Ilkogretim Online - Elementary Education Online, 2020; Vol 19 (Issue 4): pp. 6692-6700
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2020.04.765073

# Smart Rescuer

**Ms V Remya** Assistant professor, Electronics and Communication Engineering, Sri Sairam Engineering College, Chennai, Tamilnadu, India

**Aishwarya B, Auxciliya A, Yashika K** UG Student, Electronics and Communication Engineering, Sri Sairam Engineering College, Chennai, Tamilnadu, India

**Abstract—** Many areas of the world suffer from geological disorders. Disasters are impossible to prevent and causes destruction to both environment and human resources. Naturally occurring disasters like earthquake, floods, etc. can cause massive destruction and sometimes lives are buried or trapped in debris. In such situations detection by rescue workers becomes time consuming and due to the vast area, that gets affected it becomes harder. The proposed system provides a human detection quad-copter which might detect alive humans in debris in order that timely help can be made available to the victims. The alive individual detection system contains Passive Infrared sensor (PIR) which provides the information about the presence of alive human body. Radio Frequency Technology is used to control the quad-copter. Flight controller used in quad-copter is the main functioning body of the aircraft. It is a circuit board that receives different commands sent by user to control speed of motors so that quad-copter could be stable in fly mode. Electronic speed controller receives command from microcontroller and further gives command to the motors for rotation. The instructions given by transmitter are received by a radio receiver connected to flight controller. ATMEGA8A microcontroller is used to give an alerting message to the rescue operator of the affected sites and they will give proper rescue to the affected victims. In disaster sites, it will be a great help to rescuers in detection of more alive human beings at the right time. This technique is additionally user friendly, economical, semi-autonomous and efficient for detection.

**Keywords:** Drone, PIR sensor, Buzzer, Propeller, Flight Controller, Brushless DC Motor, Axis Gyro sensor.

## I. INTRODUCTION

Timely rescue can only save people who have been buried and injured as a result of any disaster**.** In such situations, the rescue system must make quick decisions under pressure and try to get the victims to safety at their own risk. Get victim location and status information as soon as possible so drugs and firefighters can enter the disaster-prone area and rescue people. All of this works are mainly carried out in very dangerous and risky situations by trained dogs and humans. Usage of drone or quad helicopter also helps in the identification of living people and rescue activities in a time effective manner.

This article proposes a drone or quad-copter that flies in a disastrous area and helps in identifying the live people and rescue operations. A Passive Infrared sensor and cascade object detection technology is used in the project which gives information about the presence of the human body. The infrared radiation emitted by human body and it is received and manipulated by the PIR sensor to detect the presence of humans. Once the people are located, it immediately gives audio alert to the authorities so that help can reach the live person very fast.

This PIR sensor is placed on a moving all direction quad-copter that can fly in the earthquake prone areas. The quad-copter is driven on a brushless dc motor for increased torque. Detection by rescue workers is time consuming; therefore, here quad-copter or drone is used for earthquake rescue system.

## II. EXISTING SYSTEM

The PIR sensor is located on a robot, which can move in all directions and can be maneuvered in earthquake-prone areas. The robot is driven by a DC gearbox. The robot consists of a three-wheel drive and a DC motor for moving forward and backward. The robot is used to send and receive infrared rays to detect buried people.

The major disadvantages of the existing system are that the inefficiency of Human detection robot to identify the people getting trapped under water. Moreover the time taken for rescue operation is very large.

## III. PROPOSED SYSTEM

A flying quad-rotor aircraft proposed, moves in disaster-prone areas. The aircraft combines PIR sensors and cascading object technology, which can be used to identify injured lives and operate rescue systems. Without the help of a large number of rescuers, the precious lives of victims can be saved.

The advantages of the existing systems are that the system is more efficient and very simple to use. Also usage of drones to locate disaster areas provides greater advantages both in cost and response time when compared to the traditional methods.

The proposed platform comprises two major parts: Drone Systems and Ground Systems.

### *A.* Drone Systems

A drone is a complex set of hardware equipment's with its own specifications, technicalities and firmware. However, they are controlled by a microprocessor with auxiliary sensors that can either be built-in or external to the microprocessor board. Since these sort of technical details are out of the scope of this paper, further reference to these technical aspects will be mostly mentioned through the technical term for this piece of hardware, Flight Controller.

