IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

Volume 10, Issue 6, June 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.282

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.282|

|| Volume 10, Issue 6, June 2021 ||

| DOI:10.15662/IJAREEIE.2021.1006010 |

Multi Purpose Unmanned Aerial Vehicle

Neena Mani[1], Aswanth K K[2], Basil Mathew[3], Bilal Kassim[4], Ruksana Muhammed[5]

Associate Professor, Dept. of EEE, M A College of Engineering, Kerala, India[1]

UG Student, Dept. of EEE, M A College of Engineering, Kerala, India[2345]

ABSTRACT: Drones are commonly known as one type of unmanned aerial vehicles (UAV). It is also known as a flying robot as they can be operated without being piloted by an on-board person. Through software controlled in conjunction with GPS, drones can be remotely controlled or can fly autonomously. Drones have most often been associated with the military. But they are also used for other outdoor applications such as search and rescue, surveillance and traffic monitoring. There are also many indoor applications for drones such as material transfers, remote inspection.

The system represents a cost effective multi-purpose drone equipped with multiple functionalities including, dropping mechanism,on-board sensor enabled spraying mechanism, live video surveillance using GPS and video recording capability. The paper presents a working model and the system has been tested on a few parameters including cost effectiveness, efficiency, flight time, payload, video surveillance etc. The multi-copter is a combination of many systems which makes work easy.

KEYWORDS: Multi-purpose drone, Sprayer System, Dropping System, Security Purpose.

I.INTRODUCTION

In the past few years the interest in unmanned aerial vehicles (UAV) has increased considerably. They are increasingly being used for surveillance, search and rescue (SAR) to a limited extent. UAVs have the advantage of not having the operator on board which makes them more expandable. This allows them to operate in extreme and dangerous environments with no risk to the operator. UAVs are agile, fast and can possess an autonomous behaviour and hence perform operations hard to execute by human operators, at low operating costs. But due to its limited range, cost of sensors required for safe flight and the requirements of skilled operators to fly the drones. Thus a system with navigation, painting on walls, dropping of food packets during floods and other disasters, can be combined to improve the range of application of UAVs.

Among all kinds of UAVs, quad-copters are more stable and easier to control. For example, it is easier to maintain a hovering position with a quad-copter than with a helicopter or airplane. We selected quad-copter as a platform to design and implement an autonomous flight control system.

This sensor equipment is heavy and usually need complex algorithms, which require high computational and processing power, for signal processing. To achieve an autonomous drone with less complex sensors and low computational and processing power for adaptive obstacle avoidance in real-world environments, a drone development and its adaptive obstacle avoidance control is required. It uses only four small and light-weight IR sensors to detect obstacles and enable the drone to autonomously avoid them.

A GPS guided drone could deliver packages to destinations drastically lowering delivery time and cost. Customer verification will enhance the security of product delivery. If the consumer is not at the location, it will not deliver a parcel to another person. Only the person who provides verification would get the product.

With the market for drones growing rapidly there is a need for autonomous drones. An important challenge for the drone is to autonomously and adaptively avoid obstacles in the environment. Some rely on computer vision and algorithms to identify objects. This provides the distance to the object such that the drone can move to ensure a safe flight trajectory. Despite this approach working well in a simple environment, it does not perform well in surroundings with complex structures or cramped indoor spaces. Once the map has been obtained, a path can be planned for the drone.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.282|

|| Volume 10, Issue 6, June 2021 ||

| DOI:10.15662/IJAREEIE.2021.1006010 |

II.SYSTEM COMPONENTS AND PRINCIPLES

For the quad-copter, brushless dc motors with permanent magnet rotor and wire wound stator poles are used. A rotating magnetic field is induced in the wound stator poles, and the attractive forces between the rotating magnetic field and the permanent magnet rotor convert electrical energy into mechanical energy. BLDC Motors generally have a three phase winding topology with star connection. An X-model configured quad copter has four propellers attached to the rotors, which are located at the cross frame. The speed at which the four motors rotate, are independent of each other. Each motor produces a torque and a thrust about its centre of rotation. If all the motors are spinning with the same angular velocity, one pair of opposite motors rotates in a clockwise direction and the other pair of motors rotating in an anticlockwise direction, the net aerodynamic torque, and then the net angular acceleration about the yaw axis will be zero. And the quad copter will be in a stable position.

