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Aerial Public Announcement Drone

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Abstract: Public Announcement drones have gained significant attention in recent years due to their wide range of applications in various fields including security, agriculture, disaster management etc. The Public Announcement (PA) Project is an innovative initiative designed to use drone technology to broadcast public messages, alerts, and announcements in various urban and rural settings. This project explores the development of an Aerial Public Announcement Drone (APAD) designed to deliver live announcements in real-time using a walkie-talkie communication system. The project aims to create a reliable and cost-effective UAV-based solution for emergency communication, capable of broadcasting critical information to large crowds or remote areas during crises such as natural disasters, evacuations, or large public events. The Public Announcement (PA) Drone Project use of drones equipped with advanced audio systems to enhance public communication, including outdoor events, urban areas, and emergency situations. The Aerial Public Announcement Drone (APAD) integrates unmanned aerial vehicle (UAV) technology with real-time voice broadcasting capabilities, providing a mobile and efficient public address system. This drone system is designed to broadcast live messages across large areas, particularly where traditional infrastructure is lacking or ineffective. APAD finds application in emergency management, public safety, large-scale events, and rural outreach. The APAD system comprises a lightweight quadcopter drone equipped with a high-decibel loudspeaker, a real-time wireless communication module, an onboard flight controller, and a ground control for flight and audio management. The design emphasizes modularity, portability, and efficiency while maintaining a cost-effective architecture suitable for deployment in both urban and remote environments. The APAD system aims to enhance situational awareness, streamline information dissemination, and improve public engagement in critical and time-sensitive situations. The findings confirm that the APAD is an effective tool for real-time public announcements during emergencies. The use of a walkie-talkie-based communication system provides a cost-effective and flexible means of broadcasting critical information, enhancing the overall response during urgent situations. This project highlights the potential of UAVs to improve public safety and emergency communication efforts by integrating live communication capabilities in areas where traditional methods are limited.

Keywords: Announcements, Drone, Walkie-Talkie, Broadcasting, UAV, Communication, Real-Time Communication, Public Safety.

I. INTRODUCTION

Public announcements (PAs) play a vital role in communicating important messages to the public. Traditionally, these announcements have been made through loudspeakers, sirens, or other fixed infrastructure in cities, public events, and emergencies. However, these systems have limitations, such as restricted coverage, noise pollution, and potential failure in emergencies.

In recent years, drones unmanned aerial vehicles (UAVs) have gained significant attention for their versatility and capabilities. Drones are already being used in various fields like logistics, agriculture, search-and-rescue missions, and surveillance. Their ability to fly over difficult terrain and reach locations that might be hard for people or ground-based systems to access makes them a promising tool for public announcements. Drones equipped with speakers can broadcast important messages directly to people in targeted areas, offering a more dynamic and flexible alternative to traditional PA systems. This project research focuses on the development of an Aerial Public Announcement Drone (APAD), which uses a walkie-talkie system to deliver live announcements in emergency situations. The walkie-talkie allows for two-way communication, enabling emergency responders to broadcast important messages to the public or respond to inquiries, all while flying the drone in real-time. This system is designed to provide a more flexible and efficient way of delivering critical information compared to static loudspeakers or sirens.

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The development of the APAD system represents a significant step toward modernizing public communication infrastructure. Its applications span a wide range of use cases, including emergency response and evacuation coordination, law enforcement operations, rural health awareness campaigns, and event management. The drone's ability to quickly navigate through complex environments and broadcast clear messages from above makes it an invaluable asset in time-sensitive and high-stakes situations.

The primary objective of this research is to design and test an Aerial Public Announcement Drone equipped with a walkie-talkie system to deliver live, real-time communication. This includes addressing key challenges such as signal clarity, battery life, and ensuring effective communication while in flight. Additionally, the study aims to evaluate the performance of the system in various environments to determine its effectiveness in different emergency scenarios. The use of walkie-talkies in emergency communication is not new. These two-way radio systems have been widely used in military, law enforcement, and emergency services due to their ability to offer reliable communication in environments where traditional networks are unreliable or unavailable. However, integrating a walkie-talkie system into a UAV to enable live voice broadcasting introduces unique challenges. These include ensuring audio clarity, minimizing interference from rotor noise, optimizing the communication range, and maximizing battery life to ensure sustained operation over the duration of an emergency.