The Drone System shown in Fig.1 is composed by all the required flight components; each of these will play a critical role towards its safe operation.

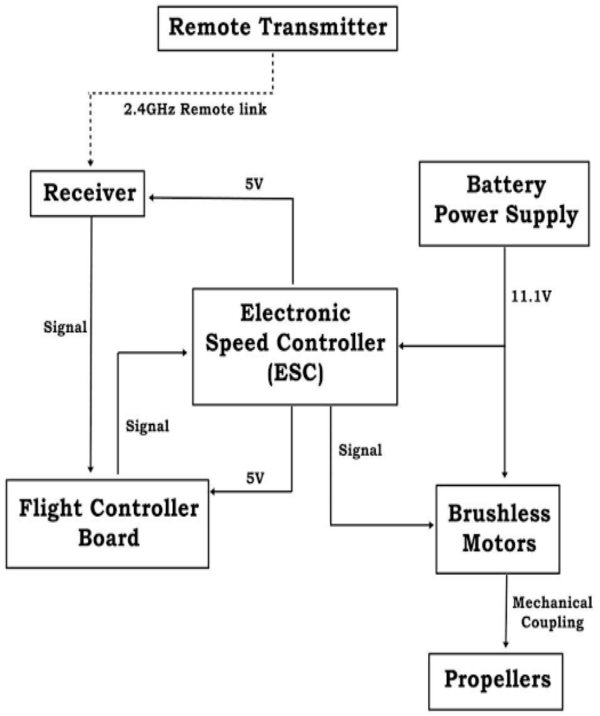


**Figure 1.** Block Diagram of Drone

Drone Broker is compatible with the main communication bus on the drone. The system also has a forwarding mechanism, which is responsible for directly transmitting messages with the ground system. Flight Analyzer connects to flight telemetry data in order to process and analyze drone behavior. Through pattern recognition and behavior analysis, the system can detect abnormal situations, proactively notify the ground system, and try to solve the problem. As a last resort, it can activate Fail-Safe Systems. A fault-tolerant system is a mechanism, after activating the mechanism; it will try to minimize the consequences of a failure. These can be very basic like preventing takeoff, or forcing a safe landing on the detection of low battery levels.

For debugging and registry purposes, the Drone Logger taps in to the required broker channels in order to create a local copy of all the events occurred within the drone. The Drone Controller acts as an adapter design pattern, translating broker command messages to messages that are readable by the FC.

The Flight Controller (FC) has the task of controlling the flying drone process and correct its behavior, which properly represents the command end-point and the internal drones' telemetry (altitude, temperatures, barometer, accelerometer, acceleration, voltage and cell voltages, GPS) data source generator. Drone Mapper is an additional extension to the features of real geofenced drones. When communicating directly with your significant other, Ground Mapper supports dynamic loading of maps based on current GPS data and a specific radius. Moreover, it is capable to provide richer information like obstacles and minimum/maximum altitude restrictions, common to urban scenarios.

*B.* **Ground Systems**

The Ground Systems are composed of services, systems and processes that are auxiliary to flight such as data storage, management. Front ends can extend flight functionalities such as support in-flight drone exchange, automated flight plan for area patrolling or aerial mapping/surveillance. The ground systems' communications are based on brokers. This plays a key role through their message routing capabilities, development and production instances. Also this co-exists side by side without the need to build a development oriented deployment of the entire platform. The composition of the ground systems architecture is details of each of the components will be explored as follows:

The function of Ground Broker is same as that of the Drone Broker which mainly supports the main communication bus to the Ground Systems. Due to the possibility of growing (vertically scalable), it has added responsibility of filtering and routing of each individual drone message. Moreover, because of its clear potential to be a platform bottleneck for architectural purposes, it must be a cluster (horizontally scalable) capable broker system. The Drone Manager has the responsibility of tracking the drones' status and serve as an internal proxy between the drone controlling and the actual controlled drone. Being a proxy, it can reroute commands to a different drone without the need of major reconfigurations either to the controller of the drones involved.

The Data Storage is the representation of a data storage system for later analysis or auditing purposes of the platform.

