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ABSTRACT

Agriculture is one of the important sectors of India. But its development in the field is very less. Most of the farmers used old agricultural techniques to produce crops. They don't have adequate resources. Hence a lot of energy of Indian farmers is wasted in the processes that can be done without much effort. Many of the times the farmers have to face a loss due to lack of technology like damage to the crops due to lack of rain or due to pests or lack of nutrition to the plant.

This damage can be minimized by incorporating new technologies into farming. This will also increase the efficiency of the farmer and hence more profit to the farmer. This report intends to solve one such problem of the farmer, i.e., spraying pesticide and insecticide with the help of new technology. This report contains the design of an Unmanned Aerial Vehicle (UAV) that can spray pesticide in the desired amount.

The UAV will be fitted with solar panels to follow the path of sustainable development. The solar panel in the UAV makes use of renewable energy and also increases the flight time of the drone and provides extra energy during the flight. The implementation of solar panels in UAV makes the product useful to even those farmers which don't have access to electricity for the entire day. Hence increases the reach of our product.

The report also describes the spraying mechanism used in the drone for spraying more pesticide in less amount of time in effective way.

Since the financial condition of most farmers in India is not so good. Hence the report aims at presenting a cheap drone and the process that can be implemented so that it can reach even poor farmers. Since it is new technology to the farmers, this report also tells the plan implementation for training the farmers.

LIST OF TABLE

CHAPTER 3

LIST OF FIGURES

CHAPTER 3

INDEX

1. INTRODUCTION:

1.1 INTRODUCTION:

Nowadays, one of the world's most challenging problems is the limitation of the sources of energy. One way to overcome this problem is to look for another source of energy that isn't limited. Solar power is one of them. These days, using solar cells has become conventional. In one aspect they are used in Unmanned Aerial Vehicles (UAV) or Drones. Conventionally, unmanned aerial vehicles are aircraft or drones either using a remote control or automatic control for their guidance. These aircraft are used for carrying devices as a payload such as a camera, sensors, communication devices and other applications.

In recent years the interest in the development of such drones with various missions has been increased. The most challenging problem in a Drone refers to its source of power. Since the battery is the common source of power for Drones, the endurance of such aircraft is restricted. Using other sources of power can be useful to increase the endurance of the aircraft. The unmanned solar drone is considered as a group of UAVs in which, solar cells are used as a source of power. The solar cells are used as an unlimited source of power for motors and other electrical subsystems. Utilizing an electrical circuit, not only power can be provided for the motor and other electrical subsystems via solar cells but also can charge the battery. Batteries are used as a backup when solar cells cannot provide enough energy (flying under shadow or cloudy weather). So, flying will be continued till solar cells can provide energy from the Sun.

Since using solar cells is the only source of power, and if in one of the flying phases, the produced power by the solar cells is lower than the power consumption of the aircraft, the fly will lead to a crash. So, in the design of a solar-powered aircraft, knowing the quantity of power consumption of the aircraft and the power produced by the solar cells is a significant matter.

Drone technology is a phenomenal innovation with the potential to transform the way routine manual activities are carried out in agriculture. Agricultural industries globally are increasingly using drone technology to modernize farming. Drones are remotely piloted aircraft systems (RPAS), having a propulsion system, a programmable controller with or without the satellite navigation system, automated flight planning features, and capable of carrying payloads such as cameras, spraying systems, etc. for accomplishing a given task. Several other acronyms, namely UAV/UAVs (Unmanned Aerial Vehicle/Systems), UAS (Unmanned Aircraft Systems) are interchangeably used; however, RPAS is the most formal and international way of addressing such systems. The drone used for agricultural activities is known as an agriculture drone. Drones are designed to carry the sensors that can provide real-time information about the crop status or livestock movement, so that decision on cultural operations and management is made efficiently and precisely. The drone can be either remotely controlled over wireless communication or can be programmed to travel the predefined path using complex navigation algorithms running on onboard controllers. It can be retrofitted with a different configuration of payloads of sensors with digital imaging capabilities such as multispectral, high-resolution camera systems and actuators, for the field survey, crop scouting, spraying, and spreading applications, and surveillance in livestock and fisheries. Using the data captured through cameras mounted on drones and data analytics, farmers can precisely calculate their land sizes, classify crop types and varieties, develop soil maps along with pest management and properly plan the harvesting of their crops. These drones can be fully automated to help further improve the scale of operation and productivity. Drones have found several applications in agriculture, however, are limited by the country's policies on its use context.

1.2 NEED OF THE STUDY:

Apart from favorable climatic conditions for growing vegetables, our country still has no leading technical facilities, necessary for the competitiveness of the market economy. Thus, any solution by which farmers can reduce production costs while maintaining product quality and integrity is considered. The Indian Agricultural sector is the most important as it amounts to a staggering 18% of India's Gross Domestic Product (GDP) and also provides employment to 50% of the national human workforce. It serves to be the backbone of the Indian economy. It is very essential to improve the productivity and efficiency of agriculture by providing safe cultivation of the farmer. The various operations like spraying of pesticides and sprinkling fertilizer are very important. Though spraying of pesticides has become mandatory it also proves to be a harmful procedure for the farmers. Farmers, especially when they spray urea, take too many precautions like wearing appropriate outfit masks and gloves. It will avoid any harmful effects on the farmers. Hence, the use of robots in such cases gives the best solutions for this type of problem, along with the required productivity and efficiency of the product. According to a survey conducted by WHO (world health organization), it is estimated that every year about 3 million workers are affected by poisoning from pesticides out of which 18000 died. This project aims to overcome the ill-effects of pesticides on human beings and also to spray pesticides over a large area in a short amount of time compared to conventional spraying by using an automatic fertilizer sprayer. This model is used to spray the pesticides content to the areas that cannot be easily accessible by humans.