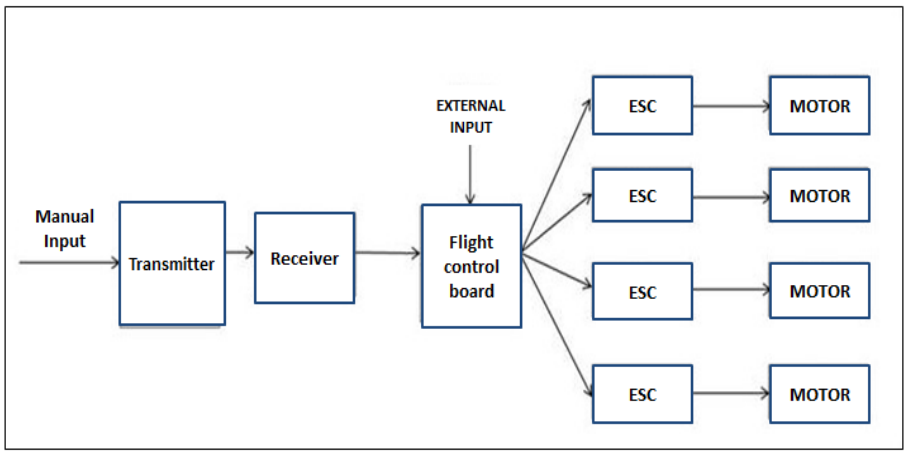


Fig 1: Block Diagram of Quad copter

From the controller of the system, the manual inputs are given according to the movement required by the person. The inputs are encoded to signals in radio frequency range, and transmitted with the help of an antenna on the transmitter. The transmitted signal, with a frequency of 2.4 GHz, is received by a receiver antenna through a band pass filter. These received signals are then decoded and then converted to PWM signals, and are sent to a pre-programmed flight controller circuit. The transmitter and receiver have a 6 channelled operation. The vital part of the whole system is the flight controller, which controls the direction of motion. The flight controller sends a PWM signal to the ESC, which controls the speed of the motor.

Frame, propeller, controller, motor, camera and batteries constitute the hardware of the system. A BLDC motor is used as the motor and the controller used for the system mainly consists of speed controlling. The frame houses all the components in the system. Weight, size and materials are taken into consideration while selecting the right frame for the drone. For a clean and easy build, the frame should be strong, light and should have a sensible configuration including a built-in power distribution board (PDB). There are plenty of spare parts available on the market, most of which are 100% compatible and interchangeable. In terms of flight attributes and aesthetics, manufactured frames are preferred over the ones that are built at home.

The propeller used in the system has a specification of 10*4.5. The number 10 in the specification denotes the length whereas the number 4.5 refers to the propeller pitch. We are using a DC motor with a voltage rating of 1000kv, and hence we use propellers of about 10inch length. For smaller values of propeller pitch, the thrust will be high, but acceleration may reduce.

The propellers are responsible for the thrust which counteracts the gravity and drag. Motors are used to turn the propellers, and each rotor should be controlled separately by a speed controller. The BLDC motors have 3 coils inside which are settled to the mountain. On the outside, it contains a number of magnets, which are responsible for turning the shaft. We use a GrabeM, 1000KVA BLDC Motor (Width*height is given as 76mm*33mm). A BLDC motor is a synchronous motor powered by DC electricity through an inverter or switching power supply. This produces an AC

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.282|

|| Volume 10, Issue 6, June 2021 ||

| DOI:10.15662/IJAREEIE.2021.1006010 |

electric currentwhich drives each phase of the motor through a closed loop controller. The speed and torque of the motor is controlled by the current pulses which are provided by the controller.

The Aurduo-pilot APM 2.8 flight controller is used in this system. It consists of a 3-axis gyro, accelerometer, along with a high performance barometer. For automatic data logging, an on board 4 megabyte data flash chip is used. Off board GPS, auBlox LEA-6H module with compass is an optional addition. The controller is manufactured with glass fibre material for anti-vibration or shock absorber set. The maximum output voltage is 16 V.

