RESCUE ASSISTING UAV

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ABSTRACT

The rescue assisting UAV is capable of being op- erated in the air at certain altitudes as well as through the surface of water. A UAV with this capability can help to locate and assess the situation of trapped people. In challenging environments such as tunnels, and confined spaces, and carrying out dangerous missions in hazardous environments. The UAV helps to identify people in challenging environments by using image processing. The UAV is also equipped with a sensor that can analyse temperature, pressure, IAQ, CO_2, VOC, and humidity in the atmosphere and other challenging environments. For the controlling,stabilization, and motions of the UAV, a flight controller and ESC were used, and additional spotlights were provided for better vision. A protecting case is used on the UAV to avoid damage to the sensor and camera. The UAV can be used for search and rescue operations in tunnels, confined spaces, and for surveillance in hazardous environments. Through this project, we aim to showcase how this innovative technology can be implemented effectively, offering enhanced capabilities for multiple applications in hazardous environments.

1. INTRODUCTION

To address the challenges of tunnel collapses and under- ground accidents, an Unmanned Aerial Vehicle (UAV) solution can be implemented. Due to these accidents various issues such as communication breakdown, psychological impact, toxic fumes, structural collapse, fire, and smoke can lead to death of individuals. This UAV is specifically designed to handle emergency situations in challenging environments. It can operate on both air and water, making it a versatile and powerful tool for assisting in rescue operations. Equipped with advanced sensors and imaging technology, the UAV can navigate through challenging environments with precision, providing real-time information to rescue teams. It can quickly locate survivors, assess their condition, and relay vital data to the rescue team. One of the standout features of this UAV is its ability to transition seamlessly from flying to floating. This means it can access hard-to-reach areas within challenging environments, even those floating in water.[1] Its unique design

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ensures it remains operational in challenging environments, such as flooded tunnels or areas with high humidity. The UAV durability and resilience make it suitable for demanding conditions. It can withstand a maximum temperature and is built to handle water submersion. This makes it an invaluable asset in disaster-stricken areas where time is of the essence. Additionally, spotlights play a crucial role in enabling the UAVs to operate in lowlight or dark conditions. [2]We use a sensor which can detect and analyse various environmental parameters such as temperature, pressure, IAQ, CO_2, VOC, and humidity in the UAVs rescue operation. They provide valuable data for monitoring and decision making. Using image processing, the UAV allows rescue teams to locate individuals and various objects who may be hidden from view. This capability is particularly valuable in situations where time is of the essence, such as in the aftermath of a tunnel collapse or fire. In summary, the Rescue assisting UAV is a game changing innovation that combines the best of aerial and aquatic capabilities. Its ability to swiftly navigate tunnels, pro- vide critical information, and withstand challenging conditionsmakes it a vital tool in saving lives during tunnel emergencies

2. COMPONENTS USED

A. Mamba f405 & f40 ESC Stack Flight Controller

The Mamba F405 & F40 ESC Stack Flight Controller stands out as a top-tier solution for FPV drones, tailored for both racing and freestyle flying. Its core, the Mamba F405 flight controller, boasts a potent STM32F405 processor, ensuring efficient execution of flight control algorithms for a stable and responsive flying experience. Additionally, its integrated on-screen display (OSD) overlays critical flight data onto the pilot's FPV video feed, enhancing situational awareness with real-time telemetry information that's customizable to individual preferences.

Complementing the flight controller are the Mamba F40 electronic speed controllers (ESCs), renowned for their high current handling capabilities and exceptional performance.

These ESCs, pre-flashed with Bluejay firmware, offer ad- vanced performance and configurability, ensuring smooth throttle control throughout flight. Their support for the DShot protocol enables digital communication with the flight

INTERNATIONAL JOURNAL OF PROGRESSIVE RESEARCH IN ENGINEERING MANAGEMENT AND SCIENCE (IJPREMS)

e-ISSN : 2583-1062

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 06, June 2024, pp: 321-330

Impact Factor: 5.725

con- troller, resulting in faster response times and improved relia- bility. The integration of the Mamba F405 flight controller and F40 ESCs streamlines the assembly process for high-performance FPV drones, reducing setup time and potential points of fail- ure. Compatible with a wide range of components, including motors and FPV cameras, this stack offers flexibility for cus- tomization to meet specific requirements. Engineered to excel in competitive racing or execute impressive aerial maneuvers in freestyle flights, the Mamba F405 & F40 ESC Stack Flight Controller delivers unparalleled control and responsiveness, enhancing the FPV flying experience with precision and reliability.

