

# ADVANCED HIGH-FEATURE DRONE FOR QR CODE-BASED MEDICAL ITEM DELIVERY

Prince Kumar Singh<sup>1</sup>, Om Prakash Yadav<sup>2</sup>, Abhishek Kumar Nigam<sup>3</sup>, Abhinav Gautam<sup>4</sup>, Ram Dayal Kumar<sup>5</sup>

<sup>1</sup>Research Scholar, ITBHU, Varanasi, Uttar Pradesh

<sup>2</sup>Research Scholar, NIT, Kurukshetra, Haryana

<sup>3</sup>Research Scholar, MNNIT, Allahabad, Uttar Pradesh

<sup>4</sup>Research Scholar, KNIT, Sultanpur, Uttar Pradesh

<sup>5</sup>UG Student, IET Engineering College, Lucknow, Uttar Pradesh

Corresponding Author: Om Prakash Yadav, Email ID: [opnit05@gmail.com](mailto:opnit05@gmail.com)

**Abstract:** Ensuring quick and secure delivery of medicine to patients is a significant challenge in the medical field. This paper introduces a highly efficient multipurpose drone equipped with an advanced security system. The primary aim of this project is to offer a cost-effective and rapid courier service tailored to the healthcare sector. The proposed drone features a QR code scanner to verify customer identities using their unique customer IDs. Authorized personnel can utilize smartphones or other multimedia devices to capture photos and videos from remote locations to authenticate clients and collect their information. The effectiveness of this drone system has been validated through successful deliveries to actual clients following numerous trial runs with test customers. Additionally, details regarding flight altitude and power consumption at varying wind speeds are provided.

**Keyword:** Drone system, medicine delivery, NODE MCU, GPS Module, QR scanner

## I. INTRODUCTION

The delivery of necessary items to a specified location and a verified customer within a set time frame has become increasingly difficult and tedious in recent years due to high delivery costs and heavy traffic congestion. Drones are considered a significant technological advancement that could revolutionize the transportation sector [1][2]. This is largely due to their potential for flexible, affordable, and fast deliveries that align with the latest developments in the transport industry [3] [4]. Consequently, numerous pilot programs have been initiated to explore the potential of drones in logistics applications [5].

Energy consumption and CO<sub>2</sub> emissions are also driving factors for transitioning from diesel vehicles to electric vehicles [6]-[8]. Inaccurate delivery information or incorrect address entries can prevent packages from reaching their intended recipients [9]. Ensuring the timely delivery of goods, free from damage and tampering, is another critical concern [10]. A GPS-equipped drone delivery system can use tracking devices to pinpoint the customer's location and determine the package's current position, ensuring precise and timely deliveries [11]-[13].

The market for goods delivery is substantial. To make the supply chain quicker and more efficient, shipping companies, logistics firms, and online retailers are heavily investing in last-mile delivery solutions [14]. There have been significant technological advancements in drone delivery, which can offer more accurate deliveries, faster turnaround times, and reduced labour costs [15][16]. This gives us confidence that our plan to use drones for delivering medical supplies can be executed effectively and will be particularly beneficial in scenarios similar to the COVID-19 pandemic [17].

With our invention, we can facilitate contactless deliveries, which will undoubtedly be useful in situations like COVID-19. Many developed countries, such as the USA, are already utilizing drone systems to supply medical necessities to remote areas.

## II. METHODOLOGY USED TO DELIVER THE MEDICINES USING PROPOSED DRONE SYSTEM

This flowchart offers a comprehensive overview of the secure and efficient medication delivery process using a medical haul drone, highlighting the multiple layers of authentication and control mechanisms to ensure accurate and safe delivery [18][19]. It details the steps involved from user authentication to medication retrieval, providing a clear elaboration of each step in the system. The methodology used to deliver the medicine using proposed system is given by figure 1. The detailed description of flowchart is given as:

### a. Initial Authentication and Setup

- **ID 1 & 2, Pass 1 & 2 (Red Box):** The process begins with the generation of user IDs and passwords (ID 1 & 2, Pass 1 & 2).
- **Mobile or Laptop (Yellow Box):** Users will use a mobile device or laptop to interact with the system.
- **Connection & Sharing, Hotspot Setting (Orange Box):** Users configure connection settings, including sharing and hotspot setup on their device.