1. Unmanned Aerial Vehicles (UAVs), commonly known as drones, offer a flexible and mobile solution for overcoming communication challenges. Drones can quickly access hard-to-reach areas, providing real-time communication and enabling broad coverage in remote or disaster-stricken locations.
2. This project develops an Aerial Public Announcement Drone (APAD), which combines a drone platform with a walkie-talkie communication system to enable live voice announcements.
3. The drone serves as the mobile platform, flying over large areas and allowing the operator to broadcast live announcements directly to affected individuals, such as evacuation instructions or safety warnings. It is capable of reaching areas that might be otherwise inaccessible by ground-based communication systems.
4. One of the key features of the system is its simplicity and reliability. The walkie-talkie system is easy to use and provides a low-cost, accessible solution for live communication, without relying on complex or expensive technology.
5. The primary goal of the project is to assess the performance of the combined system, focusing on signal clarity, range, and the ability of the drone to maintain stable flight while broadcasting clear, intelligible audio.
6. By integrating live communication capabilities with drones, this research aims to provide an innovative solution to public safety communication, improving response times, coordination, and overall effectiveness in emergencies.

II. LITERATURE REVIEW

The use of drones in emergency management has gained significant attention in recent years due to their ability to access remote areas, provide real-time data, and assist in public communication during crises. Drones are particularly beneficial in environments were traditional communication methods, such as loudspeakers, sirens, or telecommunication networks, may be compromised or unavailable.

Joung et al. (2019) discuss the application of UAVs in search and rescue operations, where they have been integrated with communication systems to broadcast live information to affected populations. These systems typically include loudspeakers or megaphones. However, their effectiveness is often limited by range, environmental noise, and the quality of communication during flight.

Bashir et al. (2020), who highlight that drones equipped with public announcement systems provide a flexible, adaptable solution for dynamic emergency situations. The ability to deploy drones quickly to affected areas, coupled with their mobility and range, makes them an excellent platform for broadcasting real-time information to large crowds or isolated individuals.

Liu et al. (2020) explored the use of walkie-talkies in drones for two-way communication during public safety operations. Their study demonstrated that, when integrated with a UAV, walkie-talkies could provide clear, live communication even in difficult environments where traditional communication infrastructure might be unavailable.

Kauppinen et al. (2020) developed a drone prototype designed to provide audio broadcasting in disaster scenarios. Their study showed that while drones could broadcast loudspeaker messages over a large area, they still faced challenges related to audio clarity, especially in windy conditions

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Zhou et al. (2021) highlighted the advantages of walkie-talkies over other communication systems, particularly in remote areas, because they do not rely on cellular networks or satellite connections. They are also relatively easy to operate and maintain, even under stress.

III. METHODOLOGY

The circuit diagram of the Aerial Public Announcement Drone outlines the connections between various components, ensuring smooth operation and reliable communication. At the heart of the system is the 2200mAh 3S Li-Po battery, which powers the entire drone and is connected to the Power Distribution Board (PDB). The PDB distributes power to essential components like the ESCs, KK 2.1.5 flight controller, and the RC receiver. The ESCs are responsible for controlling the motors, receiving power from the PDB and motor signals from the flight controller. The flight controller interprets input signals from the RC receiver to regulate the drone's movements and sends corresponding signals to the ESCs. Additionally, the walkie-talkie is integrated into the system for real-time public announcements, powered independently by its own Li-ion battery. This integrated system allows the drone to fly, respond to manual inputs, and broadcast live audio announcements simultaneously. The system is designed for manual remote operation, allowing the drone to fly reliably and deliver clear public messages from the air. This makes it highly effective for tasks such as crowd communication, emergency alerts, and informational broadcasts.