B. Velox 1950kv BLDC Motor

The Velox 1950kv BLDC motor is highly regarded in the realm of high-performance drones, especially prized for racing and freestyle applications. With its finely tuned kv rating of 1950, this motor excels in agility and speed, facilitating rapid manoeuvres and swift accelerations crucial for competitive flying.

Crafted with precision-engineered components, the Velox 1950kv motor offers an impressive power-to-weight ratio, enabling drones to achieve remarkable speeds while maintain- ing agility and responsiveness. Its lightweight design reduces inertia, facilitating rapid changes in direction and precise throttle responses, essential for navigating tight corners and executing intricate aerial manoeuvres.

Equipped with high-quality bearings and magnets, the Velox 1950kv motor operates smoothly and efficiently, ensuring con- sistent performance even under demanding flight conditions. Its robust build enhances durability, allowing the motor to endure intense flying sessions and occasional crashes with resilience. Compatible with a wide range of propellers and electronic speed controllers (ESCs), this motor offers versatil- ity, catering to various flying styles and preferences, making it a preferred choice among FPV enthusiasts and professional pilots.

C. QAV 250 4mm Carbon Fiber Frame

The QAV 250 4mm carbon fiber frame stands out as a durable and lightweight chassis tailored specifically for FPV (First Person View) racing drones. Crafted from pre- mium carbon fiber material with a thickness of 4mm, this frame offers an exceptional strength-to-weight ratio, ensuring resilience against impacts and crashes while maintaining a minimal overall weight. Its robust construction provides a sturdy foundation for mounting essential components such as motors, electronic speed controllers (ESCs), flight controllers, and FPV cameras, enabling a streamlined and compact build. With its compact and symmetrical X-shaped design, the QAV 250 frame prioritizes agility and maneuverability, mak- ing it ideal for navigating tight courses and executing rapid directional changes. The balanced weight distribution across the drone's center of gravity enhances stability and responsive- ness during flight. Moreover, the frame's aerodynamic profile minimizes drag, enabling drones to achieve higher speeds with reduced air resistance, essential for competitive racing scenarios.

Thoughtful design elements such as integrated mount- ing points, cable routing channels, and vibration-dampening features enhance both functionality and ease of assembly. These considerations simplify the installation of electronic components and ensure clean wiring layouts, minimizing the risk of interference and signal degradation. Additionally, the vibration-dampening features help reduce the Jello effect in FPV video footage, resulting in smoother and more immersive viewing experiences for pilots.

Engineered for compatibility with standard-size electron- ics and components, the QAV 250 frame offers versatility and adaptability, accommodating a wide range of motors, ESCs, flight controllers, and FPV systems. This compatibility allows pilots to customize their drones according to their specific preferences and performance requirements, whether emphasizing speed, agility, or durability. Furthermore, the modular design of the frame facilitates easy maintenance and repairs, enabling quick component swaps or upgrades without extensive disassembly. Overall, the QAV 250 4mm carbon fiber frame embodies the desired characteristics of a high-performance FPV racing drone chassis, providing a solid foundation for building fast, nimble, and reliable racing drones capable of confidently tackling the most challenging courses.

D. CNHL 1200maH 100cc 4s Lipo Battery

The CNHL (China Hobby Line) 1200mAh 100C 4S LiPo (Lithium Polymer) battery is a favored option among drone enthusiasts for its blend of power, capacity, and reliability. With its 1200mAh capacity, this battery offers ample energy storage, ensuring drones have sufficient power for extended flight durations. Its high discharge rate of 100C allows the battery to deliver bursts of power, making it suitable for both racing and freestyle applications where rapid acceleration and maneuverability are crucial.

Constructed using high-quality lithium polymer cells, the CNHL 1200mAh battery strikes a balance between energy density and durability. This results in a lightweight battery pack with an excellent energy-to-weight ratio, enabling drones to achieve impressive performance without compromising agility or responsiveness. Furthermore, its robust

construction enhances resistance to impact and vibration, ensuring reliable operation even during aggressive flight maneuvers or rough landings.

Equipped with a 4S (4-cell) configuration, the CNHL 1200mAh battery provides drones with the voltage necessary to power high-performance motors and electronics. The 4S setup delivers a nominal voltage of around 14.8 volts, offering ample power for drones to achieve high speeds and rapid accelerations. Compatible with a wide range of drones, the 4S configuration provides versatility and flexibility for pilots with various aircraft setups and preferences.