This device is the combination of spraying mechanisms on a quadcopter frame along with solar-powered. The quadcopter can be described as a UAV with four propellers in a cross configuration, which can be remotely controlled aircraft or can fly autonomously based on pre-programmed flight plans or more complex dynamic automation systems.

1.3 OBJECTIVES:

There are many objectives of this project. But the ultimate goal of this project is to develop a UAV that can spray pesticides effectively:

- More versatile and cost-effective than satellite data. Drones allow real-time monitoring at a far more accurate and cost-effective level than satellite imagery, helping farmers make data-driven decisions.
- No need for a license.
- Safe & Easy to learn.
- Pathway to sustainable farming.
- Optimize agriculture operations.
- Increase crop production.

- Monitor crop growth.
- Sensors and digital imaging capabilities can give farmers a richer picture of their fields.
- The primary objective of integrating a solar power system into a UAV is to increase the range by providing an extra power source during flight. This provides clean, emissions-free, and renewable energy sources and qualifies for tax breaks and cash incentives.

1.4 SCOPE OF STUDY:

In the present era, there are too many developments in precision agriculture for increasing crop productivity. Especially, in developing countries like India, over 70% of the rural people depend upon the agriculture fields. The agriculture fields face dramatic losses due to the diseases. These diseases came from pests and insects, which reduces the productivity of the crops. Pesticides and fertilizers are used to kill insects and pests to enhance crop quality. As much as India depends upon agriculture, still, it is far short of adopting the latest technologies in it to get a good farm. Developed countries have already started the use of UAVs in their precision agriculture, photogrammetry, and remote sensing. It is very fast and it could reduce the workload of a farmer. In general, UAVs are equipped with cameras and sensors for crop monitoring and sprayers for pesticide spraying. In India, there are over 35 drone start-ups that are working to raise technological standards and reduce the prices of agricultural drones. This project aims to develop a drone for overcoming this problem and also spray large amounts of pesticides within a smaller interval of time with solar-powered.

At present, UAVs are also being employed in various commercial and industrial applications. In particular, these include the use of unmanned helicopters for crop dusting or precision farming. Sugiura et al. (2003) used an imaging sensor and laser range finder mounted on an unmanned helicopter, to generate maps of field information such as crop status and land topographical features. Archer et al. (2004) develop a microwave autonomous copter system for monitoring the temporal changes of soil moisture as a function of depth, even in the presence of vegetative covers. Khan et al. (2010) demonstrated that the UAV sensors can be used for satellite validation in the atmospheric boundary layer, for horizontal and vertical mapping of local pollutants and greenhouse gases, and understanding carbon uptake in a forest canopy. Patel et al. (2013) designed an innovative quadcopter to survey the agricultural farm by an infrared camera to show the difference between infected or diseased crops and matured crops. Verbeke et al. (2014) tested a novel compound multicopter for inspecting fruit orchards and vineyards while flying in between the tree rows in outdoor conditions. Several studies and research applications involving the modeling, design, and control of multicopter have been performed by researchers and many solutions are proposed in the literature. We cite only two very interesting pieces of research. Achtelik et al. (2011) used technology based on an infrared laser system that transforms the laser beam back to electrical energy to show the unlimited flight time of a quadcopter. Raza and Gueaieb (2010) describe the different steps of designing and testing a quadcopter. In their research, they proposed and implemented a fuzzy logic controller.

The use of drones can be advantageous in the case of pesticide spraying, replacing labor-intensive and hazardous conventional methods particularly in difficult areas such as hills. Artificial intelligence and machine learning can be combined with NDVI (Normalised Difference Vegetation Index) imaging technology-based high-resolution images captured by drones to develop an understanding of soil conditions, plant health, and crop yield prediction. Every individual plant can be located separately and analyzed using image processing algorithms if it is stressed. Using this result, farmers can take preventive action to cease the spread of diseases to other crops. Timely actions can be taken to prevent losses from biotic stresses such as insect pests and diseases, optimize fertilization, rationalize irrigation and reduce the impact of climate change and unpredictable weather using analyzed insights from data collected by drones and satellite-based remote sensing. The agricultural labor shortage in exceptional times of the COVID19 pandemic that has necessitated the adoption of physical distancing measures has opened up several opportunities for the use of drones in agriculture. An attempt has been made in this article to assess the use of drones for facilitating farming activity amidst lockdown compliance and labor deficit.

2. LITERATURE REVIEW

Dongyan et al. (2015) [24] experimented on effective swath width and uniformity of droplet distribution over aerial spraying systems like M-18B and Thrush 510G.These agricultural planes flew at height of 5 m and 4 m respectively and with this experiment they reach to conclusion that flight height leads to the difference in swath width for M-18B & Thrush 510G.

Huang et al. (2015) [34] made a low volume sprayer which is integrated into unmanned helicopters. The helicopter has a main rotor diameter of 3 m and a maximum payload of 22.7 kg. It used to require at least one gallon of gas for every 45 minutes. This study paved the way in developing UAV aerial application systems for crop production with higher target rate and larger VMD droplet size.

Yallappa et al. (2017) [44] developed an hexacopter with 6 BLDC motors and two LiPo batteries of 6 cells- 8000 mAh. Their study also involves performance evaluation on discharge and pressure of spray liquid, spray liquid loss and determination of droplet size and density. Through their project, they finally made a drone capable of carrying 5.5 L of liquid with an endurance time of 16 min.