Fill -> Name -> ID 1, Pass 1 -> \*\*\*\* (Yellow Box): Users fill in their name, ID 1, and password (Pass 1) into the appropriate fields.

### b. QR Code Scanning and Drone Activation

- **Scan QR Code OR -> Link (Brown Box):** Users scan a QR code or follow a link to continue the setup process.
- **Medical Haul Drone (Blue Box):** The system connects to the medical haul drone.
- **User (Button) (Green Box):** The user confirms their interaction by pressing a button.

### c. Secure Delivery Process

- **Username -> ID 2, Password -> Pass 2 (Red Box):** The system prompts for the second set of credentials (ID 2 and Pass 2).
- **Take Medicine, Open/Close, Flashlight On/Off (Blue Box):** Upon successful verification, the drone allows the user to take the medicine. The system can also control the opening/closing of the drone compartment and the flashlight.

Repeat for Next User (Green Box): The system resets and prepares for the next user.

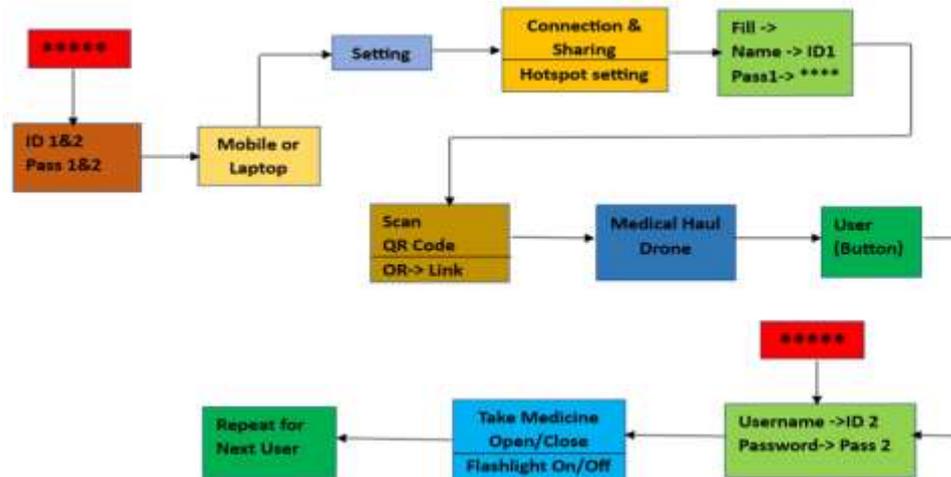


Figure1: Methodology used to deliver the medicine using proposed drone system

### III. THE WORKING STEPS OF PROPOSED DRONE SYSTEM

- **User Authentication:** The process starts with creating and assigning user IDs and passwords for both the medicine supplier team and the customer.
- **Device Setup:** Users use their mobile or laptop to connect to the drone system. They set up the connection and sharing settings, including the hotspot configuration.
- **User Details:** Users input their name, ID 1, and password 1. This step ensures the primary level of authentication.
- **QR Code and Link:** Users scan a QR code or use a provided link to connect to the medical haul drone.
- **Drone Activation:** The drone is activated, ready for the delivery process. The user interacts with the system by pressing a confirmation button.
- **Secondary Authentication:** The system requests the second set of credentials (ID 2 and Pass 2) for additional security.
- **Medicine Retrieval:** After successful verification, the user can retrieve the medicine. The system controls the opening and closing of the drone's compartment and can turn the flashlight on or off as needed.
- **System Reset:** Once the delivery is completed, the system resets to be ready for the next user.

### IV. WORKING MODEL OF PROPOSED DRONE SYSTEM

The provided circuit diagram illustrates a drone system utilizing an Arduino Nano (U1), ESP-01S Wi-Fi module (MK1), a servo motor (M1), an LED indicator (LED2), a push button (KEY1), and a battery (B1) for power supply. The circuit diagram of proposed drone system is given by figure 2 and working model of proposed system is shown by figure 3.