E. Genmfan Vanover 5-inch propeller

The Genmfan Vanover 5-inch propeller stands out as a premium-grade component tailored for high-performance FPV racing drones. Developed in collaboration with professional pilot Alex Vanover, these propellers excel in delivering excep- tional thrust, efficiency, and durability, meeting the demands of competitive racing and freestyle flying. With a 5-inch diameter, they offer a balanced combination of agility and stability, ensuring precise control and responsive handling during fast- paced maneuvers.

Crafted from top-quality materials, the Genmfan Vanover propellers feature a well-balanced design optimized for aero- dynamic efficiency and minimal air resistance. Their care- fully engineered airfoil profile and blade geometry contribute to efficient thrust generation while reducing drag, enabling drones to achieve impressive speeds and accelerations without compromising control or stability. Moreover, their durability ensures they can withstand high-speed flight and occasional impacts while maintaining peak performance.

Designed to deliver consistent performance across various flight conditions, the Genmfan Vanover propellers provide reliable thrust and precise control, whether navigating tight racecourses or executing intricate freestyle maneuvers. Their balanced construction and quality manufacturing processes minimize vibrations, ensuring smooth operation and a stable flight experience. Compatible with standard mounting hubs, these propellers offer plug-and-play convenience, enhancing versatility and ease of maintenance for pilots to customize their drones with confidence.

F. Quadkart 24cm Battery Strap

The Quadkart 24cm battery strap serves as a critical ac- cessory, ensuring the secure fastening of batteries to drone or RC vehicle frames. Its 24cm length offers ample adjustability to accommodate various battery sizes and configurations, guaranteeing a snug and reliable fit during flight. Crafted from durable materials like nylon or polyester webbing, the strap provides robust support, preventing the battery from shifting or dislodging during high-speed maneuvers or sudden changes in direction.

Equipped with a hook-and-loop (Velcro) closure system, the Quadkart battery strap enables quick and effortless installation, allowing pilots to securely attach or remove the battery with minimal effort. The hook-and-loop fastener ensures a strong and reliable hold, keeping the battery firmly in place through- out the flight session. Furthermore, the strap's adjustable length enables pilots to fine-tune the tightness of the battery mount, offering a customized fit tailored to their specific preferences and aircraft setup.

Designed for durability and longevity, the Quadkart 24cm battery strap can withstand the stresses encountered during demanding flight conditions. Reinforced stitching and high- quality materials ensure the strap maintains its integrity even after repeated use, minimizing the risk of premature wear or failure. Whether used in FPV racing drones, aerial photog- raphy platforms, or RC cars and boats, the Quadkart battery strap provides a reliable and hassle-free solution for securing batteries and other components, allowing pilots to focus on their flying experience with confidence.

G. Silicon wire

Silicone wire stands out as a versatile and highly valued electrical conductor appreciated for its flexibility, durability, and heat resistance. Comprising high-grade silicone rubber insulation surrounding conductive wire strands, silicone wire offers superior flexibility compared to traditional PVC-coated wire. Its exceptional flexibility allows it to bend and conform to tight spaces without risking damage or kinking, making it perfect for intricate wiring setups in various applications, from RC vehicles and drones to electronics projects and automotive wiring.

A standout feature of silicone wire is its remarkable tem- perature resistance. Unlike PVC insulation, which can become brittle and degrade in high temperatures, silicone insulation re- mains pliable and stable even in extreme heat conditions. This quality renders silicone wire suitable for use in environments where temperatures fluctuate or where components generate significant heat, such as within vehicle engine compartments or near high-power electronics.

Furthermore, silicone wire boasts excellent electrical per- formance, with low electrical resistance and high dielectric strength. This ensures efficient power transmission and mini- mal voltage drop over extended distances, guaranteeing consis- tent and reliable operation of electrical systems. Additionally, silicone insulation provides superb protection

INTERNATIONAL JOURNAL OF PROGRESSIVE
RESEARCH IN ENGINEERING MANAGEMENT
AND SCIENCE (IJPREMS)

e-ISSN :
2583-1062

Impact
Factor:
5.725

www.ijprems.com
editor@ijprems.com

Vol. 04, Issue 06, June 2024, pp: 321-330

against moisture, chemicals, and abrasion, further enhancing the wire's longevity and reliability in harsh operating environments. Overall, sil- icone wire is the preferred choice for hobbyists, engineers, and DIY enthusiasts seeking high-quality electrical wiring solutions that offer exceptional performance and durability across a broad spectrum of applications.

H. ESC Race Wire Extension Board

The ESC Race Wire Extension Board is a crucial accessory for FPV racing drones, designed to simplify and enhance the installation and maintenance of electronic speed controllers (ESCs). Positioned between the ESC and the motor, this board serves multiple functions. Firstly, it acts as a protective bar- rier, shielding the ESC wiring from potential damage caused by debris, crashes, or propeller strikes, thereby safeguarding critical components and preventing electrical shorts.

