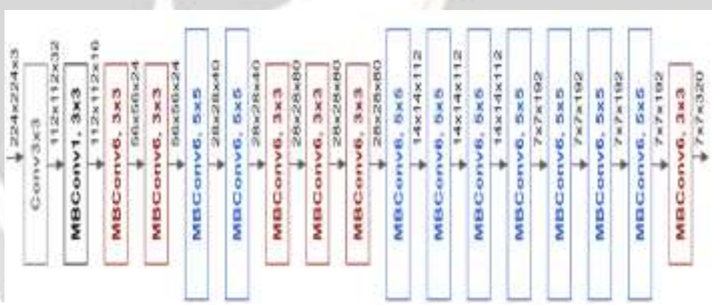

Fig -2: EfficientNet

6.2 Libraries

- Torch - It delivers a supple the N-dimensional array or the Tensor, which chains elementary procedures for indexing, sharing, moving, type-casting, sharing storage, and duplicating.
- OpenCV - A sequence of suitability functions to make undeveloped image processing purposes such as conversion, revolution, formatting, framing, and showing Matplotlib images is simple with "OpenCV".
- DJITelloPy- This library has different features like the execution of all tello commands, easily retrieving a video stream, receiving and parsing state packets.
- Torchvision - Torchvision is a collection for Computer-Vision that drives with "PyTorch". It has values for well-organized Image and Video alterations, some normally used pre-trained models, and few datasets.
- Efficientnet_pytorch - EfficientNets are a group of image arrangement models, which attain state-of-the-art correctness, existence an order-of-magnitude lesser and faster. It consists of the unique TensorFlow application, such that it is informal to load weights from a "TensorFlow" frontier.

7. DATA ANALYSIS

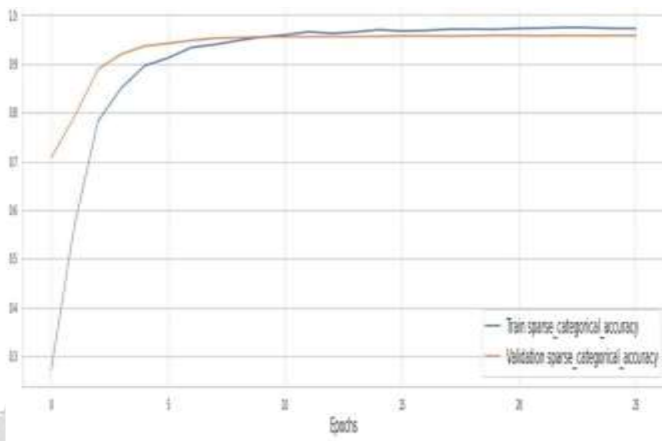

Fig -3: Model Accuracy

The fig 3**,** depicts the model accuracy for sunflower flower dataset. The train dataset has an accuracy of 97% and the test dataset has an accuracy of 96% which is convincing.

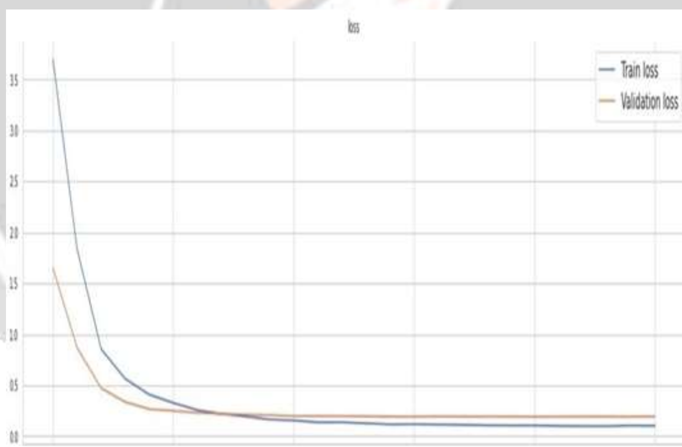

Fig -4: Model Loss

The fig 4, depicts the model loss for sunflower flower dataset. The train dataset has a loss percentage of 2% and the test dataset has the loss percentage of %3 which is acceptable.

6. RESULTS AND DISCUSSIONS

This project has designed a pollination drone that can be used for artificial pollination. In the existing system, only monitoring of insects and other complex agricultural activities has been implemented using computer vision and deep learning but not focused on pollination. But in this project, artificial pollination method has been implemented using an Efficientnet algorithm and wireless drone. Thus, by this, we have successfully designed an obstacle avoidance drone for artificial pollination

Fig -5: Pollination Drone

Fig 5: This drone is designed to perform pollination in an artificial method. This picture depicts the working of the drone. First the drone takes off with the “Take off” command. It goes up to 2-3 feet and then the search process begins where the drone rotates clockwise and then detects the flower. Once the “Flower” (object) is detected the center point of the flower is calculated and the drone moves towards the center point and performs the artificial pollination. After the completion of the pollination process, the drone moves back and continues the search process. When the next flower is detected, the process is repeated

Table -1: Autonomous Drone Pollination Routine Results

Time Stamp	***Flower Detections***	***Attempted Pollinations***	***Successful Pollination***
0.22	Positive	2*	1*
0.40	Positive	1	1
1.02	Positive	1	1
1.30	Positive	1	1
1.58	Positive	1	1
2.22	Positive	1	1
2.46	Positive	2*	2*
3.01	Positive	1	1
3.26	Positive	1	1
3.49	Positive	1	1
4.03	Positive	2*	1*
4.27	Positive	1	1
4.50	Positive	1	1
5.13	Positive	1	1
5.39	Positive	1	1
6.02	Positive	1	1
6.26	Positive	1	1
6.49	Positive	2*	2*
7.11	Positive	1	1
7.35	Positive	1	1
Obtained Accuracy		**95%**	

* → Detected the same flower multiple time.

The values in the table are recorded by conducting a real time experiment with the drone. Four flowers were placed in four directions (north, south, east, and west). During the test run we recorder the reading for "Four" rotations both clockwise and anticlockwise directions. During this experiment we obtained a positive result with an accuracy of "95%" pollination rate.

7. CONCLUSION

This project has designed a pollination drone that does artificial pollination. In the existing system, only monitoring of insects and other complex agricultural activities has been implemented using computer vision and deep learning. In this project artificial pollination method has been implemented using an efficientnet algorithm and wireless drone if any kind of obstacle comes in front of it, it will automatically turn its path in another direction. This will help to detect the obstacle. The drone has a stable performance of flying up to 2 to 3 feet of height. Thus, by this we have successfully designed an obstacle avoidance drone for artificial pollination so, we can see that artificial pollination is beneficial and can increase plant productivity. This autonomous pollination drone will expressively influence the field of artificial pollination in agriculture.

9. REFERENCES

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