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Spraying Pesticides on Weed through Drones

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ABSTRACT: Now-a-days population is increasing day by day and the world needs more food with good quality. The quality of food is gradually lowering due to increase of weeds and scarcity of water. The evaluation and assessment of noxious weed structures among native species of plants are typically performed by walking. So, removing the weeds will be tough by humans. So, by using drones we can detect weeds and we can remove the weed by spraying pesticides on them. There are so many techniques or methods to remove the weeds. We introduce a new technique that automatically identifies the weed. In this paper we briefly explained the working of drones and removing of weeds by spraying pesticides. The drone will use conventional energy i.e. by using Nano solar cells in solar panels. The energy from the solar panels is stored in the Lithium Polymer battery. Brushless D.C. motors are used so that it will consume less power and rotate with high speed. The drone will automatically detect and control every process by using microcontrollers and electronic speed controllers. There will be three stages or steps to remove weeds, i.e. color segmentation followed by edge detection and filtering.

KEYWORDS: Solar Panels, Brushless motors, Micro controller, Color segmentation, Edge detection, filtering.

I. INTRODUCTION

This report presents the research and development work towards detecting invasive weed species from unmanned aerial vehicle (UAV) imagery and satellite data and how this technology can be applied to a practical weed management program to provide positive outcomes. The combination of high (spatial and temporal) resolution UAV- or satellite-based aerial imagery and automated weed detection software operating at this scale complements more traditional weed surveillance and weed management tools such as ground surveys. The ability to collect data at high spatial resolutions means that characteristics that differentiate weed species from native species are more apparent, thus improving detection rates and accuracies. Achieving a high temporal resolution means that surveys can be conducted more regularly, which may be important in fast-moving outbreaks? We targeted in detecting weeds among crops like maize, paddy other regional crops. We are using microcontroller "ATMEGA328". The materials we used for constructing drone is aluminum as it can be bent easily and more flexible. We are using double propeller system for each wing. There are a number of challenges in the practical use of UAV-based imagery as weed surveillance and management tools. While advances in the use of UAVs in agricultural and ecological management applications have allowed end-users to acquire large amounts of data, the analysis of this data can be a time-consuming and error-prone exercise. To address this issue, we apply an automated classification algorithm that can be trained to detect different weed species. Once trained by expert users, this classification algorithm can be applied to large sets of aerial imagery and operate autonomously. Further, today's UAVs are limited in their endurance and thus the area that can be practically surveyed is also limited. To address this limitation, we demonstrate that UAV-based weed detections can be used to bootstrap the use of satellite imagery to detect the same weed species on a far larger scale.

II. WEED

A weed is a plant considered undesirable. Weeds have no botanical classification since a plant that is a weed in one reference is not a weed when growing where it is wanted. It is applied to any plant that grows or reproduces aggressively or is outside its native habitat. The term is occasionally used to broadly describe species outside the plant kingdom that can live in diverse environments and reproduce quickly. These have seeds that persist in the soil seed bank for many years. They compete with the desired plants for the resources that a plant typically needs, namely, direct

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sunlight, soil nutrients, water, and (to a lesser extent) space for growth. Weed classification is a serious issue in the agricultural research. Weed classification is a necessity in identifying weed species for control.

III. WORKING OF DRONE

Basically a Quad copter is a quad rotor helicopter that is lifted and propelled by four rotors. Unlike helicopters they use symmetrically pitched blades. Control of vehicle motion is achieved by altering the pitch and/or rotation rate of one or more rotor discs, thereby changing its torque load and thrust/lift characteristics. Check the image below for the principle behind the quad's motion.

As you can see, the motors 1 and 4 rotate in CW direction while 3 and 2 rotate CCW thus creating a downward thrust which lifts the quad. By varying the speed of the 4 rotors various movements are possible. There are three important terms mentioned above namely the YAW, ROLL and PITCH which we must have a clear concept of before understanding the quad's movement.