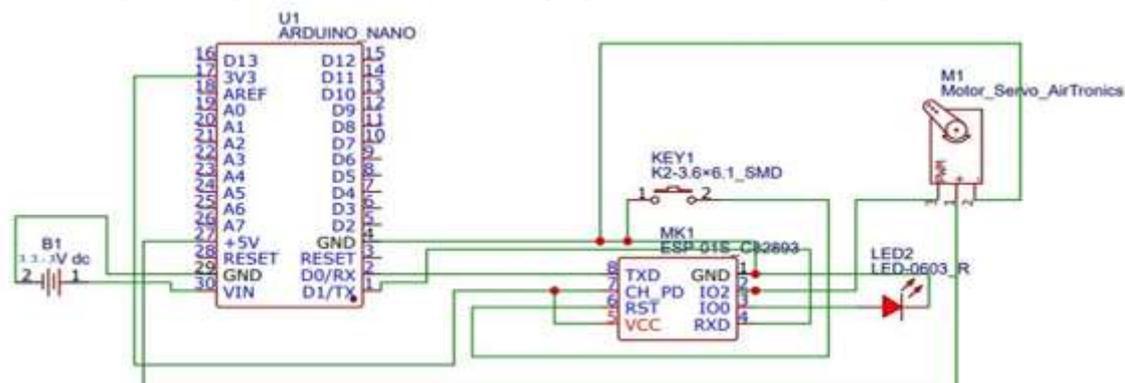


Figure2: Circuit diagram of proposed model

The main components of drone are given as

- Drone Frame
- Power Distribution Board
- Electronic Speed Controller
- Brushless DC Motor – BLDC Motor
- Flight Controller
- Transmitter & Receiver
- Analog Camera System for First Person View (FPV)
- 11.1V Li-Po Battery & Charger
- Servo motor

- o GSM module



Figure3: Working model of proposed drone system

## V. SPECIFICATIONS OF DIFFERENT COMPONENTS

The complete working and use of the used components are given below.

### A. Flight Controller:

The flight controller is the drone's brain. In this project work, CC3D Flight Controller is used. The CC3D Flight Controller is an open-source, highly capable and customizable flight control system primarily used in multi-rotors (quad copters, hex copters, etc.) and other types of unmanned aerial vehicles (UAVs) [20]. The CC3D Flight Controller is a robust, versatile, and community-supported option for both novice and experienced UAV enthusiasts looking to build and fly their own drones. The specification of CC3D flight controller is given as

1. **Microcontroller:** STM32F103CBT6 (part of the STM32F1 series)
2. **Core:** ARM Cortex-M3

### Memory Specifications

- **Flash Memory (ROM):** 128 KB
- **SRAM (RAM):** 20 KB

### Other Key Specifications

- **Clock Speed:** Up to 72 MHz
- **ADC (Analog-to-Digital Converter):** 12-bit ADC with up to 16 channels
- **Communication Interfaces:**
  - **USART:** Up to 3
  - **SPI:** Up to 2
  - **I2C:** Up to 2
  - **CAN:** 1
  - **USB:** 1 (USB 2.0 Full Speed)
- **GPIOs (General-Purpose Input/Output):** Up to 51 I/O ports
- **Timers:**
  - Up to 4 general-purpose 16-bit timers
  - 2 advanced-control timers
  - 2 basic timers
- **DMA (Direct Memory Access):** 7-channel DMA controller
- **Power Supply:** 2.0V to 3.6V
- **Operating Temperature:** -40°C to +85°C

### Sensor Specifications on the CC3D Board

- **Gyroscope:** MPU-6000 or MPU-6050 (integrated 3-axis gyroscope and accelerometer)
- **Accelerometer:** Integrated with the gyroscope (typically the MPU-6000/6050)
- **Magnetometer:** External magnetometers can be connected (optional)

### B. Brushless DC Motors

The brushless DC motors (BLDC motors) is used in quad copter due to their high efficiency, power-to-weight ratio, and reliability. DC brushless motors are needed for four DC copters. Four electronic speed controllers manage and regulate the speed of these motors. The frequency of three-phase electric impulses can be changed to control the motor's speed. These motors are powered by a DC electric source created by a switching power supply, which generates an AC signal. Motor rotors consist of many electric windings. In this project, EMAX RS2205 2300KV BLDC motor is used.

