

QUADCOPTER FOR FLOOD RELIEF

CHIRAG CHAUDHARI¹, MOHNISH BHINGARDE², RUCHIRA ACHAREKAR³,
SIDDHESH DALVI⁴, ASSISTANT PROF. RAJIV IYER⁵

¹⁻⁴Students, ⁵Assistant Professor

Department of Electronics and Telecommunication Engineering

K.C. College of Engineering & Management studies & Research, Kopri, Thane(E), 400603

Abstract— *Quadcopters are drones also known as unmanned aerial vehicles that can be controlled remotely. Quadcopters have uses in various fields. The proposed quadcopter will be used in flood relief. Components required in building the quadcopter are its frame, pixhawk flight controller, brushless motors, carbon fiber propellers, High Definition (HD) camera, Global Positioning System (GPS), telemetry module and robotic arm. The 2400kv powerful motor supplies enough strength to the propellers (carbon fibers) for smooth and balanced flight as well as stability to fly in windy conditions. The proposed system can not only be controlled by the remote controller but also with an android mobile phone using Qground control application within a range a 1km. The quadcopter can fly and record live aerial footage which will be sent to the base station for air surveillance. With this, the individual can monitor the situation and locate people who are stranded. This data can be forwarded to the higher authorities for their rescue mission. By the time they are rescued the quadcopter can also supply goods up to 3 pounds like food, medicine, potable water. It can also be used to drop disinfectant in the infected floodwater where people are stuck. It can also pick small animals up to 2-3 pounds.*

Keywords- *drone, flood, pixhawk, quadcopter, rescue, surveillance*

I. INTRODUCTION

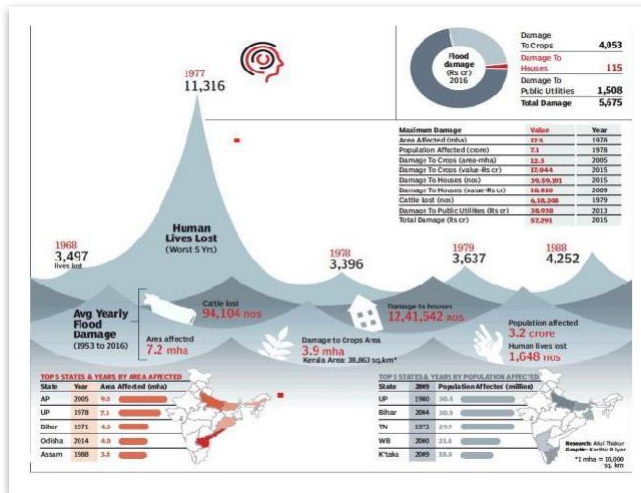
Flood is a natural disaster. Flood has many deadly consequences on society, human life, wildlife. Flooding occurs mostly from heavy rainfall when natural watercourses cannot carry excess water. However, floods are not always caused by heavy rainfall. In coastal areas, water inundation can be caused by storm surge as a result of a tropical cyclone, a tsunami or a high tide coinciding with higher than normal river levels. If a dam fails, triggered for example by an earthquake, the downstream area will flood, even in dry weather conditions.

Other factors which can contribute to flooding include:

- Volume, spatial distribution and duration of rainfall over a catchment
- Capacity of watercourse or stream network to carry runoff
- Ground cover
- Topography
- Tidal Influences [5]

There are few measures that people take during a flood-like evacuating immediately. Depending upon the location and the impact, people go to a safe location which is previously identified.

People listen to weather radio or local alerting systems for current emergency information and instructions. It is always avoided to walk, drive or swim through floodwaters. People stay off bridges over fast-moving water because fast-moving water can wash bridges away without warning. People are advised to stay inside their vehicles if they are trapped in rapidly moving water. If people are trapped in a building then it is advised to go to the highest level. They also signal for help from the rooftop [4].



[2] Fig. 1: Loss by floods

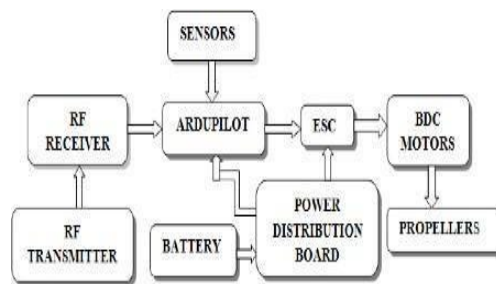
[3] Fig. 2: Aerial view from a drone

Unmanned Aerial Vehicle (UAV) is a type of aircraft which has no pilot or passenger on board. UAVs include both autonomously controlled (drones) and remotely piloted vehicles (RPVs) controlled via Radio transmitter. UAVs are commonly used in situations where there is high risk in sending a human-piloted aircraft or where using a manned aircraft is impractical. Drones are being used in flood management and relief. Drones can provide a live video feed of the affected areas from an aerial view. The live aerial video can be hosted on internet platforms and can be accessed by anyone. It can help the government in finding out which areas are severely affected so that they can provide immediate relief and rescue teams there as soon as possible. It can also be useful to locate many people who are still trapped on their roofs in highly water-logged areas as well as in far-off places. It can help in creating a digital map of the entire area [3].