Another significant feature of the ESC Race Wire Extension Board is its integrated signal wire routing system, which enables pilots to neatly manage the signal wires from the ESC to the flight controller. This organization minimizes clutter and reduces the risk of interference or signal degradation, optimiz- ing the performance and reliability of the drone's electronic systems for precise control and responsiveness during flight.

Moreover, the extension board often includes built-in volt- age regulators or filtering circuits to stabilize the power supply to the ESCs. These components ensure the ESCs receive clean and consistent power, free from voltage spikes or fluctuations that could lead to erratic motor behavior or electrical interfer- ence. By providing a stable power source, the extension board optimizes the performance of the ESCs, enhancing the overall flight experience for pilots.

In summary, the ESC Race Wire Extension Board is an invaluable accessory for FPV racing drones, offering pro- tection, organization, and power optimization for the ESCs. Whether used by amateur racers or seasoned professionals, this accessory streamlines the build process, enhances reliability, and improves drone performance, allowing pilots to focus on pushing the limits of speed.

ESC Race Wire LED (Spotlight)

The ESC Race Wire Extension Board presents a compact and innovative solution tailored to simplify the installation and upkeep of electronic speed controllers (ESCs) in FPV racing drones. Positioned as a protective barrier between the ESC and the motor, this board shields the ESC wiring from potential damage due to debris, crashes, or propeller strikes. Its sturdy housing ensures critical components are safeguarded, reducing the risk of electrical shorts and prolonging the lifespan of the drone's electronic systems.

Furthermore, the extension board integrates a signal wire routing system, facilitating organized management of wires from the ESC to the flight controller. This streamlined layout minimizes clutter and diminishes the likelihood of interference or signal degradation, thereby optimizing the drone's per- formance and responsiveness during flight. Certain extension boards may also incorporate voltage regulators or filtering circuits to stabilize the power supply to the ESCs, ensuring they receive clean and consistent power for peak performance. Overall, the ESC Race Wire Extension Board provides a comprehensive solution for improving the reliability, organi- zation, and performance of FPV racing drones. Its protective features, wire management capabilities, and power optimiza- tion functions render it an indispensable accessory for both amateur and professional pilots seeking to optimize their drone builds for speed, agility, and durability.

Flysky FS-i6x 2.4GHz 6CH AFHDS 2A RC Transmitter

The Flysky FS-i6X 2.4GHz 6CH AFHDS 2A RC transmit- ter stands out as a versatile and dependable control system tailored to meet the needs of a diverse range of RC (Radio Control) enthusiasts. Operating on the 2.4GHz frequency band, this transmitter ensures robust and interference-free communi- cation between the pilot and their RC vehicle, whether it's an airplane, helicopter, drone, car, or boat. The implementation of the AFHDS 2A protocol further enhances signal stability and range, providing pilots with greater confidence in controlling their aircraft or vehicle with precision and accuracy.

Equipped with six channels, users of the FS-i6X transmitter enjoy ample flexibility in controlling various functions of their RC vehicle. Each channel can be customized and programmed to suit specific preferences, enabling pilots to fine- tune throttle, steering, and auxiliary functions to match their flying or driving style. Moreover, the transmitter features advanced functionalities such as endpoint adjustment, dual rates, and exponential curves, allowing pilots to tailor their control inputs with precision and finesse, thereby enhancing their overall experience and performance.

Designed with user-friendly functionality in mind, the FS- i6X transmitter boasts an ergonomic design and an intuitive interface. The large backlit LCD screen provides pilots with real-time telemetry data and menu settings, enhancing situa- tional awareness and ease of operation during flight or driving sessions. Additionally, the transmitter is equipped

with rotary dials and push-button controls for effortless navigation through menus and settings, ensuring quick and hassle-free adjustments while in the field or at the track.

FS-iA10B 2.4GHz Receiver

The FS-iA10B 2.4GHz receiver offers reliable radio com- munication for RC vehicles and aircraft, operating on the advanced AFHDS 2A protocol. With ten channels, it provides extensive control options, including telemetry data transmis- sion for real-time monitoring. Its fail-safe function and antenna diversity enhance reliability, while compatibility with a range of transmitters makes it suitable for various RC applications, from airplanes to boats. Overall, the FS-iA10B ensures smooth and responsive operation, catering to pilots of all skill levels in diverse flying scenarios.