- The Specification of EMAX RS2205 2300KV BLDC motor is as:
  - KV: 2300
  - Max Current: ~30A
  - Voltage: 2S-4S
  - Thrust: ~1200g with 5x4.5 propeller

### C. Global Positioning System (GPS)

GPS is utilised to pinpoint the precise location of the drone. An Ublox NEO 6M GPS Module is used in this work. The specifications of Ublox NEO 6M GPS Module are:

1. **Receiver Type:**
  - 50 channels
  - GPS L1 frequency (1575.42 MHz)
  - C/A code
2. **Position Accuracy:**
  - 2.5 meters CEP (Circular Error Probable)
3. **Time to First Fix (TTFF):**
  - Cold start: 27 seconds
  - Warm start: 27 seconds
  - Hot start: 1 second
4. **Sensitivity:**
  - Tracking: -161 dBm
  - Cold start: -148 dBm
  - Hot start: -156 dBm

### D. Battery

In this copter system, lithium polymer battery (LiPo) of capacity rating 2200mAh has been used. Lithium polymer battery has high energy density. The specification of battery is given as:

- Capacity-2200 mah,
- Nominal Voltage-11.1V,
- Configuration-3S1P (3 cells in Series),
- Discharge Rate-40C,
- Max Burst discharge Rate-80C.

### E. Remote

A remote is an electrical device that remotely transmits orders to a radio receiver via radio signals. The FS-CT6B remote has been utilised. T6 configuration software is used to configure it. Signals are sent from the remote to the flight controller's FS-R6B receiver. The remote control is powered by a 12-volt battery.

## VI. RESULTS AND DISCUSSION

The proposed drone system for secure medication delivery involves both hardware and software components. Each user, including the medicine supplier team and the customer, is assigned a unique ID and password. When the customer's location and order details are entered, a QR code is generated and sent to the customer's profile. This QR code is crucial for verifying the delivery. The drone, equipped with a GPS module, enables both the delivery agent and the customer to track its location [20]. The drone takes off once the delivery agent approves and the customer confirms their availability.

As the drone reaches the designated location, it notifies the customer. A QR scanner on the drone scans the customer's order, and the customer's identity is verified using an OTP sent during dispatch. Additionally, an ESP 32 camera module allows the delivery agent to visually confirm the customer's identity [21]. Upon final confirmation from the delivery agent, the drone door opens, and the medication packet is delivered [22].

The figure 4 illustrates the relationship between power consumption and the height of a quadcopter at two different wind speeds: 7 m/s and 3 m/s. The Red Curve (Wind Speed 7 m/s) represents the height of the quadcopter at a wind speed of 7 m/s. It shows how the height changes with varying power consumption at this wind speed. The Purple Curve (Wind Speed 3 m/s) represents the height of the quadcopter at a wind speed of 3 m/s. It shows how the height changes with varying power consumption at this wind speed. Both curves show an upward trend, indicating that as power consumption increases, the height of the quadcopter also increases for both wind speeds. Initially, at low power consumption, both curves are closely aligned, indicating similar heights at the start. However, as power consumption increases, the curves start to diverge slightly, with the quadcopter at 3 m/s wind speed generally achieving slightly higher heights than at 7 m/s for the same power consumption. As the power consumption increases, the divergence becomes more noticeable. The quadcopter achieves greater heights at 3 m/s wind speed compared to 7 m/s wind speed for the same power consumption. Thus, it is concluded that at higher power consumptions, the quadcopter at lower wind speed (3 m/s) tends to maintain higher altitudes compared to the higher wind speed (7 m/s), indicating that higher wind speeds may require more power to achieve the same height.