The Ground Logger connects to the required broker channels or topic to create a local copy of all the events occurred within Ground Systems for debugging and registry purposes. The Diagnosis Dashboard is a visual front-end that can access performance and sensor data from the entire platform and drones with the lowest latency possible, allowing visual trouble diagnosis. Moreover, it shall be capable of review older datasets for history purposes. The Control Dashboard stands for a GCS like front-end dashboard in which users may control their active drones through high-level commands which makes the drone to move up/down, left/right, etc. Moreover, they shall allow control for embedded-drone sensors like video cameras, thermal cameras, etc. The Systems Monitor is responsible for the monitoring of the Ground Systems for automated detection of service failures, network latency, disk usage and alert emission to the platform administrators.

The Telemetry Stream Processor connects to telemetry data sent by the drones, and it processes the received data to generate new information to feedback the platform like computing number of packets received by drone, computing statistical data for drone behavior analysis and so on. The Telemetry Analyzer connects to the flight telemetry data to analyze the behavior of the drone and detect anomalies. Through this system, the Ground Systems can react to behavior changes to mitigate the issues like parachute deployment, emergency landing. Unlike its similar process on board, the drone can perform complex analysis of flight parameters potentially gaining extra knowledge. Also it possesses awareness about the drone flight conditions. This is possible because of the availability of large computational capacity.

The Ground Mapper is the concept to extend the natural geo-fencing supported by most of the drones. It has the responsibility to track each drone location and actively update it for hazards, safe zones, landing zones, no fly zones, etc. Using dynamic map loading techniques, therefore saving memory and storage in the drone also removes the need to reupdate maps and geo-fencing configurations, keeping all the drones constantly up to date. The Drone Coordinator has the task of ensuring that drones in a certain area can coexist without interfering with each other. Tapped to flight telemetry, it can detect distances between each drone, up on trespassing a minimum safe distance can notify each of them and even suggest safe actions on how to proceed, like an aerial traffic controller.

### *C.* PIR Sensor

The block diagram of human body detection system consists of a Passive Infrared Sensor, an ATMEGA328P microcontroller and a buzzer which is used as an alarming device as shown in Fig.2.


**Figure 2.** Block Diagram of PIR Sensor

The Passive Infra-Red sensor (PIR sensor) is an electronic device that can measure infrared light emitted by objects in its field of view. Apparent movement is detected when an infrared source with a temperature, such as a human, passes in front of an infrared source at a different temperature like damaged wall or any other damaged materials under the debris.

Infrared radiation enters through the front of the sensor, called the sensor face. At the core of a PIR is a solid-state sensor or set of sensors, made from approximately 0.25 inches square of natural or man-made pyro electric materials. These pyro electric materials are in the form of a thin film which made of Gallium Nitride (GaN), Caesium Nitrate ($CsNO_3$), polyvinyl fluorides, derivatives of phenyl pyrazine, and cobalt phthalocyanine. The crystal which exhibits both piezoelectric and pyroelectric properties is Lithium Tantalate ($LiTaO_3$).

The Passive Infrared sensor used in the project which emits infrared rays to detect humans. Since the living human body emits thermal radiation and received by the PIR sensor and processed to identify people. Once the alive human being is located in debris, it immediately sends the signal to the microcontroller and this microcontroller will digitize the signal. The buzzer which is connected at the output pin of microcontroller is enabled. To generate the alarming sound, the buzzer needs 100mA of current. So there is a need of resistor and transistor circuit to amplify the current from 30mA to 100mA to the microcontroller.

### *D.* ATMEGA328P Microcontroller

The ATMEGA8A is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. ATMEGA8A achieves throughputs close to 1 MIPS per MHz's by executing powerful instructions in a single clock cycle. This allows the system to optimize the device for power consumption versus processing speed.

### *E.* Flight Controller

Flight controller is the main functioning body of our aircraft. It's a circuit board that receives different commands sent by user to control speed of motors so that quad-copter could be stable in fly mode. By changing the RPMs of each propeller, the quadcopter flies and moves on. So, when one moves a stick on the transmitter it sends the signal to the controller via receiver. This command needs to be converted into the proper commands to operate each of the four motors on the quad-copter. This can be done by the flight control system. The coordination of the control of all four propellers needed to make the drone fly can be simplified by the Flight controller. The flight controller has the ability to connect to several other devices and sensors.