Kurkute et al. (2018) [49] worked on quadcopter UAV and its spraying mechanism using simple cost-effective equipment. The universal sprayer system is used to spray for both liquid and solid content. In their research, they have also compared different controllers needed for agricultural purposes and concluded that quadcopter system with Atmega644PA is the most suitable due to its efficient implementation.

Rahul Desale et al. (2019) [50] described an architecture based on UAV that could be employed for agricultural applications. Their UAV was designed not only for spraying but also for monitoring agricultural fields with the use of cameras and GPS. Their design was optimized for cost and weight. They used a microcontroller kk 2.1.5 which has inbuilt firmware.

Prof. B. Balaji et al. (2018) [51] developed an hexacopter UAV with the purpose of spraying pesticides as well as crop and environment monitoring using Raspberry Pi that run on python language. Their UAV also contains multiple sensors like DH11, LDR, Water Level Monitoring sensors. From this experiment, they finally concluded that with proper implementation of UAVs in the agricultural field almost 20%- 90% savings in terms of water, chemical maltreatments and labor can be expected.

3. DESIGN AND ANALYSIS

3.1 COMPARISON OF SPRAYING SYSTEM: MANUAL VS DRONE:

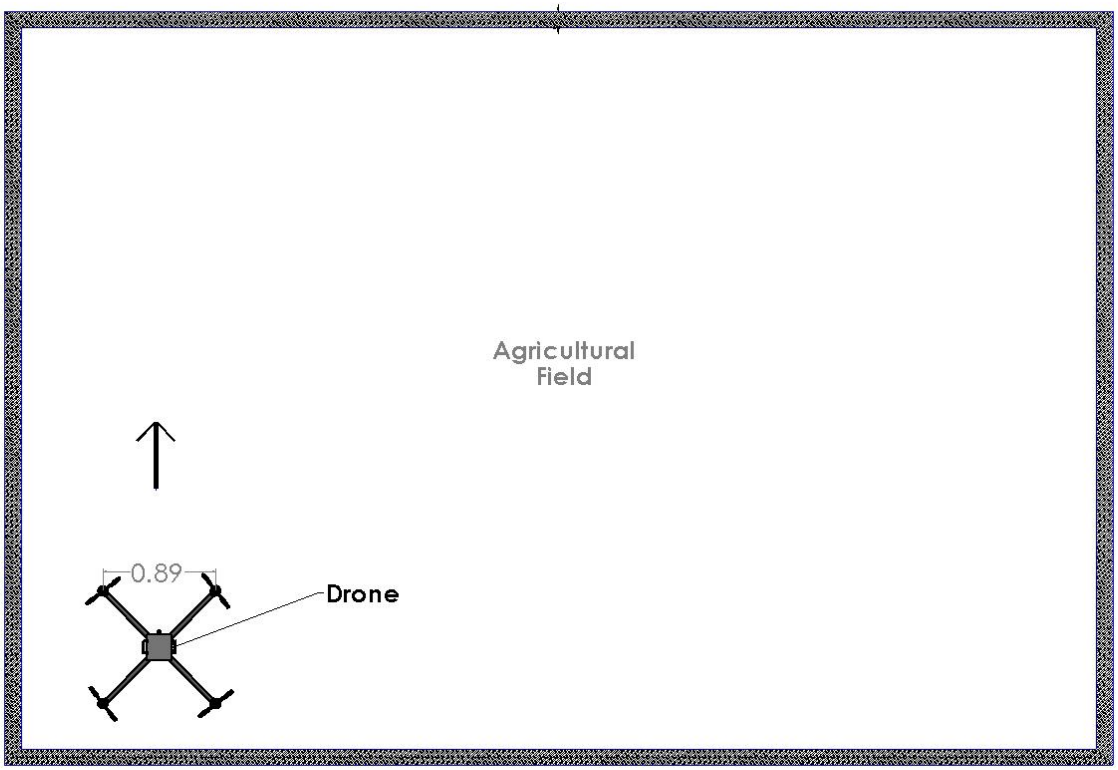

Figure 1 Drone in farm

1. Manual

On talking with farmers, we got to know that a farm of 1 acre takes about 12.3 hours to spray pesticide. Further we got to know that a laborer works for 8 hours a day and the average pay of a labor for a day is Rs 300/-. So, the cost per hour of a labor = Rs 300/8= Rs 37.5.

Hence the total cost of spraying per acre = Rs 12.3*37.5 = Rs 461

2. Drone

On researching we find out that the speed of agricultural drone for spraying varies from 6 m/s to 25 m/s. But the speed of 25 m/s is very large and it can cause improper spraying Hence a speed of 7 m/s is finalized.

Since the size of drone is 1m*1m. Hence with a speed of 7 m/s it can cover 7 m^2 area in one second.

So for spraying 1 acre (4046.86 m^2), it requires = 4046.86 / (7*60*60) hrs = .16 hrs.

Assuming the drone rents Rs 1000 for one hour. Total cost spraying by drone per acre = Rs 160/-

Table 1 Manual Vs Drone

	Manual	drone
Size of field (in acre)	1	1
Time required (in hrs)	12.3	.16
Cost per hour (is rs)	300/8=37.5	1000
Total cost (in Rs)	461	160

The increased efficiency is (12.3-.16)/12.3 * 100 = 98.69%.

The cost-saving per acre land on drone usage is 461-160=301 and the percentage saving is 301/461*100 = 65.2%

3.2 TYPE OF UAV:

i. WHY DO WE SELECT 4 ROTORS?