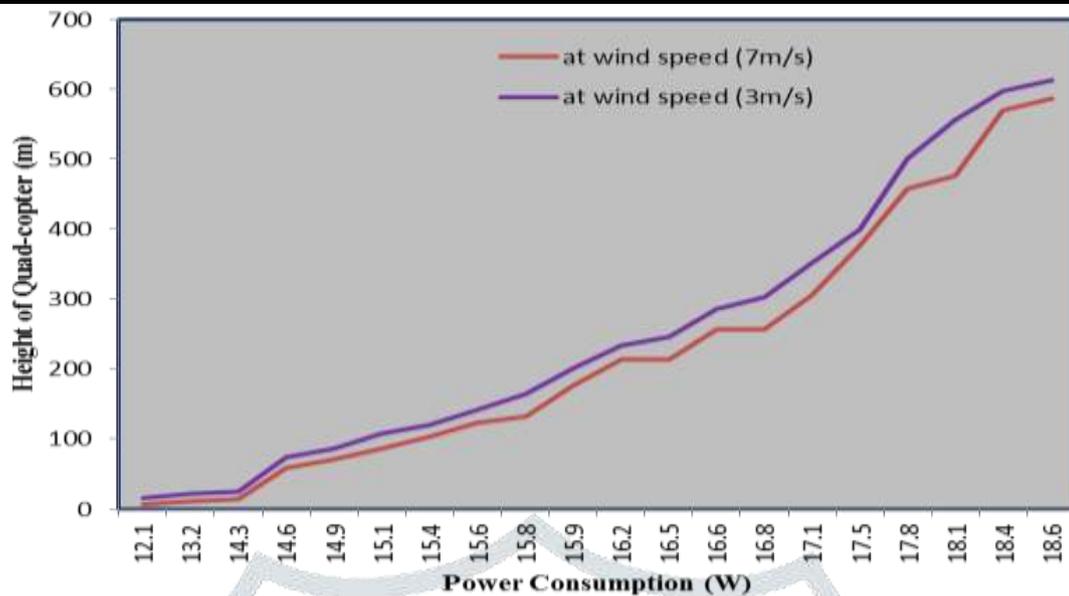


Figure 4: the height of quad-copter at different wind speed and power consumption level

## VII. FUTURE SCOPE

In our project, we have successfully delivered medications to the intended destinations using a manually flown drone. Currently, many businesses are focusing on developing unmanned drones capable of autonomously transporting medications to remote areas without human intervention. These unmanned drones will be especially beneficial for providing patients with doorstep delivery of time-sensitive goods such as medications. For instance, the Indian Council of Medical Research (ICMR) utilized its "i-Drone" operation to deliver essential medical supplies to remote regions of the Northeast, transporting 17,275 units of medical supplies over a distance of 735 km in 12 hours. This approach will be particularly advantageous in pandemic scenarios by enabling contactless delivery to patients. While drone technology is already popular, it holds potential for numerous other applications in the future.

## VIII. CONCLUSION

In areas where regular traffic transport services are unavailable or the topography makes traditional transit methods impractical, our effort assists by providing essential medications. Additionally, in emergency situations such as earthquakes or floods, when physicians and residents need critical medications, our medical drone delivery system proves highly effective. Furthermore, this drone is beneficial in urban areas. It has been demonstrated that wind speed significantly affects the power efficiency and performance of a quadcopter, with lower wind speeds being more favourable for maintaining higher altitudes with less power consumption. The growing urban population and the surge in private vehicle usage have led to traffic congestion, complicating the operations of conventional delivery systems. Hence, our drone is also valuable in these scenarios.

## IX. REFERENCE

- [1] Ha, Q.M.; Deville, Y.; Pham, Q.D.; Hà, M.H. On the min-cost traveling salesman problem with drone. *Transp. Res. Part C Emerg. Technol.* 2018, 86, 597–621.
- [2] Yoo, W.; Yu, E.; Jung, J. Drone delivery: Factors affecting the public's attitude and intention to adopt. *Telemat. Inform.* 2018, 35, 1687–1700.
- [3] Hong, I.; Kuby, M.; Murray, A.T. A range-restricted recharging station coverage model for drone delivery service planning. *Transp. Res. Part C Emerg. Technol.* 2018, 90, 198–212.
- [4] Shavarani, S.M.; Nejad, M.G.; Rismanchian, F.; Izbirak, G. Application of hierarchical facility location problem for optimization of a drone delivery system: A case study of Amazon prime air in the city of San Francisco. *Int. J. Adv. Manuf. Technol.* 2018, 95, 3141–3153.
- [5] Torabbeigi, M.; Lim, G.J.; Kim, S.J. Drone delivery schedule optimization considering the reliability of drones. In *Proceedings of the 2018 International Conference on Unmanned Aircraft Systems, ICUAS 2018, Dallas, TX, USA, 12–15 June 2018*; pp. 1048–1053.
- [6] Wang, X., Poikonen, S., Golden, B., 2017. The vehicle routing problem with drones: several worst-case results. *Optim. Lett.* 11 (4), 679–697.
- [7] Chang, Y.S.; Lee, H.J. Optimal delivery routing with wider drone-delivery areas along a shorter truck-route. *Expert Syst. Appl.* 2018, 104, 307–317.
- [8] Ulmer, M.W.; Thomas, B.W. Same-day delivery with heterogeneous fleets of drones and vehicles. *Networks* 2018, 72, 475–505.
- [9] Rahul Prasad, Sumit Kumar, Swaleha, Vidika Saxena, O.P. Yadav "Smart Traffic Control System for Lifeline Vehicles", *Journal of Microcontroller Engineering and Applications, STM Journal*, vol. 6, issue 1, pp.17-20, 2019, ISSN: 2455-197X, DOI: <https://doi.org/10.37591/jomea.v6i1.2486>
- [10] Mahony R., Kumar V., and Corke P., *Multirotor aerial vehicles: modeling, estimation, and control of quadrotor*, IEEE Robotics and Automation Magazine. (2012) 19, no. 3, 20–32, <https://doi.org/10.1109/MRA.2012.2206474>, 2-s2.0-84866354549.
- [11] Om Prakash Yadav, Dheeraj Joshi and G.L. Pahuja, "Artificial Neural Network based Health Monitoring of Induction Machines", *International Journal of Research*, vol-2, p.p. 113-116, 2011. ISSN No.: 0976-8211
- [12] Meier, P., and Soesilo, D. Using drones for medical payload delivery in Papua New Guinea. *Drones Human Action Case Study*. (2015):2. <https://drones.fsd.ch/wp-content/uploads/2016/04/Case-Study-No2-PapuaNewGuinea.pdf>