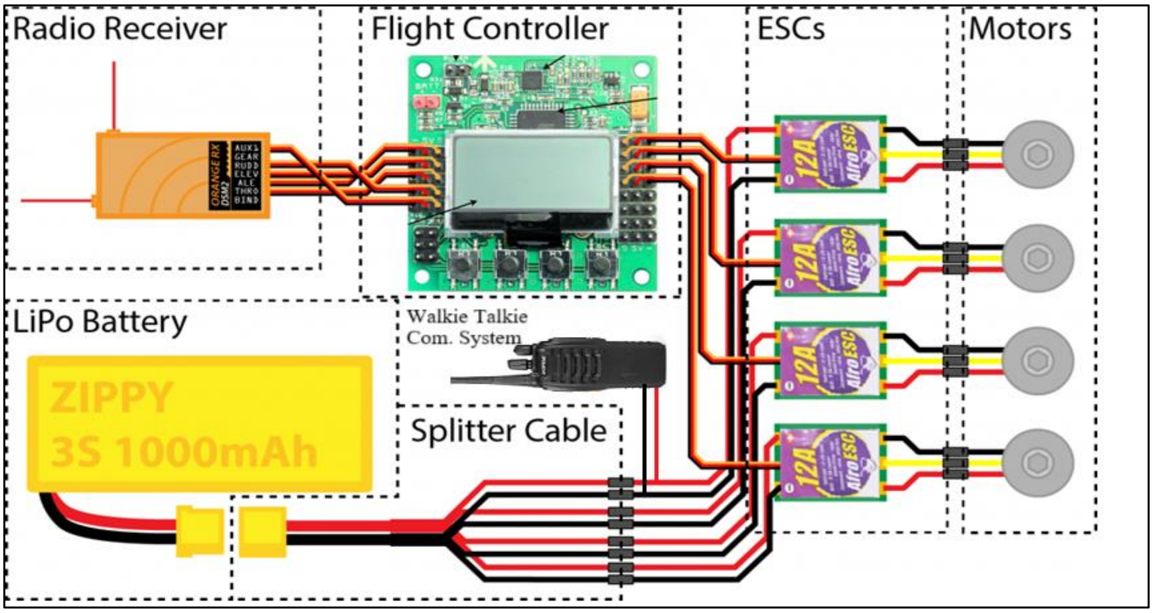

Fig. 1 Circuit Diagram

1. Power System and Battery

The drone's power system is primarily driven by a 2200mAh 3S Li-Po battery. This battery acts as the main source of energy for all the components in the drone, providing the necessary power for flight and communication. The positive terminal of the battery connects directly to the Power Distribution Board (PDB), which is responsible for distributing power to all components that require it. The negative terminal of the battery connects to the PDB ground, ensuring a common ground across the entire system. The PDB ensures that power is routed appropriately to the ESCs, KK 2.1.5 flight controller, and other electronic components, enabling efficient energy management throughout the system.

2. ESC Connection and Motor Control

Each Electronic Speed Controller (ESC) is connected to the PDB for power distribution. The positive pin of the ESC receives power from the positive output of the PDB, while the negative pin is connected to the PDB's ground, ensuring both power and ground connections are established for proper functioning. The ESCs are responsible for regulating the speed of the brushless motors and ensuring the drone's movement in all directions. Each ESC receives a PWM signal from the KK 2.1.5 flight controller, which controls the motor speed. These signals are distributed from the motor output pins on the flight controller to each respective ESC, ensuring the motors spin at the correct speed to maintain flight stability and precise movement.

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3. KK 2.1.5 Flight Controller and Signal Processing

The KK 2.1.5 flight controller is the central processing unit of the drone, managing the flight dynamics and coordinating the control signals. It receives 5V power from the BEC (Battery Eliminator Circuit) of ESC1 and shares a common ground with the other components. The flight controller's input pins receive control signals from the RC receiver, which is connected to the channels of the receiver (such as Aileron, Elevator, Throttle, and Rudder). These inputs from the RC receiver are processed by the flight controller, which then sends PWM motor control signals to the ESCs. The flight controller plays a critical role in interpreting manual inputs from the operator and translating them into precise motor commands for controlling the drone's flight.