- After estimating the weight, we decided "Not to use Wing included aircrafts" because both wing and stabilizers increase unnecessary weight, leading to lesser battery life.
- Bicopters are unstable in the Longitudinal direction i.e. in the direction of the fuselage, based on this, solve this by opting for a swashplate mechanism as the control of rotors but it would complex the system. Bicopter UAVs task performance is also quite lower than that of Quadcopters and Hexacopters so we rejected the Bicopter.
- Quadcopters are mostly used UAVs, they have better "Controllability, Power Efficiency, Manoeuvrability, Ease of Payload packaging". So, we selected 4 rotors, as we increase the number of rotors the stability gets increased but at the same time manoeuvrability decreases. In our project, we need More manoeuvrability.

ii. AERO VS NON-AERO:

We thought of 2 main ideas regarding Solar drones. One was to make our drone in an aerodynamic shape and fit the solar panel on the wing and the other one was to make our drone simpler and lighter and fit the solar panel on the top.
For shortlisting One from these two types we have gone through the following advantages and disadvantages and accordingly, we have shortlisted the one which is convenient to us.

AERODYNAMIC SHAPE:

Advantages:

- Extra lift is produced by the wing.
- Less Drag.
- More surface area available forfeiting the panel

Disadvantages:

- As mentioned in Advantages, that extra lift will be produced by the wing but it is at a higher speed but in our case, the drone won't fly at higher speeds.
- To make a wing-like structure we have to make a tail to overcome the pitch down moment at Positive AOA. otherwise, we have to control it with our rotors which may be tough for Farmers and require more practice.
- The transition phase of the rotor from vertical to horizontal axis is more difficult because during this process, the net thrust vector will come, and our drone may get unstable. Proper coding and proper controls are required.
- Heavyweight, so we need to produce more downward force to lift u, resulting in more power consumption.

So, according to the above advantages and disadvantages we can see for our application a simpler drone with low weight is more convenient.

3.3 CALCULATIONS:

1. WEIGHT ESTIMATION INCLUDING PAYLOAD:

Table 2 Weight estimation

Component	max value of weight (in kg)	min value of weight (in kg)
Rod+Electronics	6	4
10 litres Pesticides	10	10
Stand	0.6	1.5
Others (Pump, Nozzle, Solar panel, etc)	1	1
Total	17.6	16.5

2. THRUST CALCULATION:

- Thrust @ 6S with 1045 propeller: 2000 gms approx. [12]
- Thus Thrust @ 6S with 2472 propeller:

As thrust due to propeller is depends upon its (blade tip radius)2,
Thrust @ 6S with 1045 propeller Thrust @ 6S with 2472 propeller
= (blade tip radius of 1045)2(blade tip radius of 2472)2
2000/ Thrust @ 6S with 2472 propeller =0.05 0.3
Thrust @ 6S with 2472 propeller = 11904.76 gms= 11.9 kg

- Thrust due to one motor is 11.9 kg.
- ∴ Thrust due to all the rotors are = 11.9 * 4=47.62 kg
- Our weight = 17.6kg
  Thrust to weight ratio = 47.62/17.6 = 2.7 :1

3. BATTERY DRAINAGE TIME CALCULATION:

Table 3 Current required by components

Component	Current required
Motor	140
Receiver	0.1
ESC	0.8
Flight Controller	0.1
camera	0.32
transmitter	0.31
Pump	6
Total	147.63

Current from battery = 20000 mAh = 20Ah

Total current consumption of all components = 147.63 A

Battery endurance = current output from battery/ Total current

Consumption of all components= 20/147.63 = 0.135 hr = 8.13 minutes

3.4 PUMP & NOZZLE SELECTION:

To pressurize a liquid a 12 V DC water pump is can be used which has 3.5 L/min capacity. Then pressurized liquid enters into the nozzle and then sprayed. A nozzle which is used is flat fan type spraying liquid. All the four nozzles are connected with ducts.

Figure 2 Nozzle

A pump (control volume or cv) is a steady-flow device that is used to increase the pressure of the fluid. So here we are using a pump to increase the pressure energy of the pesticides and send them to the nozzle whose datum head difference is 10 cm.

Here we are going to use a steady-flow energy equation,

There is no temperature difference between the surroundings and pump thus heat flow rate and enthalpy transfer rate are zero so the equation becomes,

$\dot{W}_{cv}=\dot{m}*\{(C_o^2)/2 + g*0.1\}$

$\int_{p1}^{p2} v * dp = \dot{m} * \{4 * 4/2 + 10 * 0.1\}$

$V*(p2-p1) = \dot{m}*(8+1)$

$0.05*(137800-100000)/60= \dot{m}*9$

$\dot{m}= 3.5$ litre/min

Here, $W_{cv}/60$ = power required for the pump. (divided by 60 to calculate per minute.)

Volume inside the pump (V)= 50 ml = $5 * 10^{-5}$ m^3 = 0.05 litre.

C_o = velocity at outlet of pump = 4 m/s.

C_i = velocity at the inlet of the pump = 0 m/s.

g = Acceleration due to gravity which is taken as 10 m/s^2.

Figure 3 Pump

3.5 SOLAR PANEL SELECTION:

There are many criterions which determine the selection of solar panel. The first criterion is the selection of material of the solar panel. There are mainly two types of solar panel:

a) Monocrystalline Solar Panel
b) Polycrystalline solar panels

The monocrystalline solar panel has a higher efficiency of about 15-19%. Hence, we selected monocrystalline solar panel. Hence the efficiency of selected solar panel is 19%.

Another important factor is the size constrains. Since solar panels are planned to be placed between the propellors. Hence a square panel of area of .81 m2 is chosen. The other parameter is the required power. The required power is calculated based on the power required by the BLDC motors to uplift the weight and the power required be the pump to spray the liquid. Based on calculations the required power comes out to be 0.6 kW-h.

If the amount of solar radiation falling on this panel is 1000W/m2.

So the power produced by the panel= 1000*.19*.81= 153.9W.