The proposed quadcopter is unique in design and applications. Besides aerial surveillance, the quadcopter has various uses. The proposed system will be equipped with a robotic arm. This arm has various applications. It will be used in logistics. It can deliver first aid, snacks, potable water. It can carry small animals (pets) and goods up to 3 pounds. It can be used in disinfecting the flood water by the chemicals from the air. This will help the people stranded in flood to survive until the time the rescue team arrives.

II. SYSTEM DESIGN

A. Block Diagram



[1] Fig 3: Higher Level Block Diagram of Quadcopter

B. System Specifications and working

The entire system is held together on the quadcopter frame. The quadcopter is controlled and operated by pixhawk. The system can fly due to the rotation of the carbon fiber propellers. The propellers are mounted on the high capacity brushless DC motors. The motors are connected to the ardupilot through ESC. The pixhawk flight controller helps in conducting a stable flight. The location of the quadcopter can also be tracked. The quadcopter can maintain its altitude. These operations are carried out because of the GPS and Telemetry modules. This entire system is powered by a 5400mAH Lithium Polymer (LiPO) battery. The proposed quadcopter will be controlled by a wireless remote controller. It can also be controlled by a mobile phone using an android application where the user need not control the drone by the remote controller. It will follow the specific path given by the user via the application. It can pick and drop essential goods needed to help the stranded. During the flight, it will also capture the live footage by the HD camera which works on wireless fidelity (Wi-Fi). The live footage will be wirelessly transmitted to a display device that has Wi-Fi (mobile phone).

C. Components list and Specification.

1. Flight Controller:

A flight controller (FC) is a small circuit board of varying complexity. Its function is to direct the RPM of each motor in response to input. A command from the pilot for the multi-rotor to move forward is fed into the flight controller, which determines how to manipulate the motors accordingly [6].



[6] Fig 4: Flight Controller

2. Pixhawk:

The Pixhawk is an open hardware autopilot that was originally developed by ETHZ in the PIXHAWK project. Paparazzi now supports the Pixhawk and the firmware can be uploaded through the original PX4 custom bootloader, which happens directly through the USB port of the Pixhawk. This means that it is possible to easily switch between the Paparazzi AP and other projects that support the Pixhawk hardware. Pixhawk is an independent open-hardware project that aims to

provide the standard for readily-available, high-quality and low-cost autopilot hardware designs for the academic, hobby and developer communities. Pixhawk supports multiple flight- stacks: PX4 [7].



[7] Fig 5: Pixhawk

3. Frame:

While a quadcopter is equipped with 4 rotors and an octocopter with 8 propellers and motors, the hexacopter is characterized by its 6 rotor arms. The proposed quadcopter will have the following F450 frame [8].



[8] Fig 6: Frame of Quadcopter

4. Motor:

A brushless DC motor (BLDC) is a DC electric motor that uses an electronically-controlled commutation system, instead of a mechanical commutation system [9].



[9] Fig 7: BDC Motor

5. Electronic Speed Control (ESC):

The term ESC stands for an electronic speed control is an electronic circuit used to change the speed of an electric motor, its route and also to perform as a dynamic brake. These are frequently used on radio- controlled models which are electrically powered, with the change most frequently used for brushless motors basically providing an electronically produced 3-phase electric power low voltage source of energy for the motor [10].



[10] Fig 8: Electronic Speed Control

6. Battery:

The lithium battery packs used to power quadcopters have two common chemistries: Lithium polymer (LiPO) and lithium polymer high voltage (LiHV). The primary difference between the two is that a LiPO cell has a fully charged voltage of 4.2V compared to a LiHV cell which has a voltage of 4.35V at full charge. A LiPO has a resting or nominal voltage of 3.7V versus a LiHV which has a storage voltage of 3.8V. In regards to the performance of the two packs, a LiHV battery will initially provide more power but abruptly drops in voltage when discharged whereas a LiPO has a more linear discharge making it easier to qualitatively gauge the remaining flight time [11].