4. RC Receiver and Control Input

The RC receiver is a vital component in the drone’s control system, receiving the operator’s inputs and transmitting these signals to the KK 2.1.5 flight controller. It is powered by the 5V output from the flight controller, ensuring continuous operation during flight. The receiver’s ground pin connects to the flight controller’s ground, maintaining a unified electrical reference. The receiver’s channels, such as Aileron, Elevator, Throttle, and Rudder, correspond to the flight controller’s input pins, allowing the operator to control the drone’s roll, pitch, yaw, and throttle, respectively. These signals directly influence the drone's movements by modulating the PWM control signals sent to the ESCs, allowing the operator to steer the drone effectively.

5. Walkie-Talkie and Audio Transmission

The walkie-talkie is an integral component of the Aerial Public Announcement Drone, providing the capability to broadcast live audio announcements during flight. Unlike the flight system, the walkie-talkie operates independently with its own Li-ion battery (typically 3.7V or 7.4V). The walkie-talkie is mounted securely on the drone and is continuously powered, with its push-to-talk button locked in the ‘On’ position to allow continuous audio transmission. The walkie-talkie transmits live announcements while the drone is in flight, communicating messages to people on the ground. This feature enables real-time communication, making the drone a useful tool for public announcements or emergency messaging.

IV. HARDWARE COMPONENTS

1) Drone Frame:

The drone frame provides structural support for all components, ensuring a lightweight and balanced design for stable flight. Made from durable materials like carbon fibre or plastic, it houses the motors, battery, flight controller, and walkie-talkie. The Power Distribution Board (PDB) is securely mounted within the frame and receives power from the Li-Po battery. It distributes this power to the ESCs and flight controller, enabling efficient energy management. Together, the frame and PDB ensure proper layout, safety, and performance of the drone.

2) KK 2.1.5 Flight Controller

The KK 2.1.5 Flight Controller is the central processing unit that stabilizes and controls the drone during flight. It features an integrated LCD for configuration and has built-in gyroscope and accelerometer sensors. Unlike advanced controllers, it lacks GPS and autonomous navigation but offers responsive manual control, suitable for beginners and basic project builds. It receives manual commands from the RC receiver and translates them into control signals sent to the ESCs. Powered via a 5V BEC from ESC1, the KK board ensures stable control by processing sensor data and pilot input in real time.

3) Electronic Speed Controllers (ESCs)

Each of the four Electronic Speed Controllers (ESCs) connects between the battery (via the PDB) and a brushless motor. ESCs regulate the speed of each motor by interpreting PWM signals from the flight controller. One ESC provides a 5V output (BEC) that powers the KK 2.1.5 board. Proper synchronization between the ESCs is vital for stable flight, as they control the thrust produced by each motor. The ESCs must be compatible with the motor’s current rating and battery voltage to prevent overheating or failure.

4) Brushless DC Motors

The drone is equipped with four brushless DC motors, which are lightweight, high-efficiency motors ideal for multirotor. These motors receive three-phase power from the ESCs and spin propellers to generate lift and thrust. The speed and direction of each motor determine the drone’s movement along different axes (pitch, roll, yaw). Selecting motors with an appropriate KV rating (e.g., 1000–1400 KV) ensures optimal performance with the 3S Li-Po battery. These motors are the main actuators responsible for flight.

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5) RC Transmitter and Receiver (5–6 Channel)

The RC transmitter and receiver system allows the pilot to manually control the drone in real time. The receiver is mounted on the drone and connects to the input pins of the KK 2.1.5 flight controller. Each channel corresponds to a specific control input such as throttle, pitch, yaw, and roll. The receiver is powered by the 5V output from the flight controller. It transmits pilot commands wirelessly from the transmitter to the flight controller, which then adjusts motor speeds accordingly. This system is essential for manual flight operation.