Now the cost of the panel is found out and it comes about Rs 50000/- which is feasible money for the project. Hence this solar panel is finalized.

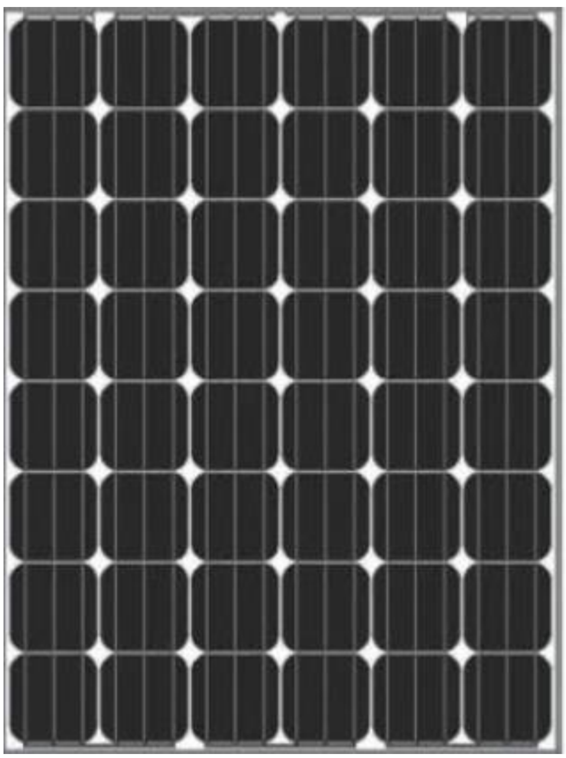

Figure 4 Monocrystalline Solar Panel

3.6 SPRAYING SYSTEM:

Generally, the sprinkling system is attached to the lower region of the UAV which has a nozzle beneath the pesticide tank to sprinkle the pesticide downstream. The sprinkling system has two modules, one is the sprinkling system itself and the second one is the Controller. The sprinkling system contains the spraying content (pesticides or fertilizers) and a nozzle for spraying. Second one is the controller used to activate the nozzle of the sprayer. A pressure pump is a component of the sprinkler system which pressurizes the pesticide to flow through the nozzle. A motor driver integrated circuit is used to pressure the pump as per the requirement. Analysis of different spraying speeds and nozzles used in UAVs for spraying are shown in Table.

Reference	Sprinkling Speed	Nozzle Type
[4]	Depends on immersable pump	-
[5][17]	Depends on Communication between UAV and WSN	-
[7]	1.15 ha/h	Flat fan
[8]	4.45 m/sec	-
[9][10]	0.4 ha/min (1 acre/min), 2.2 m/s	Micron air ULV–A+
[15]	47 l/ha	Flat fan
[16]	1 l/min	Universal
[18]	0.6-1 l/min	Centrifugal
[27]	13.61 g/30s	Micron air –A+
[37]	0.2 MPa (Pressure)	Flat fan
[40]	0.3 MPa (Pressure)	Fan-shaped (electrostatic)
[41]	0.3-0.8 l/m	Flat-fan, Centrifugal and cone
[42]	1.25 l/min	conical
[43]	850 ml/min	Electric centrifugal
[47]	850 ml/min	Rotary atomizer
[48]	0.2–1.0 MPa (pressure)	Flat fan

Figure 5 Analysis of different spraying systems

3.7 ELECTRONICS:

1. FLIGHT CONTROLLER:

KK 2.1.5. {ADRAXX} [MULTI ROTOR]

The flight controller helps in the maneuvering operations and also it provides Auto level function. The accelerometer and gyroscope sensors in the Flight controller processes the signals from the receiver and gives the output to the ESC. The KK 2.1.5 Flight controller board can be used in the drone as it has inbuilt firmware. The features of this Flight controller board are much easier for calibration. It uses ATMEL Mega 644PA 8-bit AVR RISC-based microcontroller with 64K of memory.

Figure 6 Flight controller

2. BATTERY

The battery that can be used is a Li-Po battery of 10000mAh capacity and 22.2 V. In this battery six Li-Po cells are connected in series (6x3.7=22.2V). (2 in quantity)

Figure 7 Battery

3. FPV CAMERA AND TRANSMITTER

The camera that can be used is HD FPV camera CMOS 1500TVL Camera (FPV) Lens, auto/color/ black & white Day and night format.TS5828 32CH mini transmitter can be connected to the camera for transmission of video signals to receiver at ground.

Figure 8 FPV camera

Figure 9 Transmitter

4. RADIO TRANSMITTER AND RECEIVER

The Transmitter and receiver used are Fly Sky CT6B 2.4Ghz 6CH and FS-R6B respectively. This combination provides a range of about 1000 meters. This Transmitter and receiver provide up to 6 channel options.

Figure 10 Transmitter

Figure 11 Receiver

5. MOTOR & PROPELLER:

Robodo A2212/13 Kv1400 Brushless Motor BLDC Hex Rotor Multi-Copter and RC Aircraft. (4 No)

Robodo provides A2212/13 kv1400 brushless motor BLDC hex rotor multi-copter and RC aircraft. It provides the required thrust for airlifting to the quadcopter.

Figure 12 BLDC motor

The propeller is of 24 inches length and has 7.2 inches pitch. It is made up of carbon fiber which possesses high strength to weight ratio when compared to the propellers made up of plastics.