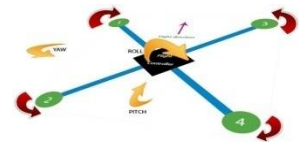


Figure 1

IV. BASIC COMPONENTS

IV.I Frame

This is the most basic and important part of the quad copter. You can mount your brushless motors, power cells and other electronic equipment on it easily. You can even create your own frame. Just make sure your frame is firm and stable. The most popular quad copter frame is the X4 where the arms are 90 degrees apart. Two of the motors turn clockwise while the other two turn anti clockwise. This is necessary for stable flight. If all the motors turns rotation in clockwise or anti clockwise, the quad copter will have a tendency to turn clockwise or anti clockwise.

IV.II Material

1. Aluminum is a fine material and is widely used. Aluminum is easy to fabricate and can often be bent back into shape after crashes. If you have machine shop access, it would be an obvious choice for you. A big drawback is that it blocks RF (as does carbon fiber). That means you have to exercise a bit of care in how you place antennas on your craft.

2. Another material you could consider is thin G-10 fiberglass sheet which is easily machinable. This is nice for the body area as it's RF transparent. It also makes nice motor mounts.

IV.III Propellers

The "tractor" propellers are the props at the front of the quad copter. These props pull the quad copter through the air like a tractor. While some drones like the DJI Phantom look more or less the same from any angle, there is a front and back. Most drone propellers are made of plastic and the better quality made of carbon fiber. You can also buy drone prop guards which you need especially if you are flying indoors or near people.

IV.IV Pusher Prop

The Pusher props are at the back and push the uav forward hence the name "Pusher props". These contra-rotating props exactly cancel out motor torques during stationary level flight. Opposite pitch gives downdraft. Again be made of plastic with the better pusher props made of carbon fiber. You can also purchase guards for the pusher props.

IV.V Brushless Motors

Practically all the latest drones use a brushless electric "out runner" type, which is more efficient, more reliable, and quieter than a brushed motor. Motor design is important. More efficient motors save battery life and give the owner more flying time which is what every pilot wants.



Figure 2

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IV.V.1 Motor Ratings

Brushless out runner motors are rated in KV per RPM which is usually specified as just KV. For racing and acrobatics a good starting point in motor selection is to consider motors that are rated over 1200kv and for heavy payloads motors that are rated under 1200kv (850kv is a nice starting oint for heavy payloads). For drones weighing more than 1kg use a motor in the range of 700-900kv, between 500gms-1kg use motors between 900-1300kv and for craft below 500gms motor around 1300-2200kv are used. Here in this we are using a motor with 850kv which is used for heavy payloads.

IV.VI Electronic Speed Controllers (Esc):-

Electronic Speed Controllers are an essential component of modern quad copters (and all multirotors) which offers high power, high frequency, high resolution 3-phase AC power to the motors in an extremely compact miniature package.

The latest ESC innovation was on the DJI Inspire 1 which uses new sinusoidal drive ESC which replaces the squarer wave drive of traditional ESCs. The Inspire 1 goes further by using closed loop torque control and distinct functional redundancy which adds extra efficiency and reliability to the motors.

IV.VII Battery

We use Lithium Polymer battery which is mostly used for drones. It has got really good specifications which are suitable for a drone.

IV.VII.1 Battery Notation

- Capacity per cell: 5000mAh
- Number of cells: 4
- Nominal Voltage: 14.8v

IV.VII.2 Cell Voltage

- Full Charge: 4.2 volts per cell
- Nominal: 3.7 volts per cell
- Discharged: 3.5 volts per cell
- Discharging a LiPo battery past this level will result in permanent damage.

IV.VIII Micro-Controllers

A microcontroller is a computer-on-a-chip, or, if you prefer, a single-chip computer. Micro suggests that the device is small, and controller tells you that the device might be used to control objects, processes, or events. "Primarily, the microcontroller is capable of storing andrunning a program (its most important feature). The microcontroller contains a CPU, RAM, ROM, I/O lines ,serial and parallel ports, timers, and sometimes other built-in peripherals such as A/D and D/A converters.We are using atmega328,atmega328/p microcontroller . It is shown in figure 3 and figure 4.