BME680 Digital Humidity Temperature Pressure High Al- titude Sensor Module

The BME680 Digital Humidity Temperature Pressure High Altitude Sensor Module is a state-of-the-art environmental sensing solution, packing multiple sensors into a single com- pact package. Powered by the Bosch Sensortec BME680 sensor chip, renowned for its accuracy and reliability, this module delivers comprehensive measurements of temperature, humidity, barometric pressure, and air quality (Volatile Or- ganic Compounds - VOCs). Its versatility extends to applica- tions ranging from weather monitoring and indoor air quality assessment to altitude tracking in drones and environmental sensing in IoT devices.

The module's temperature sensor provides precise ambient temperature measurements, crucial for climate monitoring, thermal management, and industrial control. Additionally, its integrated humidity sensor offers accurate readings of relative humidity, valuable for monitoring moisture levels in various environments, including agriculture and HVAC systems.

The pressure sensor within the BME680 module delivers ex- ceptional precision in measuring barometric pressure, essential for weather forecasting, altitude estimation, and atmospheric studies. Moreover, its air quality sensor detects VOCs in the atmosphere, offering insights into indoor air quality, pollutant levels, and potential health risks.

Interfacing with microcontrollers or development boards via digital communication protocols like I2C or SPI, the BME680 module enables seamless integration into electronic systems. Its low power consumption makes it suitable for battery- powered applications, ensuring extended operation without rapid battery depletion.

Compact and lightweight, the BME680 module is easily integrated into space-constrained environments, suitable for both indoor and outdoor use. Its versatility, accuracy, and relia- bility make it a preferred choice for engineers, researchers, and hobbyists seeking precise environmental sensing capabilities. Whether deployed in weather stations, IoT devices, or indoor air quality monitors, the BME680 module provides a compre- hensive solution for measuring key atmospheric parameters with confidence and precision.

ESP32 Camera Module

The ESP32 Camera Module, powered by the ESP32 mi- crocontroller, brings imaging capabilities to IoT projects. Its integrated OV2640 camera captures high-quality images and video streams. Its compact size enables easy integration into space-constrained projects, while supporting both Wi-Fi and Bluetooth allows for wireless transmission of captured media. Programmable in various languages like Arduino IDE and MicroPython, developers can customize functionalities such as motion detection and object recognition. With low power con- sumption, it's suitable for battery-powered applications, and its compatibility with external sensors enhances its versatility, making it a robust solution for IoT systems with integrated camera functionality.

Pool noodle

Pool noodles are the quintessential symbol of summertime fun, offering buoyant support and endless entertainment in swimming pools worldwide. Their lightweight, colorful design appeals to swimmers of all ages, providing a playful element to aquatic activities. Children learning to swim find comfort in their buoyancy, while adults enjoy lounging on them for relaxation.

But beyond their conventional role as flotation aids, pool noodles have proven to be remarkably versatile. Their soft foam texture and flexible nature make them perfect for various DIY projects and creative endeavors. Whether repurposed into homemade pool games, used as cushions for poolside lounging, or transformed into whimsical party decorations, pool noodles inspire endless possibilities.

In recent years, pool noodles have transcended their aquatic origins, becoming staples in crafting, hobbies, and DIY projects. From constructing DIY crafts to enhancing home or- ganization solutions, pool noodles have established themselves as versatile materials with wide-ranging applications.

In essence, pool noodles epitomize the spirit of summer- time creativity and relaxation, offering a simple yet endlessly adaptable tool for fun and innovation both in and out of the water.

ESP-8266 D1 Mini Board

The ESP8266 D1 Mini board stands out as a compact yet powerful platform for IoT projects, leveraging the capabilities of the ESP8266 Wi-Fi module. Its built-in Wi-Fi connectivity enables seamless internet connectivity, facilitating remote con- trol, data logging, and cloud integration for IoT applications. Powered by the ESP8266 microcontroller, the D1 Mini offers ample processing power and memory for diverse tasks, including sensor data acquisition, web server hosting, and device communication. Its small form factor and Arduino compatibility streamline prototyping and integration, while its affordability ensures accessibility to hobbyists and profession- als alike. Moreover, the board supports various development environments and programming languages, offering flexibility to developers.

Despite GPIO numbering differences, the D1 Mini board provides clarity through its extensive ecosystem of libraries and community support. Whether you're a novice experiment- ing with IoT or a seasoned developer creating commercial solutions, the D1 Mini offers a robust platform to material- ize your ideas. Its compact size, robust features, and broad support make it a favored choice among IoT enthusiasts and professionals alike, empowering innovation in the IoT domain.