The duty of the electronic speed (ESC) controller is to tell the motor, at which rate it should spin. Different rotors rotate at different speeds. Hence an ESC should be associated with each motor. Batteries are connected to the ESC through PDB. Most ESC's have a battery elimination circuit which will also act as a voltage regulator, and allows flight controllers and other components to power up without connecting them directly to the battery. This provides control for the system. For our system, REES52 Esc 30a brushless motor speed controller is used.

For the controlling of multi rotor drones Lithium polymer batteries are the most famous. The nominal output of the battery is 3.7V/cell. Hence we use 3 batteries to obtain a minute output of almost 11V. Our drone system requires a power of 1800MAh. This particular battery will provide a flight time of 5 to 8 minutes for the drone.

III. FEATURES OF QUAD-COPTER

In the quad copter, a sprayer control system is added for the various applications like painting the wall, spraying chemicals during high humidity, fire extinguisher at high temperature, etc. Different types of sensors are mounted on the system (humidity sensor, temperature sensor, etc.) which continuously monitors the corresponding values from the surroundings. The inputs from the sensors are given to a system connected over a NodeMCU. The NodeMCU is programmed in such a way that, if the readings from the sensors are beyond the pre-set value, then the system performs its operation as per the rules. If the sprayer system is used for the purpose of painting, then an additional switch is given for the manual operation.

The sprayer circuit has three inputs, such as inputs from the switches and inputs from the DTH11 temperature bar humidity sensor. The temperature bar humidity sensor continuously monitors the temperature and humidity of the surroundings and sends the signal to the microcontroller. The microcontroller is programmed in such a way that if any of the parameters rise above a certain degree then a signal is given as an output to the NPN transistor through the diodes. The NPN transistor acts as a switch and it forms the connection by which the fire extinguisher operates. The sprayer motor operates at 12V, and when the connection is made the motor sprays the liquid depending upon the application. The Node MCU can be connected and monitored through a mobile application called BLYNK. The connection is made through Wi-Fi, and the operation can be done either manually or automatically. Pre-set values for the temperature and humidity are 70g/m^3 and 30° respectively. If the drone is used for anti-fogging purposes then anti-fogging agents are sprayed. If the drone is used for fire extinguishing purposes then water is sprayed.

During a disaster, supplying food, medicine, and clothes in different areas is necessary. A quad copter with a dropping system can be put into use, in such necessary times. Our system can carry a load up to 500 grams. The object that needs to be dropped is attached to the system after being packed and sealed securely, in order to dispatch to the desired location. The operation can be either done based on GPS control or manual control. The location at which the package needs to be dispatched is sent as an SMS to the controller, and based on the information given the drone moves. When the desired area has reached, the area is monitored through the surveillance camera. If the area is found suitable for dispatch, then the package is dropped from the system. The operation of dropping is controlled by the NodeMCU.

IV. RESULT AND DISCUSSION

Matlab and Simulink software is used for the simulation of the motor. Mosfet and the gate circuits of ESC control the operations of the motors. By using the scope component in the Simulink, the output waveforms based on the input is obtained.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.282|