[11] Fig 9: Lithium Polymer Battery

7. Propellers:

A propeller is a rotating fan like structure which is used to propel the ship by using the power generated and transmitted by the main engine of the ship. The transmitted power is converted from rotational motion to generate a thrust which imparts momentum to the water, resulting in a force that acts on the ship and pushes it forward [12].



[12] Fig 10: Propeller for Quadcopter

8. Power module:

Power modules are power switching/control circuit elements integrated into convenient isolated-

base packages that offer a broad spectrum of commonly used diode, SCR/Diode circuit configurations and ratings. Power modules often power semiconductor devices, and also provide an easy way to cool the device as well as connect them to the outer circuit. Power Modules are mechanically and thermally optimized for ease of assembly, long life and reliable operation. There are several common structures that power modules are available in, such as IGBT or MOSFET [13].



[13] Fig 11: Power Module

Battery charger:

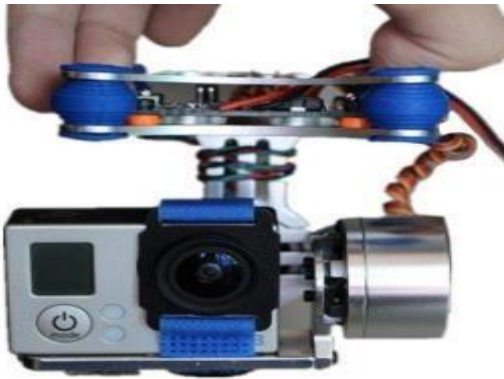
For drone battery safety, it is crucial that the batteries occasionally have their individual cells “balanced,” meaning the charger will adjust, up or down, the voltage of each cell in a battery so that they match. Modern battery chargers will have “balance” ports so that the individual cells of a battery pack can be balanced. While of variable use to the drone enthusiast, most battery chargers on the market are capable of charging multiple types of batteries in addition to the LiPo. For example, most chargers are also capable of charging lead-acid batteries like what is in your car, or NiCd batteries for other uses [14].



[14] Fig 12: Battery Charger

9. Gimbal:

A gimbal whether handheld or mounted on a drone is designed to give the camera operator the independence of photographing or filming without camera vibration or shake. Generally powered by three brushless motors (3-axis), the gimbal has the ability to keep the camera level on all axes (pan, roll, tilt) as the operator moves the camera. An inertial measurement unit (IMU) responds to movement and utilizes its three separate motors to stabilize the camera [15].



[15] Fig 13: Gimbal for Quadcopter

10. Camera:

Most action cameras are capable of recording 4k videos in top-notch quality without any hassle. Thanks to their large sensors, they are also able to capture excellent photos that can be immediately transferred to your smartphone using Wi-Fi. To get a similar quality of videos, you will have to get a large sized camera, which is at least twice or thrice as expensive [16].



[16] Fig 14: Action Camera

11. Robotic arm:

Their design is capable of picking up a wide range of objects while simultaneously sensing its own deformation. As shown in the images, the two-fingered gripper – weighing only 1.5 g – can pick up solid items such as a Teflon cylinder and an oil can, but also deformable and fragile items such as a flat sheet of paper (1 g), a water-filled balloon (36 g), and even a raw chicken egg (61 g) [17].



[17] Fig 15: Robotic Arm Gripper

12. Servo motor driver module:

The servo motor is actually an assembly of four things: a normal DC motor, a gear reduction unit, a position- sensing device and a control circuit. The DC motor is connected with a gear mechanism which provides feedback to a position sensor which is mostly a potentiometer. From the gear box, the output of the motor is delivered via servo spline to the servo arm. For standard servo motors, the gear is normally made up of plastic whereas for high power servos, the gear is made up of metal [18].



[18] Fig 16: Servo Motor Module

13. GPS module for APM:

GPS receiver module gives output in standard (National Marine Electronics Association) NMEA string format. It provides output serially on Tx pin with default 9600 Baud rate. This NMEA string output from GPS receiver contains different parameters separated by commas like longitude, latitude, altitude, time etc. Each string starts with '\$' and ends with carriage return/line feed sequence [19].



[19] Fig 17: GPS Module

14. Radio telemetry for APM Pixhawk:

Radio telemetry uses radio signals, which are made up of invisible and silent **electromagnetic waves**, to determine location. A radio telemetry system is made up of three parts: a **radio transmitter**, a **radio antenna** and a **radio receiver**. The radio transmitter is worn by the animal and is the part that transmits, or sends, the radio signal. Scientists use the antenna to pick up the radio signals, which are then transformed into a beeping sound by the receiver. As the receiver gets closer to the transmitter, the beeps get louder, meaning the animal wearing the transmitter is close by. The researcher can use this audible clue to locate and follow the animal wearing the transmitter [20].