Figure 13 Propeller

6. ESC

Electronic Speed Controller is used to vary the Revolution Per Minute (RPM) of the motor. Techleads provides 30A brushless motor speed controllers (ESC). (4 no)

Figure 14 ESC

7. CONNECTION DIAGRAM:

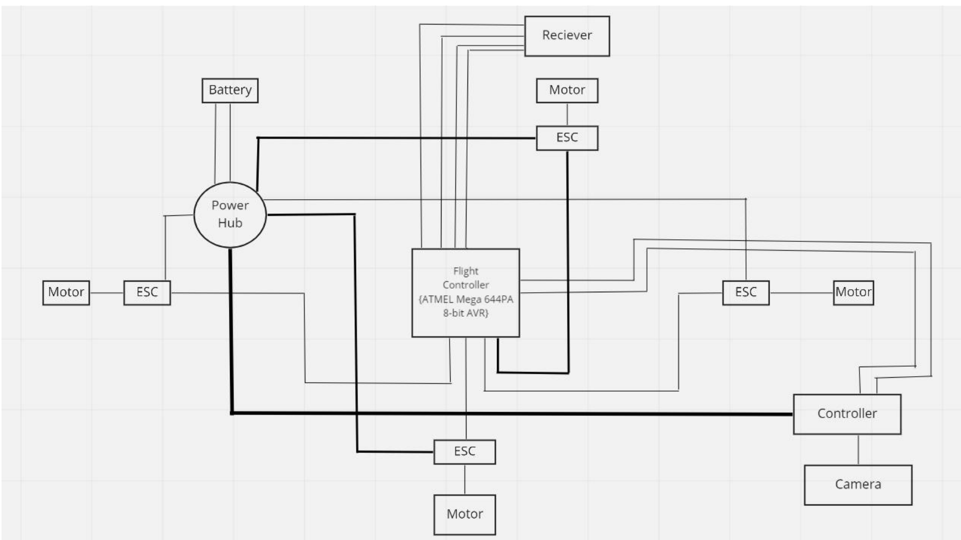

Figure 15 Circuit diagram

3.8 CAD DESIGN:

To design a CAD model, first of all we have decided various components that need to be to be designed. The various components must be selected or designed in such a way that they are feasible while manufacturing. After selecting the parts, a proper mechanism is developed so that the various components can be assembled easily. After that the lengths of various components are decided. Some of the lengths are decided based on the electronics we need to place while others are assumed according to other dimensions and the research. After those various parts are made and then assembled.