|| Volume 10, Issue 6, June 2021 ||

| DOI:10.15662/IJAREEIE.2021.1006010 |

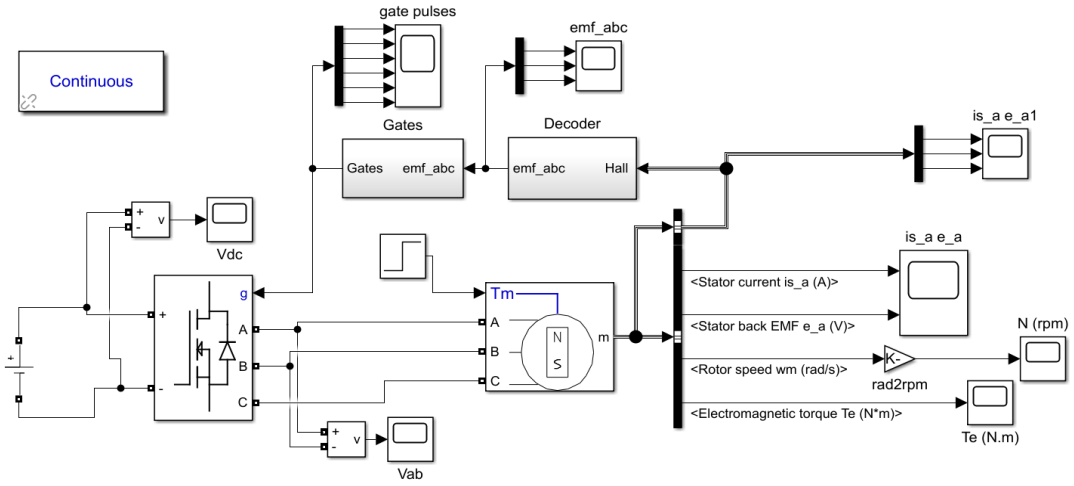


Fig 2: MATLAB Simulation of brushless dc motor

For obtaining the desired output based on the input or operation, from the system, the entire system is calibrated. For that we are using software called 'Mission Planner'. The software is a ground control station for the drone. It can be considered as a dynamic control supplement for autonomous vehicles.