Forex Board

A Forex board, also known as a foamex board or PVC foam board, is a lightweight and versatile material commonly used in signage, advertising, and display applications. It is made from expanded PVC (polyvinyl chloride) foam, which gives it a rigid yet lightweight structure.

Forex boards are known for their durability, weather re- sistance, and ease of use. They can be easily cut, drilled, and shaped to create custom signage or display solutions for indoor and outdoor use. The smooth surface of Forex boards also makes them suitable for printing high-quality graphics, text, and images, making them popular for advertising and promotional displays.

Due to their lightweight nature, Forex boards are easy to handle and transport, making them ideal for temporary or portable displays at trade shows, exhibitions, and events. They are also commonly used for permanent signage in retail stores, restaurants, and offices, thanks to their long-lasting durability and professional appearance.

3. METHODOLOGY

In this project, the primary purpose of Rescue Assisting UAVs is to provide real-time assistance in locating individuals trapped or injured in disaster situations. The UAV is designed to navigate through both air and water environments. A crucial component enabling water navigation is the use of pool noodles, cylindrical pieces of buoyant polyethylene foam, attached to the UAV's arms to ensure flotation on the water's surface.[3]

The UAV incorporates a BME680 sensor from Bosch Sen- sortec, capable of detecting various gases, pressure, humidity, and temperature. This sensor plays a critical role in monitoring

air quality in disaster situations where there may be gas leaks or other hazardous conditions. Additionally, an ESP32-CAM module is utilized for object detection in rescue applications. This module, equipped with a 2MP camera and TF card slot, aids in identifying objects and individuals in challenging environments.[4]

The UAV's frame is constructed using a Q250 carbon fiber frame, known for its high stiffness-to-weight ratio, rigidity, and stability. The carbon fiber arms, with a thickness of 4mm, ensure durability and minimize arm breakage during hard landings. The propulsion system comprises a 1950kv BLDC motor and 5-inch propellers, providing sufficient thrust on a 4S battery for movement over water and in hazardous environments.

To enhance visibility during rescue operations, the UAV is equipped with two spotlights mounted on the rear arms. This placement ensures optimal visibility regardless of the UAV's orientation during flight.[5] The Mamba Flight Con- troller and Bluejay-configured ESC provide additional features such as stabilization, handling improvements, motor rotation customization, and reduced power consumption.

Overall, this UAV system combines advanced sensors, ro- bust frame design, powerful propulsion, and intelligent control systems to assist in disaster response scenarios effectively.

4. BLOCK DIAGRAM

Flight Controller, this is the 'brain' of the drone. It receives input from the user (via the RF Receiver), processes it, and sends out commands to the ESC. It also receives data from the various sensors and uses this information to maintain stable flight.[6] ESC (Electronic Speed Controller) This is a crucial component of a drone. It controls the

speed of the drone's motors, ensuring precise control interpreting and directing the commands it receives from the flight controller. The flight controller manages the overall UAV operation, orchestrating the movements based on user inputs. The ESC is connected to the BLDC Motor.[7] BLDC Motor (Brushless DC Motor) This is the drone's main source of propulsion. The BLDC Motor spins the propellers, which generate Thrust to lift and allow the drone to fly. The speed of the motor is controlled by the ESC. RF Transmitter It sends signals to the RF Receiver. For UAV navigation and control. RF Receiver receives the control signals from the RF transmitter. These signals are then passed to the Flight Controller for processing. Microcontroller The en- tire sensor suite is connected to a microcontroller, specifically the ESP8266 D1, which acts as the brain of the sensors. This microcontroller processes the data collected by the sensors, enabling intelligent decision-making based on environmental inputs. Sensor's UAV is equipped with a single sensor named BME680. The BME680 sensor helps to detect various envi- ronmental parameters including, temperature, pressure, IAQ, VOC CO_2, and humidity. The sensor collects all the details and passes it onto the microcontroller. Camera Module ESP-32 is a low-cost ESP32-based development board with onboard camera. Which is used for image recognition it sends real- time video to ground station screen as an image recognition model. In conclusion, this block diagram represents a UAV system that integrates various components for efficient and autonomous operation. The key components include the ESC, BLDC Motor, Flight Controller, RF Receiver, Sensors, Micro- controller, RF Transmitter, and ESP-32 Camera Module. The ESC controls the speed of the BLDC Motor, which provides the UAV propulsion. The Flight Controller, acting as the UAV brain, processes inputs from the user and sends commands to the ESC. The RF Receiver receives controlled signals from the RF Transmitter. Microcontroller sends the data from the sensor to the ground station and the CAM module sends receiving object direction visuals to the ground station.[8] This block diagram illustrates the interconnected nature of UAV components and their roles in ensuring successful flight oper- ations and application ranging from confined-space navigation to environmental monitoring and surveillance. It underscores the importance of each component in achieving the UAV objectives. This understanding is crucial for troubleshooting and enhancing UAV performance.
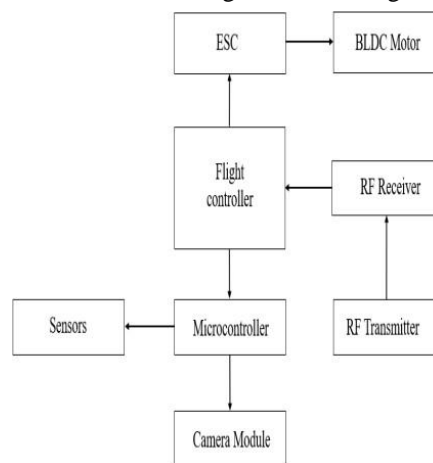