Figure 16 Top view

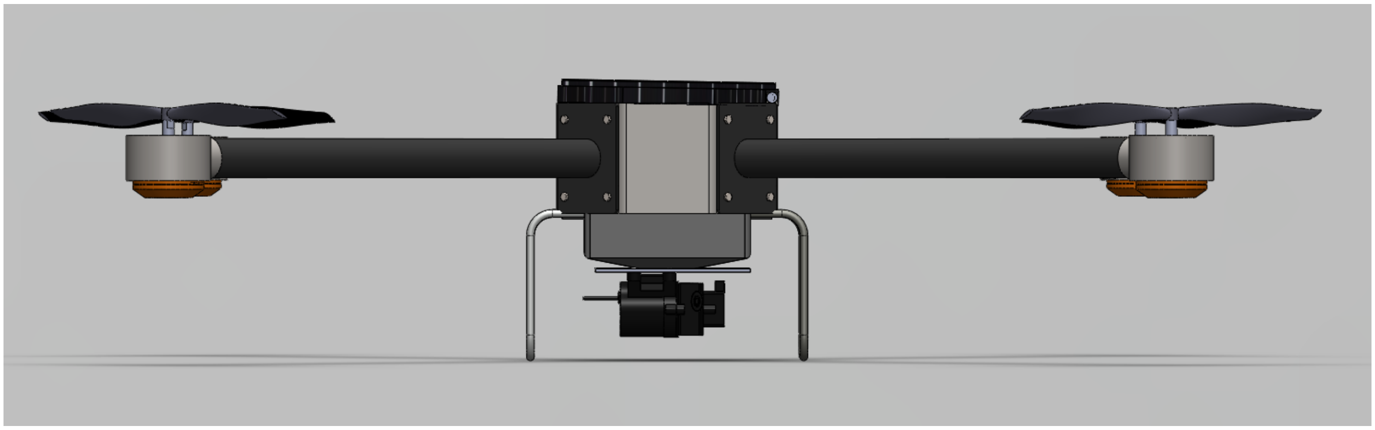

Figure 17 Side view

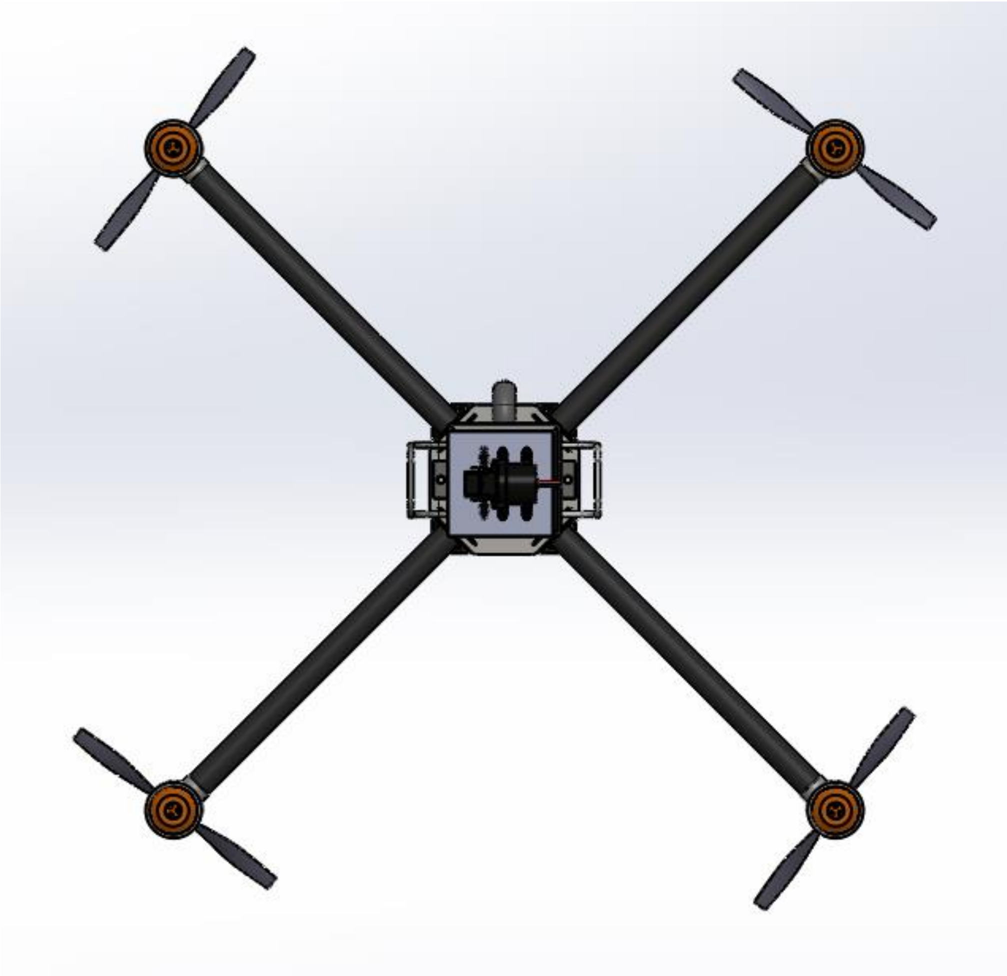

Figure 18 Bottom View

Figure 19 Isometric view

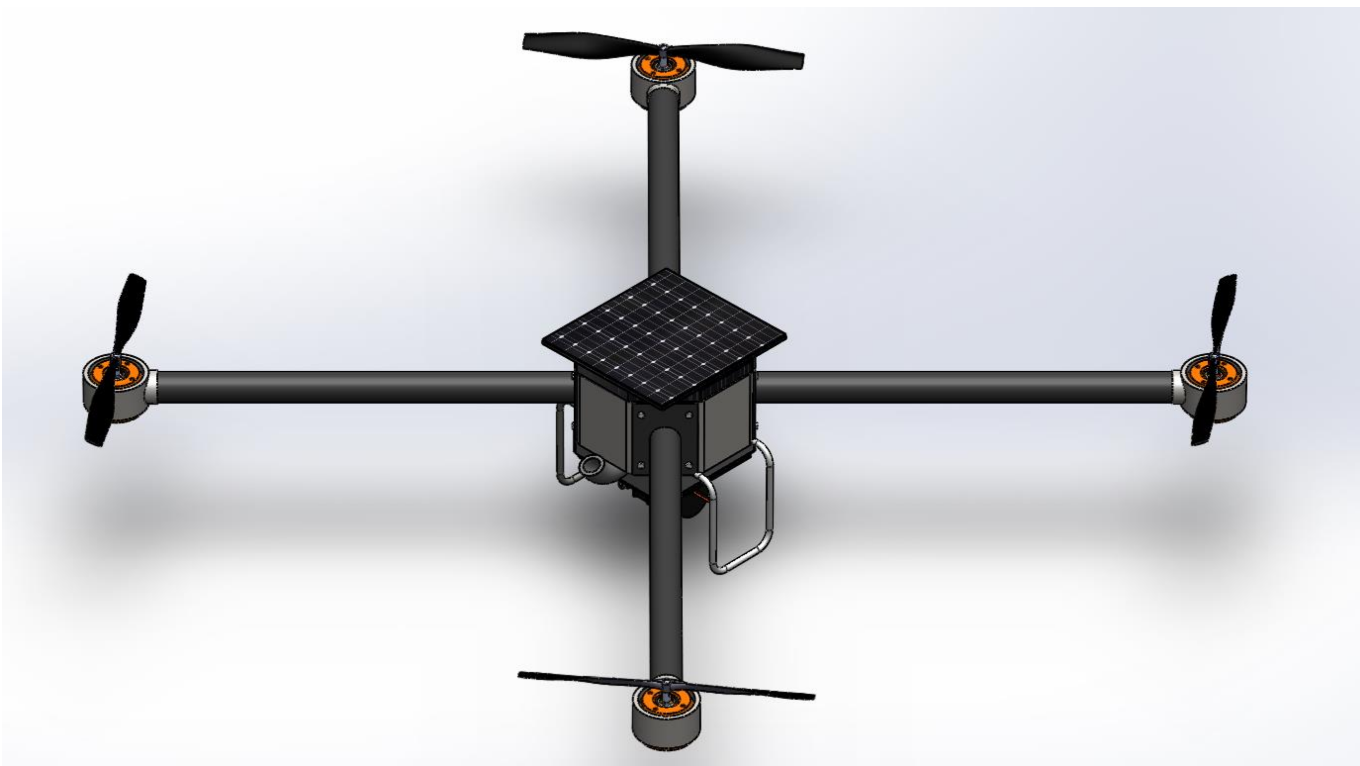

Figure 20 Isometric view

4. PROPOSAL: Rural Development Proposal

Rural Development in India is one of the most important factors for the growth of the Indian economy. India is primarily an agriculture-based country. Agriculture contributes nearly one-fifth of the gross domestic product in India. To increase the growth of agriculture, the Government has planned several programs about Rural Development in India. The Ministry of Rural Development in India is the apex body for formulating policies, regulations, and acts about the development of the rural sector. Agriculture, handicrafts, fisheries, poultry, and dairy are the primary contributors to the rural business and economy. Rural development in India has witnessed several changes over the years in its emphasis, approaches, strategies, and programs. It has assumed a new dimension and perspective as a consequence. Rural development can be richer and more meaningful only through the participation of clienteles of development. Just as implementation is the touchstone for planning, people's participation is the centerpiece in rural development. People's participation is one of the foremost prerequisites of the development process both from procedural and philosophical perspectives. For the development planners and administrators, it is important to solicit the participation of different groups of rural people, to make the plans participatory. The basic objectives of Rural Development Programmes have been alleviation of poverty and unemployment through the creation of basic social and economic infrastructure, provision of training to rural unemployed youth, and employing original farmers and laborers to discourage seasonal and permanent migration to urban areas.