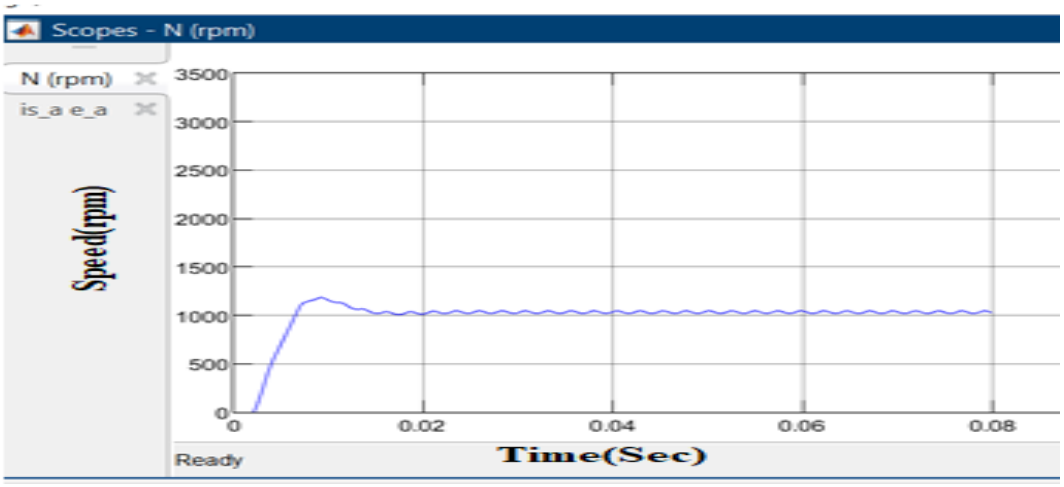


Fig 3: Scope waveform of rotor speed

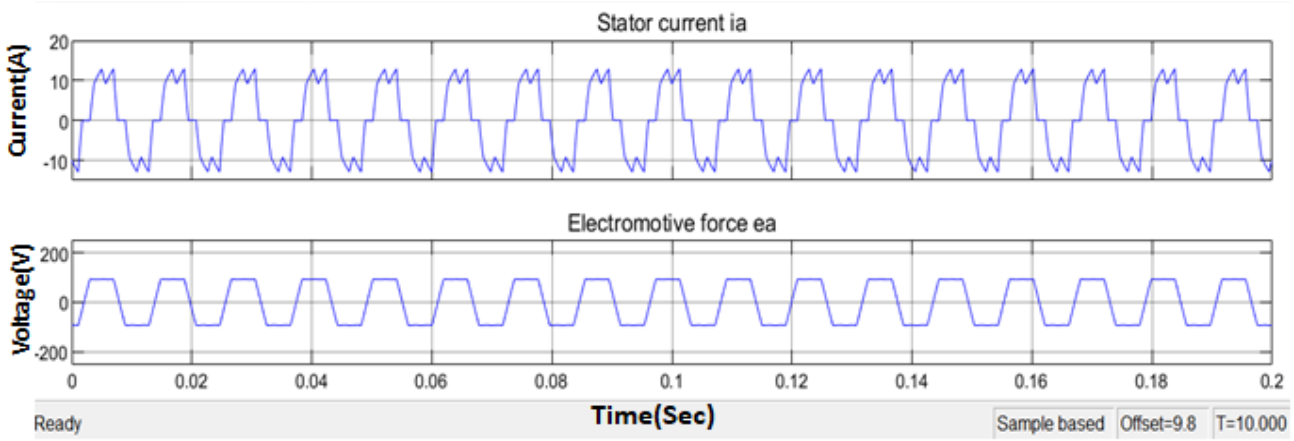


Fig 4: Scope waveform of Stator Current and EMF

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.282|

|| Volume 10, Issue 6, June 2021 ||

| DOI:10.15662/IJAREEIE.2021.1006010 |

Future scopes for the multi-purpose quad copter is vast, when we consider the various fields it can be applied including rescue operations where it's humanly impossible to reach. It can be put to surveillance purposes in fields such as Military applications, without risking human life. Apart from that, the drones could also be utilized in missile obstruction, and can be used as bomb droppers, by incorporating slightest modifications.

The range of applications can be increased by the development of more automated quad-copters. And hence can ensure their commercialization. Thus quad-copters can be put to use in various situations in day to day human life, ensuring their well-being.

V. CONCLUSION

Our project is to design an autonomous flying drone, specifically a quad-copter. The drone is fitted with a GPS tracking system and programmed to be able to autonomously fly from one location to another using GPS coordinates, then a dropping system to carry food, medicine and other products to unreachable areas. A painting system is also mounted to the quad-copter for spraying the areas in case of smog, fire etc. and for spraying purposes. Significant consideration is given to safety and ruggedness due to the possibility of collision with a variety of objects. In addition to collisions, the drone is also rugged enough to operate during moderately windy conditions. Quad-copters could be useful in all kinds of situations and environments. Quad-copters capable of autonomous flight could help remove the need for people to put themselves in any number of dangerous positions. This is a prime reason that research interest has been increasing over the years.

REFERENCES

[1] AnuragSaiVempati, Mina Kamel, Nikola Stilinovic, Qixuan Zhang, "PaintCopter: An Autonomous UAV for Spray Painting on 3D Surfaces", IEEE transactions robotics and automation, pp. 2377-3766, June, 2018.

[2] AdityaVijaychandra, Mina Kamel, Chandykunju Alex, "Autonomous Cloud Based Drone System for Disaster Response and Mitigation", International Conference on Robotics and Automation for Humanitarian Applications, pp. 1022-1040, April, 2016.

[3] PankajAgarwal, Mukesh Kr. Singh, "A multipurpose drone for water sampling and video surveillance", International Conference on Advanced Computational and Communication Paradigms (ICACCP), pp. 978-982 June, 2019.

[4] Pradeep Kumar, AkashChaudhary, Sunil Chanderia, Narendra Kumar Verma, "GPS Based Navigation Design For a Bio Inspired Precision Air Drop System", International Conference on Computing, Communication and Automation (ICCCA), pp. 902-906, May, 2016.