Fig. 1. BLOCK DIAGRAM

5. PROGRAM LOGIC

Introduction:

The Rescue assisting program orchestrates the functionality of a device designed for environmental monitoring and data visualization. It uses an ESP8266 microcontroller along with the BME680 sensor to collect data on various environmental parameters such as temperature, pressure, humidity, gas resis- tance, Indoor Air Quality (IAQ), CO2 equivalent, and breath VOC equivalent. This device aims to provide insights into indoor air quality and aid in identifying potential health haz- ards. The integration of Blynk IoT platform enables users to visualize the collected data in real-time, facilitating informed decision-making regarding environmental conditions.[9]

Libaries Used:

*   bsec.h: This library facilitates communication with the BME680 sensor. It providespredefined functions to in-
*   teract with the sensor and retrieve environmental data accurately.
*   Blynk.h: Used for integrating the device with the Blynk IoT platform. It enables the transmission of sensor data to the Blynk server for visualization and monitoring.
*   ESP8266WiFi.h: This library enables the ESP8266 mi- crocontroller to establish a WiFi connection, allowing the device to connect to the internet and communicate with external servers or platforms.

- BlynkSimpleEsp8266.h: This library simplifies the pro- cess of integrating the ESP8266 microcontroller with the Blynk IoT platform. It provides functions for initializing the Blynk connection and transmitting data to virtual pins.

Working/Logic: The program begins with the initialization of various components, libraries and establishes necessary connections. Serial communication is initiated to facilitate debugging and monitoring. Next, I2C communication is con- figured for communication with the BME680 sensor, allowing the microcontroller to communicate with the sensor over the I2C protocol. The program then proceeds to establish a Wi-Fi connection using the provided SSID and password, enabling internet access for data transmission.[10]Once connected, it initializes the Blynk integration by providing the authen- tication token required for communication with the Blynk server. The BME680 sensor is initialized, and its subscription is updated to include relevant sensor data types such as temperature, pressure, humidity, gas resistance, IAQ, CO2 equivalent, and breath VOC equivalent. This ensures that the sensor provides accurate and comprehensive data readings. In the main loop, the program continuously checks for new sensor data. When new data is available, it is processed and formatted for output. The sensor data, including temperature, pressure, humidity, gas resistance, IAQ, CO2 equivalent, and breath VOC equivalent, is printed to the serial monitor for debugging purposes. Additionally, the program transmits the sensor data to the Blynk server for visualization and monitoring. This allows users to access real-time environmental data remotely through the Blynk mobile app or web dashboard, enabling them to monitor indoor air quality and make informed deci- sions based on the collected data. Error handling mechanisms are implemented to detect and handle any issues with the BME680 sensor or the BSEC library. If errors or warnings are detected, corresponding error codes are printed to the serial monitor for diagnostic purposes. Furthermore, helper functions are defined to handle errors and provide feedback to the user. For example, the check Iaq Sensor Status function checks the status of the BME680 sensor and the BSEC library for errors or warnings.

Fig. 2. Top view of the UAV

Fig. 3. Side view of the UAV

sensor, ESP32 Camera Module, ESP-8266 D1 Mini Board are placed. At the top we can see the battery strip at which we can place the CNHL 1200mAH 100cc 4s Lipo Battery is placed. The 4 Genmfan Vanover 5-inch propellers are also visible placed at the 4 ends of the QAV 250 4mm Carbon Fiber frame. The figure 4 shows the output readings of the BME680 sensor. The sensor has the ability to find out various environmental parameters including the temperature, VOC, Air quality, Pressure and Humidity. It shows the reading of each parameter in its SI unit. The temperature is calculated in the °C unit. The human body has an "upper critical temperature" which it can tolerate safely of between 40 and 50 degrees Celsius. The sensor has the ability to measure the temperature from 0-100°C. The air quality is calculated using the unit ppm (Parts Per Million). It can measure up to 1000 ppm The VOC is also measured in ppm up to a maximum of 1000 ppm. The pressure is calculated in hPa (Hectopascal) upto a maximum of 1000 hPa. A person can withstand perhaps 100 hPa. The Carbon Dioxide is measured in the ppm (Parts Per Million) upto a maximum of 1023 ppm.The figure 5 shows the output of