4.1 INNOVATIVE IDEA:

Of late, rural development has assumed global attention, especially among the developing nations. It has great significance for a country like India where the majority of the population, around 65% of the people, live in rural areas. The present strategy of rural development in India mainly focuses on poverty alleviation, better livelihood opportunities, provision of basic amenities, and infrastructure facilities through innovative programs of wage and self-employment.

So, our motive is to design a drone that can be remotely controlled aircraft, fully solar-powered, used for spraying pesticides, fertilizers & disinfectants for agricultural purposes. Since using solar cells is the only source of power, and if in one of the flying phases, the produced power by the solar cells is lower than the power consumption of the aircraft, the fly will lead to a crash. So, in the design of a solar-powered aircraft, knowing the quantity of power consumption of the aircraft and the power produced by the solar cells is a significant matter. The main parts of a quadcopter: the frame connects all of the other components, it's shaped in either an **x** or a **+** shape and need to be strong, but also lightweight; rotors (coreless or brushless DC motors) that can provide the necessary thrust to propel the craft; an electronic speed controller to control separately each rotor by specific needs; IMU sensors to measure the attitudes of the vehicles; microcontroller - "the brain" of the quadcopter - an on-board processor that collects data, implement control algorithms, drive actuators and communicate with ground stations; propeller; battery is the power source for the whole quadcopter; radio control transmitter; optional-GPS, sensors, camera vision subsystem. Along with that, a pesticide tank is fitted below the frame along with a compressor pump to increase the pressure of water and send it to the nozzle which is fitted under all the motors, and after that, the nozzle starts spraying them over the vast paddy fields.

The selection of material is a crucial selection of the configuration of arms. The material plays a significant role in determining the drone's stability and efficient performance. The material for the arms was chosen as carbon fiber due to its properties like lightweight and high-strength-to-weight ratio. However, the radio and antenna were connected properly to stop the radio signal interference by carbon fibers. The material for the base plan was selected as Carbon/Kevlar composite due to its properties like high tensile strength, no shrinkage, and embrittlement at extreme temperature, scratch, and electrical resistance.

FUTURE SCOPES:

- Under the current COVID19 Pandemic situation, it can be used to sanitize large hotspots areas without actually going there in person.
- Manual control can be changed in autonomous control with GPS technology and the auto-return home option.
- With image processing techniques, the drone can be involved in surveillance to determine the pest attack on the plants, condition of ripening fruit.

4.2 IN LINE OF GOV. SCHEME/GUIDELINES:

The Ministry of Science and Technology plays a pivotal role in the promotion of science & technology in the country. The department has wide-ranging activities ranging from promoting high-end basic research and development of cutting-edge technologies on one hand to serving the technological requirements of the common man through the development of appropriate skills and technologies on the other.

Appropriate rural technology focuses mainly on those technologies which are simple and within the reach of the ordinary people for their benefit and the benefit of their community and harness the local or regional capacity to meet local needs without increasing dependence on external factors. A large number of governments, public and private non-government organizations are involved in developing technologies for rural areas.

However, these technologies have hardly touched the lives of the rural population. The problem lies not only in the generation, diffusion, and adoption of technologies but also in poor documentation. Recently, efforts have been made by several organizations like NRDC, CAPART, TRCS, NIRD, DST, DBT, CSIR, ICAR, KVKs, and other voluntary organizations, etc. to bring out a compendium of technologies for rural areas for wide information dissemination and public awareness. A brief account of technologies that are low cost, energy-efficient, and environment-friendly as well as appropriate and sustainable for application in rural areas.[6]

4.3 IMPLEMENTATION STAGES FOR EACH YEAR:

UAVs in precision agriculture are still in their early stage and may have scope for further development in both technology and agriculture applications. As we have our CAD design and data ready, we can break its implementation in several stages:

Manufacturing: In this pandemic time probably, it will be the most difficult task. The manufacturing thing can be further divided into two stages:

Proof of concept: According to availability of materials it can take 2-3 months of time.As we have to perform several flight tests and analysis.

Main Model: After successfully completing our proof of concept the next important step is the Main model. This may take 3-4 months of time for the first model.

Marketing and awareness: After completion of our manufacturing process the next step is to make people aware about our concept and to make them understand the benefits of this project.

After that we will have to arrange some workshops and short training sessions to train them how to fly drones.

Once these all things done then we can go for mass production of our main model.

5. OBSERVATIONS/FINDINGS/SUGGESTIONS

5.1 OBSERVATIONS:

- The design is feasible for manufacturing and implementation.
- The Idea of this project can save lots of time of farmer.
- The given drone is almost pollution free so we can save our environment indirectly.
- Drone is designed in such a way that it can carry sufficient payload for our purpose.

5.2 SUGGESTIONS:

- In Future, Machine learning algorithms can improve its efficiency and make it perfectly autonomous.
- By these kind of projects in agricultural side we can move towards Digital India.

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