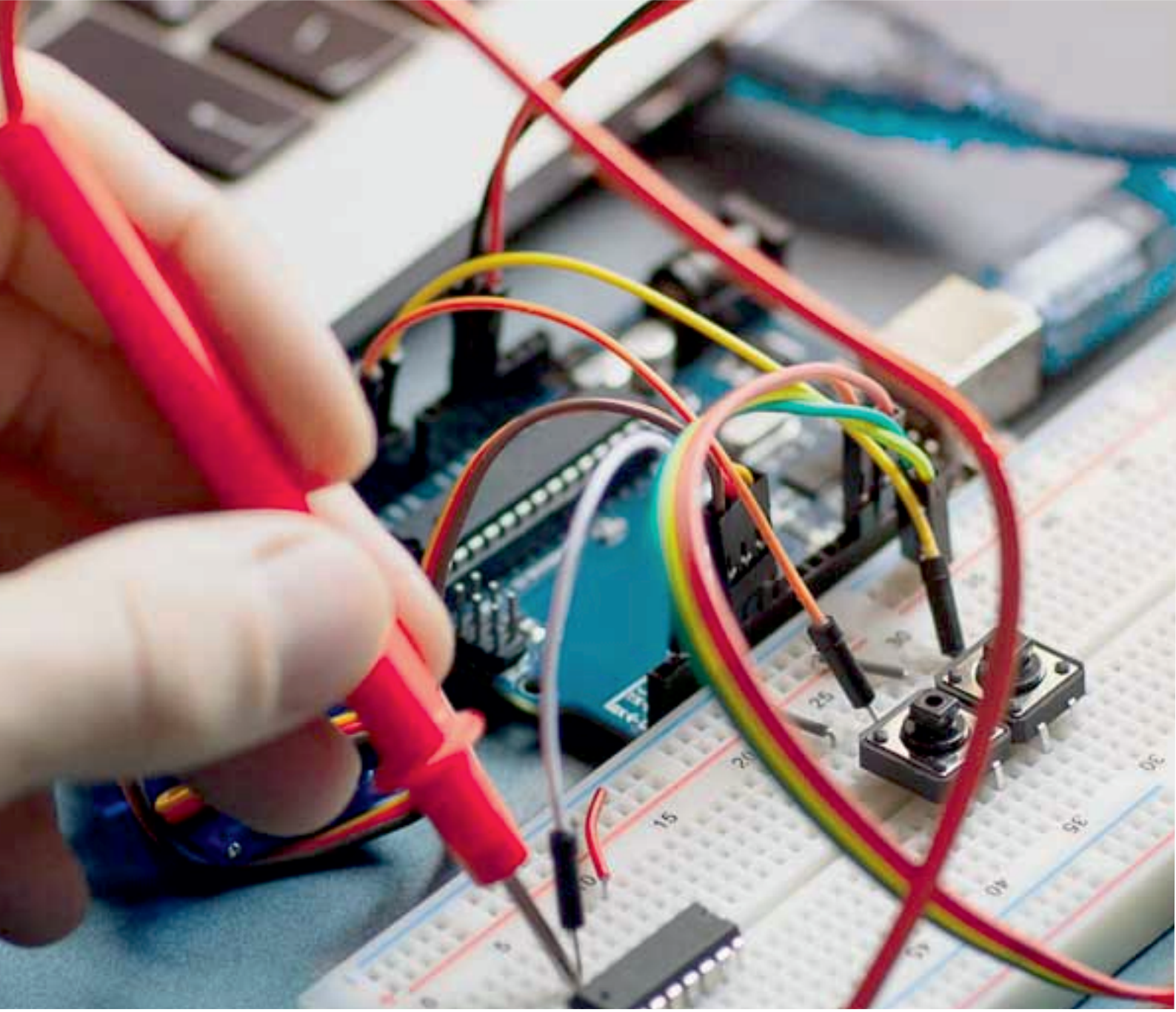
[5] Mark W. Mueller and RaffaelloD'Andrea, "Stability and control of a quadcopter despite the complete loss of one, two, or three propellers", IEEE International Conference on Robotics & Automation (ICRA), Hong Kong Convention and Exhibition Center, May 31 - June 7, 2016.

[6] B. S. Faic¸al, H. Freitas, P. H. Gomes, L. Y. Mano, G. Pessin, A. C. de Carvalho, B. Krishnamachari, and J. Ueyama, "An adaptive approach for uav-based pesticide spraying in dynamic environments", Computers and Electronics in Agriculture, vol. 138, pp. 210-223, 2017.

[7] Jakob Engel, C. Richter, A. Bry, and N. Roy, "Polynomial trajectory planning for aggressive quad-rotor flight in dense indoor environments", in International Robotics Research, Springer, pp. 649-666, 2016.

[8] Yallappa D, M. Veerangouda, DevanandMaskiVijayakumar Palled, and M. Bheemanna, "Development and evaluation of drone mounted sprayer for pesticide applications to crops", IEEE Robotics Automation Magazine, vol. PP, no. 99, pp. 1-1, 2017.

[9] A. S. Vempati, I. Gilitschenski, J. Nieto, P. Beardsley, and R. Siegwart, "Onboard real-time dense reconstruction of large-scale environments for uav," in IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS), pp. 3479-3486, September, 2017.



INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 7.282

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

9940 572 462 6381 907 438 ijareeie@gmail.com

Scan to save the contact details