6. RESULT

From both the above figures 2 and 3 we are able to view the UAV from two different angles. From the top view as well as the side view the external parts of the UAV are visible. These parts include the 4 pool noodles placed at the UAV below the frame. We can also see the box created of the ferox board in which all the major components including the BME680 the ESP cam module. It detects the number of people in the challenging environment. It shows the accuracy of the detectedimage in percentage using machine language.
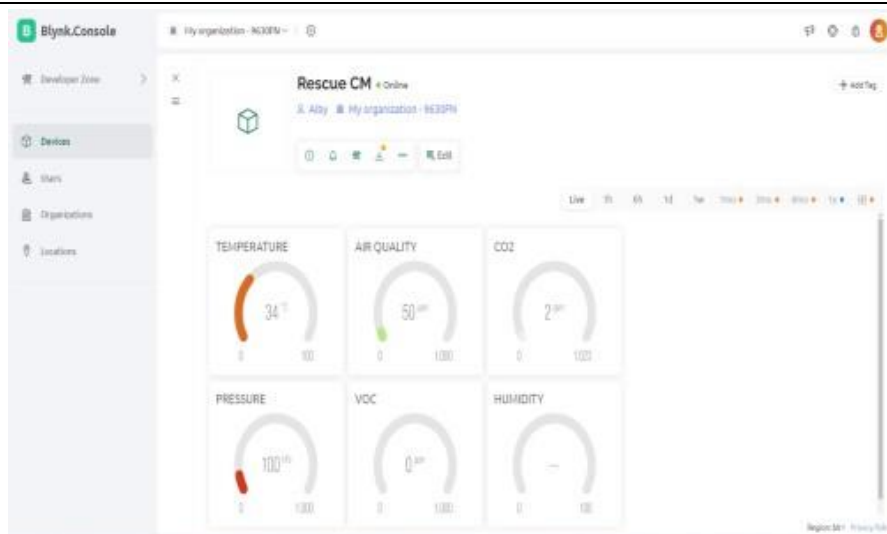
Fig. 4. BME680 Sensor output

Fig. 5. ESP Cam module output

7. CONCLUSION

In conclusion, the UAV is a revolutionary flying machine that combines the capabilities of traversing challenging envi- ronments and confined spaces, surfing on water, and perform- ing advanced sensing tasks. Its ability to detect temperature, monitor air quality, and identify gas exposure makes it an important tool for various industries and missions. One of the key applications of this UAV is in search and rescue operations. Its agility and capability to access confined spaces can greatly aid in locating and rescuing individuals in chal- lenging environments. Additionally, its ability to surf on water using pool noodle opens new possibilities for water-based rescue missions. Another important application is environmen- tal monitoring. Equipped with sensors like the BME680, the UAV can gather data on temperature variations, air quality, and gas exposure. This is crucial for assessing and mitigating the impact of pollution, wildfires, and industrial accidents, helping to protect both the environment and human life. The UAV also has significant potential in industrial inspections. Its ability to navigate confined spaces and hazardous en- vironments, combined with its sensing capabilities, allows for efficient monitoring of gas leaks, temperature detections, and structural issues. This can enhance workplace safety and prevent accidents in industries such as oil and gas, nuclear power plants, and manufacturing facilities. In the agricultural sector, the UAV's ability to travel in challenging environments and confined spaces can be utilized for crop monitoring. This can help farmers optimize their practices and improve crop yields. Furthermore, the UAV can contribute to wildlife conservation efforts. Its agility and ability to access challeng- ing environments make it ideal for monitoring endangered species and their habitats. It can also detect illegal activities like poaching and gather valuable data on animal behaviour. This information can aid conservationists in making informed decisions to protect and preserve wildlife. Overall, the UAV's unique combination of capabilities makes it a versatile and powerful tool. Whether it's for search and rescue, environ- mental monitoring, industrial inspections, agricultural surveys, water gliding or wildlife conservation, this

flying machine has the potential to revolutionize various industries and contribute to a safer and more sustainable future.

ACKNOWLEDGMENT

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