Flood Rescue Operation using Intelligent Drone for Supporting Disaster Management

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Abstract

This project is primarily about the improvement of flood relief operations using UAV (Unmanned Aerial Vehicle) technology. This work provides a system to communicate with the victims in real time and to acquire the required statistics and data to plan the relief operations in a faster and efficient manner. The model will have a UAV, communication system and live video streaming system. The first responders will move to the location and to assess the situation like number of people stranded, boat routes planning and to do routine checks, they can use the UAV and its accessories to plan their action in an efficient way. It will have an on-board communication system to have half-duplex communication with the survivors and first responders. To make the disaster management easier and rescue planning faster, we have used a computer vision library tool which detects people and sends their location back to the Control Centre.

Keywords: Flood Relief, UAV, Communication, Disaster Management, Rescue Planning, Video Streaming

1. INTRODUCTION

We have taken inspiration from the enormous possibility of an Unmanned Aerial Vehicle (UAV) in diverse terrains, its ability to manoeuvre quickly in the air and its low-cost flight which helps in looking at the problem from a different perspective. Natural Disasters are always prone to invaluable data collection or sometimes there will be much data to be processed during the post disaster management. Having the right data at the right time will be helpful in quick

assessment of the situation we are in. NDRF (National Disaster Response Force) of India uses their elite team of volunteers and military men to quickly assess the situation and rescue people. During Bihar floods in India there was a case where the first responders got a call to rescue a pregnant woman from a village, but the name of the village was not heard clearly and due to this fail in communication the exact location of the woman was not acquired. Therefore, we need to have proper data to rescue the people on priority basis.

In this project, we have discussed the possible solutions for improving the disaster management during floods. UAVs in floods are valuable because of the immobility of vehicles on the land and the waterways restrict the amount of data to be collected in an area, thereby having a UAV which can fly over the area can be of great help.

2. PROPOSED WORK

The flood affected area will be located and the first responders will setup the control station at a suitable place. Fig. 2.2. demonstrates the working of the flood relief operations, but is not limited to, using UAV Once the control station is setup, they can deploy the UAV initially for knowing boat routes aerially and the route data will be sent back to the control station. Simultaneously another UAV can be deployed to begin the search operations looking out for people. This is done by OpenCV (open computer vision, it's an open-source computer vision documentation which helps in detecting

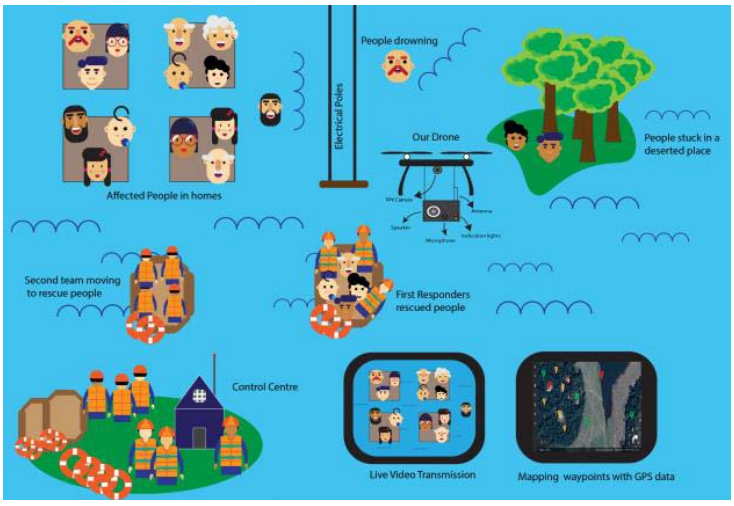

Figure 2.1. Illustrated idea.

people, water, trees, obstacles etc., using python programming and Machine Learning Techniques to train the cameras to better recognize the event and send valuable data. Once the people are detected, the GPS location of the people is sent to the control station where they mark the waypoints using the GPS data and plan the action accordingly. This system also helps in talking to the stranded people there and giving them valuable instructions and information on a timely basis.

Figure 2.2.

3. SYSTEM DESIGN AND CHALLENGES

A. Design of UAV:

The connections are made according to the block diagram shown in Fig. 3. Initially we have to setup the configurations for the transmitter. This is done using the screen provided in the transmitter as shown in figure 3.7. Here we key-in the quadcopter model and the transmitter is all set to operate for the quadcopter flight. Next, we set up the 'Fail Safe' option. This option helps us keep the drone in the initial stick position for different channels so that when the communication fails the drone gets the initial channel PPM so that it won't fly away from the area.

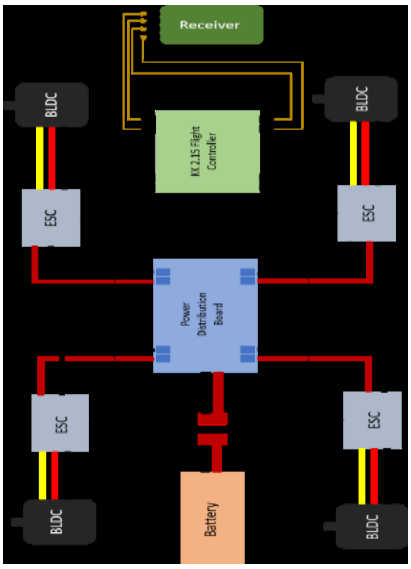

Figure 2.3. Block Diagram of Quadcopter

After setting up the transmitter for the quadcopter model we need to bind the receiver and the transmitter. This is done by placing the binding key in the receiver and power the receiver from the esc to the channel 1 of the receiver. Connect the Lithium Polymer Battery to the ESC and the Receiver will turn ON. Now hold the binding key in the transmitter and turn ON the transmitter. After few seconds the transmitter will indicate that the receiver has been bound.