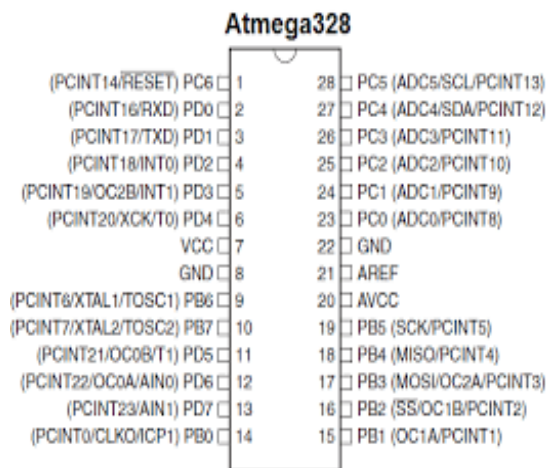


Figure 3

FEATURES	ATMEGA328
Pin count	28/32
Flash(bytes)	32K
SRAM(bytes)	2K
EEPROM(bytes)	1K
Interrupt vector size	1/1/2
General purpose I/O lines	23
SPI	2
TWI	1
USART	1
ADC	10-bit 15SPS
ADC channels	8
8-bit timer/counters	2
16-bit timer/counters	1

Figure 4

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IV.VIII.I Software Development For Microcontrollers

Programming a microcontroller normally involves the following steps:

- **Coding / debugging** in a high level language (such as C, or Java) or assembler. This is the most time consuming step. A compiler for a high level language helps to reduce production time. To program the microcontrollers the *ICCAVR PRO v6* Compiler from Image *craft* was used. Although inline assembly was possible, the programming was done strictly in the C language. The source code has been commented to facilitate any occasional future improvement and maintenance.

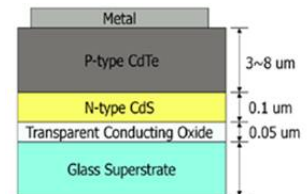


Figure 5

- **Compiling** the code into machine language. The machine language file (.hex) does not make any sense to the layman, (or even to an experienced programmer) when examined with a text editor. But it is the only thing the microcontroller will understand, because it contains the original program code converted into a hexadecimal format. During this step the programmer will be warned about eventual errors in the program. An interesting feature in the professional version of the *ICCAVR* program (in which the code was written) was the so-called Code-compressor option, which allowed more code to be packed into the program memory. When the program seems to be complete and free of errors the programmer can move to the next step.

- **Burning** the machine language (hex) file into the microcontroller's program memory. This is achieved with a dedicated programmer, which attaches to a PC's peripheral (such as a COM, or a parallel port). In this project the *STK500* programmer transferred the machine language file into the microcontroller's program memory. Part of this project involved debugging. The *AVR Studio v4.0* software besides of communicating with the programmer, it offered advanced debugging options. Despite this, debugging was not done with the traditional debugging software, but with a standard LCD to show variables of interest. Communications problems that arose between different integrated circuits (SPI communication), were resolved with a digital oscilloscope. The microcontrollers were reprogrammed in approximately two seconds with a high speed programming mode. The program memory which is of Flash type, has, just like the *EEPROM*, a limited lifespan. On the *AVR* microcontroller family it may be reprogrammed up to a thousand times without any risk of data corruption.

- **Evaluation** If the microcontroller performs all the required tasks and behaves as expected the software development phase is over. If not, the whole procedure will have to be repeated again. Most of the work with this project involved the above steps, repeated in a circular fashion, until evaluation of the unit revealed if the requirements were fulfilled. One of the difficulties of programming microcontrollers is the limited amount of resources the programmer has to deal with. In PCs resources such as RAM and processing speed are basically limitless when compared to microcontrollers. In contrast to a PC, the code on microcontrollers should be as low on resources as possible.

IV.X Nano Solar:-

1. Light passes to the middle semiconducting ink layer, which breaks up the electrons.
2. The molybdenum on the fourth layer acts as an electrode, and as the end of the circuit.
3. The second layer is a P/N junction, which conducts the electrons through to the top layer.
4. The top layer conducts the electrons and work as the beginning of the circuit.

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V. IMAGE PROCESSING

By using drone we are detecting waste plants in crops which will decrease the crop production. There are three stages to detect waste crops i.e weed.

V.V.I Color Segmentation

Color segmentation is the method used to separate the crop (which also include weed) from the background. The method helps in separating all the visually distinguishable colors from one another. Color Segmentation is shown in figure 6.