### *F.* RF Transmitter and Receiver

The radio frequency transmitter transmits the radio frequency signals whereas the radio frequency receiver receives the radio frequency signals and demodulates the same. In this way, the commands given by transmitter are received by a radio receiver connected to flight controller. The number of channels in transmitter determines how many actions of aircraft can be controlled by pilot. Minimum of four channels are needed to control a quad copter which includes pitch, Roll, throttle, yaw. RF receiver operates on 2.4GHz of radio frequency.

### *G.* Electronic Speed Controller

Electronic speed controllers (ESC) receive command from micro controller circuit board and further give command to the motors for rotation. Four 30A ESCs (electronic speed controllers) are utilized in proposed Quadcopter. It converts the PWM signal received from flight controller or radio receiver and then drives the brush less motor by providing required electrical power. ESC is an electric circuit that controls the speed and direction of electric motor by varying the magnetic forces created by the windings and magnets within the motor.

### *H.* Brushless DC Motor

BL-DC motor additionally called electronically commuted motors (i.e., ECMs motors). BLDC motor is a synchronous motor that runs on DC current. The rated power, in kV, rotates at 1000 rpm per 1 volt (if its rated power is 1 kV).It has several advantages over brushed DC motors like more reliability, low noise, reduction in EM Interference (EMI), high torque per watt etc.

### *I.* Propeller

A propeller is a type of fan that transfers power by converting rotary motion into thrust. The pressure difference occurs between the forward and backward surfaces of the airfoil-shaped blade, and a fluid such as air or water is accelerated behind the blade.

### *J.* Axis Gyro Sensor

Quad copter requires flight stability sensors that stabilize quad copter during its flight mode. The gyroscope is a low-power sensor, a sensor element and an IC interface. The measured angular velocity can be transmitted to the user through the digital 12C/SPI interface.

### K. Frame or Chasis

Li-Po (Lithium Polymer battery) is a storage battery of lithium-ion technology that can provide higher specific energy. This can be used in applications with strict weight requirements. It also provides high voltage and long run time as they hold huge power in small package and have high discharge rates which are required for powering quadcopters.

### L. Lithium-Ion Battery

The plastic polymer frame is used and it is best suited for the propellers and payloads which have to be lifted along with quadcopter. Quad copter requires a frame to host a 4 BLDC motors, 4 ESCs.

Activity Flowchart is a graphical representation of step-by-step action and activity workflows with support for selection, iteration, and parallelism as shown in Fig 3. Flowcharts can be used to describe the business and step-by-step workflows of the components of a system. The Activity Flowchart shows the general flow of control.

As listed in Flowchart once the rescue process gets started, the flight controller activates all the system necessary for flight, positioning and speed. The PIR sensor unit is also activated which scans for the presence of any living creatures under the debris.

## IV. Conclusion And Future Work

The proposed system shown in Fig. 4 is an effective and a safe system to ensure that there are no humans left behind in a rescue operation.