- [13] Sparsh Tripathi, Ayush Mishra, Sonu Kumar Singh, Ravi Kumar Gupta, Ashtabhuji Srivastava, and O.P.Yadav, "Voice Oriented Interactive Electrical System", International Journal for Research in Applied Science & Engineering Technology (UGC care list), vol. 4, issue IV, pp.687-690, 2016. ISSN No: 2321-9653, link: <https://www.ijraset.com/files/serve.php?FID=4497>
- [14] Peckham, R., and Sinha, R. An architecture of health: futures for the biomedical drone. *Glob Public Health*. (2019) 14:1204–19. doi: 10.1080/17441692.2018.1546335
- [15] Chamata, J., and Winterton, J. A conceptual framework for the acceptance of drones. *Int Technol Manag Rev*. (2018) 7:34–46. doi: 10.2991/itm.r.7.1.4
- [16] Om Prakash Yadav, Dheeraj Joshi and G.L. Pahuja," Support Vector Machine based Bearing Fault Detection of Induction Motor", Indian Journal of Advanced Electronics Engineering, Volume.1 Number.1, pp.34-39, January-June 2013.
- [17] Ankit Yadav, Anshul Tiwari, Divya Sharma, Ratnesh Srivastava, Sachin Kumar, and O. P. Yadav, "Smart Spy Robot" International Journal of Science, Engineering and Technology Research, vol.5, issue.4, pp.973-977, 2016.
- [18] Perozzi G., Efimov D., Biannic J. M., and Planckaert L., Trajectory tracking for a quadrotor under wind perturbations: sliding mode control with state-dependent gains, *Journal of the Franklin Institute*. (2018) 355, no. 12, 4809–4838, <https://doi.org/10.1016/j.jfranklin.2018.04.042>, 2-s2.0-85048571738.
- [19] Anbaroğlu, B. Parcel delivery in an urban environment using unmanned aerial systems: A vision paper. *ISPRS Ann. Photogramm. Remote. Sens. Spat. Inf. Sci.* 2017, 4, 73–79.
- [20] Hii, M.S.Y.; Courtney, P.; Royall, P.G. An Evaluation of the Delivery of Medicines Using Drones. *Drones* 2019, 3, 52. <https://doi.org/10.3390/drones3030052>.
- [21] Rishi Ashthana, O P Yadav, Desh Deepak Verma, Mohammad Shaad, Sunil Shah, Luvkush Gupta, and Ankur Agarwal, "A Critical Review on the Development of Intelligent Traffic Congestion Control System", International Journal of Advanced Research in Engineering Technology and Sciences, vol. 3, issue-4, pp.78-84, 2016.
- [22] Mathew, N.; Smith, S.L.; Waslander, S.L. Planning paths for package delivery in heterogeneous multirobot teams. *IEEE Trans. Autom. Sci. Eng.* 2015, 12, 1298–1308.