[20] Fig 18: Radio Telemetry Module

D. SOFTWARES

1. Mission Planner:

Mission Planner is a ground control station for Plane, Copter and Rover. It is compatible with

Windows only. Mission Planner can be used as a configuration utility or as a dynamic control supplement for your autonomous vehicle [21].



[21] Fig 19: Mission Planner

2. Qground Control:

QGround Control provides full flight control and configuration for Ardupilot or PX4 Pro powered vehicles. The goal for Qground Control is improved ease of use for new users as well as high end feature support for experienced users [22].



[22] Fig 20: Qground Control Android Application

III. EXPECTED RESULTS

The quadcopter can fly about 50 meters above the ground continuously for 2 hours. The range for the remote controller is 2 km in open space but can also be remotely controlled by the mobile application. It can lift objects to 3 pounds for rescue as well as logistics. The

HD action camera can record video 4K 30fps as well as can transmit live footage over Wi-Fi. The camera will not be affected by floodwater as it is 30m water-resistant.

IV. CONCLUSION

In this paper, a quadcopter is proposed, which provides an efficient and reliable method for flood relief that could be implemented in UAVs and used in real-time for assisting the stranded people. Our approach and results are limited due to the sensors' range and can be improvised with expensive and more efficient pieces of equipment. The future scope is to use this in an aquarium, zoo, forest to feed the animals.

V. REFERENCES

- [1] Dhruv Bhatti¹, Juee Bhalbar, Satish Chaurasiya, Krishna Mannikeri, "Clairvoyant Raven: Smart Drone For Wild Fire"
- [2] Times of India dated July 2, 2018
- [3] Prince Diwaker, August 22, 2018 accessed on September 16,2019
- [4] Department of Homeland Security, accessed on September 16, 2019 <<https://www.ready.gov/floods>>
- [5] Geoscience Australia, accessed on September 16, 2019 <<https://www.ga.gov.au/scientific-topics/community-safety/flood>>
- [6] Quadcopter FPV, accessed on August 18, 2019 <<https://www.tomshardware.com/reviews/multi-rotor-quadcopter-fpv,3828-2.html>>
- [7] Pixhawk, accessed on August 18, 2019 <<http://pixhawk.org/>>
- [8] Power Module , accessed on August 18, 2019 <, accessed on August 18, 2019 <<https://www.mydronelab.com/accessories/quadcopter-frames.html>>
- [9] BDC Motor, accessed on August 18, 2019 <https://radiocontrol.fandom.com/wiki/Brushless_motor>
- [10] ESC, accessed on August 18, 2019 <<https://www.elprocus.com/electronic-speed-control-esc-working-applications/>>
- [11] Battery, accessed on August 18, 2019 <<https://www.getfpv.com/learn/new-to-fpv/all-about-multirotor-fpv-drone-battery/>>
- [12] Propellers, accessed on August 18, 2019 <<https://www.marineinsight.com/naval-architecture/propeller-types-of-propellers-and-construction-of-propellers/>>
- [13] Power Module, accessed on August 18, 2019 <<https://www.galco.com/comp/prod/powermod.htm>>
- [14] Battery Charger, accessed on August 18, 2019 <<https://www.getfpv.com/learn/new-to-fpv/all-about-multirotor-fpv-drone-battery-charger/>>

- [15] Gimbal, accessed on August 18, 2019
<<https://www.dronezon.com/learn-about-drones-quadcopters/drone-gimbal-design-components-parts-technology-overview/>>
- [16] Action Camera, accessed on August 18, 2019
<<https://economictimes.indiatimes.com/wealth/spend/should-you-invest-in-an-action-camera/articleshow/63947954.cms?from=mdr>>
- [17] Robotic Gripper, accessed on August 18, 2019
<<https://www.advancedsciencenews.com/robot-grippers-can-mimic-human-hand-function/>>
- [18] Servo motor and module, accessed on August 18, 2019
<<https://www.elprocus.com/servo-motor/>>
- [19] GPS Receiver, accessed on August 18, 2019
<<https://www.electronicwings.com/sensors-modules/gps-receiver-module>>
- [20] Radio Telemetry, accessed on August 18, 2019
<<https://nationalzoo.si.edu/migratory-birds/what-radio-telemetry>>
- [21] Mission Planner, accessed on August 18, 2019
<<http://ardupilot.org/planner/docs/mission-planner-overview.html>>
- [22] Qground control, accessed on August 18, 2019
<<http://qgroundcontrol.com/>>