Figure 6

V.V.II. Edge Detection

In an image, an edge is a curve that follows a path of rapid change in image intensity. Edges are often associated with the boundaries of objects in a scene. Edge detection is used to identify the edges in an image. To detect edges properly we have to convert the color segmented image into the gray scale image. Edge detection is show in below figure 7.

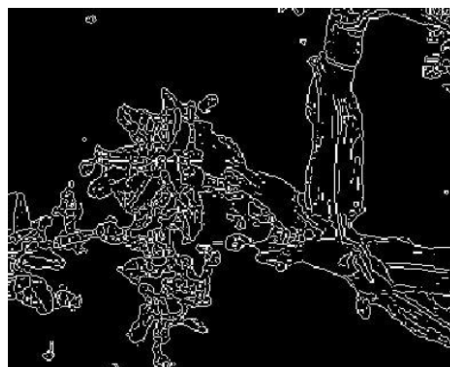


Figure 7

V.V.III. Filtering

The filter here is used for recognizing regions in which edges appear with a frequency in a specific range (weed frequency range). Here the image after the edge detection in above step as input. There is a trade-off between the block size and gained accuracy. If the block size is too large, frequency estimation can be faulty due to the existence of both crop and weed in the same block. If it is too small, the frequency cannot be calculated correctly because of an

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inadequate number of edges in a block. A small block may detect the inner part of the weed leaf as the crop because of less number of edges in it. It is shown in the below figure 8.

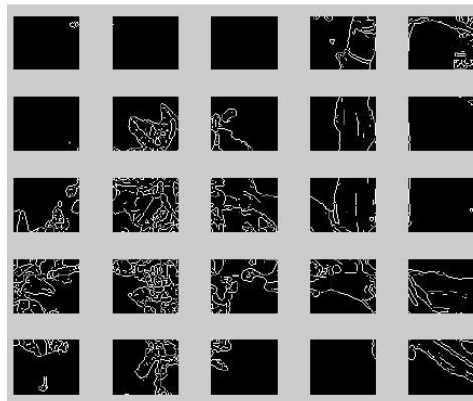


Figure 8

VI. SPRAYING PESTICIDES THROUGH NOZZLES

VI.I Sprayer Module

Sprayer module (Figure 4) has two sections, they are 1) Transmitter section (Remote controller), 2) Sprayer with controller. Transmitter section used to control the actuator of sprayer module. The nozzle of sprayer module will be activated by remote control. Whenever need to activate the sprayer, just comment by remote RF transmitter. Sprayer module contains two sections, spraying module and controller. Spraying module contains the spraying content i.e., pesticide or fertilizer and the controller section used to activate the nozzle of sprayer. The command is received from remote controller which is activated manually. Tank contains the chemical content which is going to spray on crops that may be a pesticide or fertilizer. The Nozzle of the sprayer module will be activated by GPS device. This GPS module having the preloaded GPS coordinated, Liquid Pump Motor with Tank. The spraying pump overflow rate is max, 1L/minutes. The maximum spraying height is 4 meters. Flying speed is max. of 5m/s. It covers 2m range of green fields with compatible land edge.

VI.II Coverage Rate

1) Minimum speed = 2m/s

Coverage of sprayer = 2m

Coverage

rate = $2 * 2 = 4 \text{ sqm/s} = 0.000988422 \text{ acre/s}$

CR per hour = $CR * 3600s$

= $0.000988422 * 3600 = 3.5 \text{ acre/hr}$

2) Maximum speed = 4m/s

Coverage of sprayer = 2m

Coverage

rate = $4 * 2 = 8 \text{ sqm/s} = 0.001976843 \text{ acre/s}$

CR per hour = $CR * 3600s$

= $0.001976843 * 3600 = 7 \text{ acre/hr}$.

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VII. CONCLUSION

In this system, we have developed a Drone. That drone automatically detects unwanted plants i.e weeds and spray pesticides on weed through nozzles. We can detect and separate out weed affected area from the crop plants. The reason for developing such system is to identify and reuse weed affected area for more seeding. This specific area can be considered for further weed control operations, resulting in more production.

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