We need to ARM the flight controller by holding the Channel 4 to the right and the quadcopter is ready to fly!

B. OpenCV people detection:

OpenCV is an open-source computer vision library, tools and hardware support which is used in Machine Learning (ML) and Artificial Intelligence (AI). It currently consists of various types of computer algorithms to detect faces, track objects, track camera movements and many more. This provides a vast range of applications to be explored. This project uses OpenCV with Python programming language to detect people stranded in the flood affected area.

C. Communication System:

Audio communication helps in good maintaining of communication with the other person in the flood hit areas, hence we use nRF24l01 transceiver module which we are using it like walkie talkie. Arduino Nano is a microcontroller

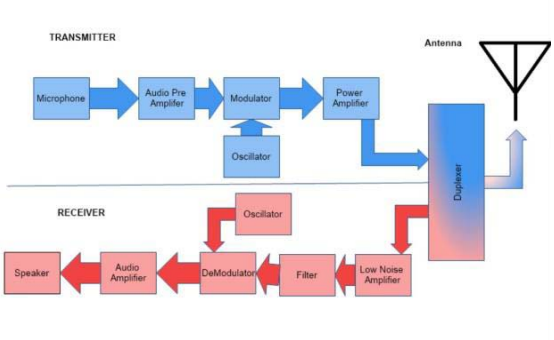

Figure 2.4. Communication block diagram.

board we will use to transmit and receive the audio. nRF24l01 is a 2.4GHz wireless transceiver module which is used to send the data and receive using radio waves. It uses SPI protocol for transmitting the data and its data rate is up to 2Mbps. We have flexibility of using channels up to 125 channels ranging from 2400 – 2525 MHz, this will give us 800 meter of range in line of sight and a good module to test the communication initially as it uses frequency within the ISM (Industrial Scientific and Medical) Band, later we can test the same audio communication with the operating frequencies of the first responders.

4. RESULTS AND DISCUSSION

The interpretation drawn after completion of some parts of the project is that the UAV is equipped with Pi Camera which gave us the bird's eye view of the area which it flew in. Later the video was sourced to the code and run to detect the people in the surroundings. In addition to this we had to run the code from the drone visuals taken from different sources. The code has been tested and it is proved to be effective in recognizing people who are standing and visible in the video. In the future scope of the project the code can send the location request to GPS Module and thereby send the same information to the control station. We developed the UAV which can do or can perform the tasks in fetching the required data and helping the first responders to better analyse the area and plan their actions accordingly.

Figure 2.5. UAV

As seen in Figure 2.4. the UAV has been tested for the flight and gives us good altitude range to hover over the disastrous area and to quickly manoeuvre over the area to give us valuable data. The quadcopter is developed using FlySky FSi6 transmitter and receiver and the KK 2.15 Flight Controller board which controls the path of the flight according to the input given by the pilot. Currently the drone can fly a small distance without any obstruction, and it is almost stable during the flight.

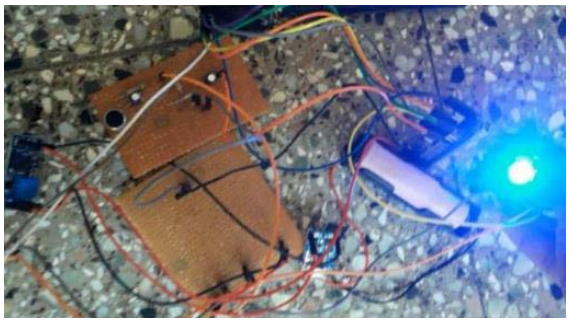

Figure 2.6. Communication working LED

Fig. 5 shows the output of the audio communication setup is received through the speaker when the input is given to the microphone. Here we used an electrate based microphone to capture the audio, this electrate microphone has a 2V of working voltage when biased with the amplifier circuit and connecting it to a pre-amplifier as constructed above amplifies the signal to around 5V which is analogous in nature.

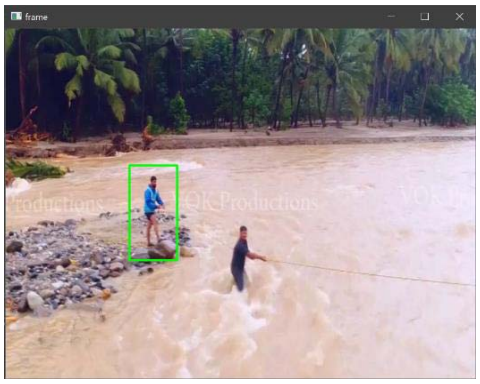

Figure 2.7. Propel detection output.

As seen in Figure 2.6, the OpenCV library code which we have used is being able to detect people stranded in the flood affected area. The above visual was outsourced, during the floods in Charmadi, India. The above picture is part of the outsourced video which we have fed to the code. Once the code detected people and marked a rectangle over them, we captured the same output as seen above.

This is the primary goal of the project which detects people in the flood affected area.

5. CONCLUSION

This UAV system for flood relief operation can fetch the data of human existence in a particular area using OpenCV code and the communication module helps in providing valuable information to the people stranded so that they take the necessary safety precautions and thereby help in proper conduct of flood relief operations. However due to the constraints in the computational power required to use advanced computer algorithms for people detection and the constraints in reducing the noise generated by the audio communication circuit we will need to enrich the features in the project before actual implementation and testing in the flood affected area.

6. REFERENCES

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