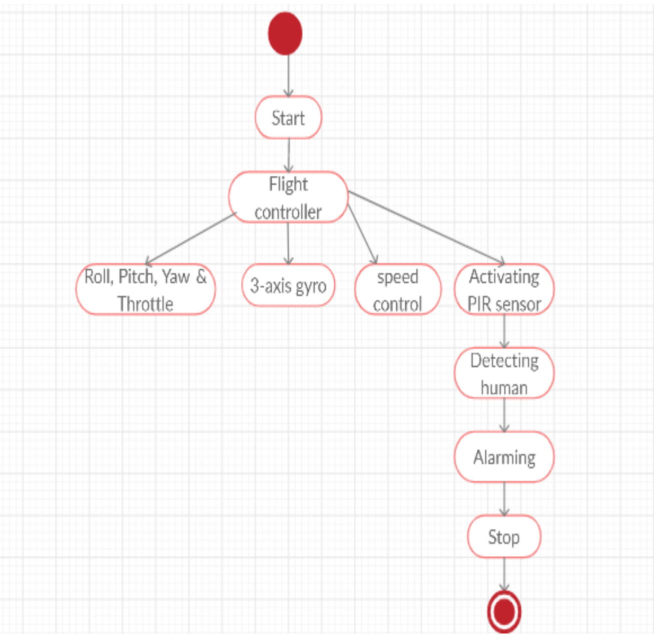


**Figure 3.** Activity Flowchart

**Figure 4.**Drone Design

In the existing system, Human detection robot is not very effective and it is not able to identify the people getting trapped on the water and the proposed system is very helpful for the detection of human in all kind of natural calamities. The system is used to handle the quad-copter by everyone and does not need an expert to handle. The system is friendly, economical, efficient, semi-autonomous and very simple to use.

The proposed an automated flying drone's platform, building a modular platform to support control abstraction and direct control decoupling, therefore effectively standardizing integration methodologies to allow drones as a service, where high level commands can be issued to the platform, removing the complexities of actually flying the drone itself directly. Moreover, the platform supports user-friendly control of drones, which is an important step towards integrating multiple drones and multiple types of drones within the platform, therefore creating a value-added tool to develop and support more complex tasks and use cases with usage of flying drones. The results show that the proposed platform is able to properly abstract and decouple the direct control, handling up to 32 drones without significant impact to the observed efficiency. The platform is also capable of displaying and correlating sensor metrics obtained in real-time during the drones' flight.

In future, the system is to integrate external sensors and provide mechanisms for data gathering, as well as cameras for tracking objects and people. Thus, the system can also be used to generate energy from the rotating propellers which increases the battery capacity utilized for the camera and for the flight of the drone. The new control devices, new drives and advanced algorithms can be used to make more accurate and faster. Long range LIDAR sensors can be implemented in the future work to make more effective.

**References**

[1] Alexis, K.; Nikolakopoulos, G.; Tzes, A. "On trajectory tracking model predictive control of an unmanned quadrotor helicopter subject to aerodynamic disturbances". Asian J. Control 2014, 16, 209–224

[2] Asha Gupta, Dhruti Desai, Divya Dangi, Nidhee Panchal, "Live Human Detection Robot", International Journal for Innovative Research in Science and Technology (IJIRST)Volume 1, Issue6, November 2014.

[3] Baiocchi, V.; Dominici, D.; Mormile, M. UAV application in post-seismic environment. Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci. XL-I W 2013, 2, 21–25

[4] B. Uthra, D. Adchiya, K. Anupriya, "Live Human Detection System for Earthquake Rescue Operation", Journal of Computation in Bioscience and Engineering, Volume 2, Issue 3, September 11, 2015.

[5] Chanchal V. Dahat, Mittika Ukey, Sonam Gupta, Bhagyashali Masane, "Alive Human Detection Robot in Rescue Operation", International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 5, Issue 3, March2016.

[6] H. Shakhatreh et al., "Unmanned Aerial Vehicles: A Survey on Civil Applications and Key Research Challenges," arXiv preprint arXiv:1805.00881, 2018.

[7] J. Senthilnath, M. Kandukuri, A. Dokania, and K. Ramesh, "Application of UAV imaging platform for vegetation analysis based on spectral spatial methods," Computers and Electronics in Agriculture, vol. 140, pp. 8-24, 2017

[8] K. Máthé and L. Buşoniu, "Vision and control for UAVs: A survey of general methods and of inexpensive platforms for infrastructure inspection," Sensors, vol. 15, no. 7, pp. 14887-14916, 2015.

[9] L. Gupta, R. Jain, and G. Vaszkun, "Survey of important issues in UAV communication networks," IEEE Communications Surveys & Tutorials, vol. 18, no. 2, pp. 1123-1152, 2016.

[10] M. B. Bejiga, A. Zeggada, A. Nouffidj, and F. Melgani, "A convolutional neural network approach for assisting avalanche search and rescue operations with UAV imagery," Remote Sensing, vol. 9, no. 2, p. 100, 2017

[11] P. Daponte, L. De Vito, G. Mazzilli, F. Picariello, S. Rapuano, and M. Riccio, "Metrology for drone and drone for metrology: Measurement systems on small civilian drones," in Metrology for Aerospace (Metro Aerospace), 2015 IEEE, 2015, pp. 306-311: IEEE.