6) Walkie-Talkie (Transmitter Unit)

A standard walkie-talkie is integrated into the drone for live public announcements. It is powered by its own rechargeable Li-ion battery (typically 3.7V or 7.4V) and is entirely independent from the drone's electrical system. The device is securely mounted on the drone frame, with its Push-To-Talk (PTT) button locked in the ON position to allow continuous audio transmission. This setup enables real-time announcements from the ground operator.

7) Propellers

Propellers are aerodynamic blades mounted on each motor, responsible for generating lift and thrust. They must be correctly sized and balanced to match the motor's specifications for efficient and stable flight. Proper installation with alternating rotation directions (CW and CCW) ensures accurate control of pitch, roll, and yaw.

V. WORKING FLOW CHART

The working flowchart illustrates the complete operational sequence of the Aerial Public Announcement Drone, from system initialization to the delivery of live announcements and landing. The flowchart provides a step-by-step overview of how the drone is powered on, stabilized, controlled in flight, and used to transmit public announcements while airborne. It ensures clarity in understanding the logical progression of operations and highlights the integration of both aerial mobility and communication functionality.

The RC transmitter sending control signals, the flight controller processing these commands, and the ESCs powering the motors to maintain stable flight. Simultaneously, the walkie-talkie is activated and begins transmitting audio, ensuring that public announcements can be heard clearly at specified altitudes. It also emphasizes the role of the walkie-talkie system, which operates independently of the drone's flight controls, thus preventing any interference between the systems. By outlining these processes, the flowchart helps visualize the drone's integrated capabilities for both flight and communication, showcasing its potential applications in real-time public announcements, emergency communication, and crowd management.

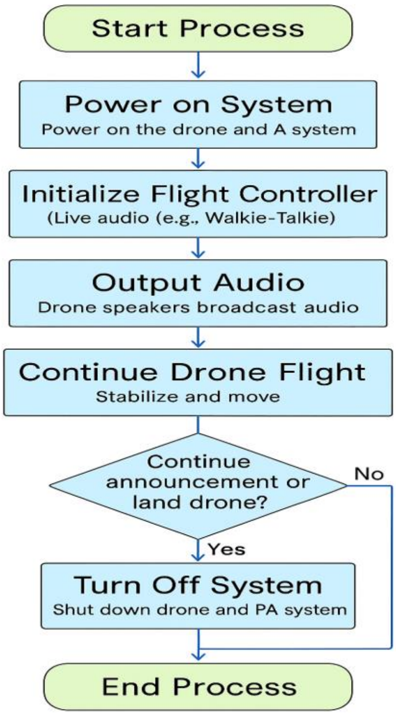

Fig.2 Working Flow Chart

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VI. RESULT

The Aerial Public Announcement Drone successfully performed stable flights and real-time audio broadcasting. The drone was tested at altitudes ranging from 10 to 30 meters, with the best clarity for announcements achieved between 15 to 20 meters. Voice transmission was clear and audible up to 70 meters in radius, suitable for outdoor public communication. The flight and audio systems operated independently without interference, ensuring smooth operation. Test flights showed consistent performance and effective control. The project met its objectives by integrating flight stability with live announcement capabilities. This system demonstrated practical potential for emergency alerts and crowd communication in open areas.

The project successfully met its design goals by integrating stable flight with live announcement capabilities. It showed strong potential for real-world applications such as emergency communication, public announcements, and crowd management in open areas. The results validate the drone as a functional tool for mobile, airborne public address systems.

Fig.3 Aerial Public Announcement Drone Setup

VII. CONCLUSION

The Aerial Public Announcement Drone successfully demonstrated the potential of drones for real-time public communication. By integrating flight control systems with wireless communication, the drone was able to maintain stable flight while transmitting live announcements. The system operated effectively with minimal interference between the flight and communication components.

Testing showed that the drone could operate at altitudes between 10 and 30 meters, with the best announcement clarity achieved between 15 to 30 meters. At these heights, the drone was able to broadcast clear audio within a 70–100-meter radius. This makes it suitable for a variety of outdoor public communication applications, including crowd management, emergency alerts, and public event announcements.

The independent operation of the walkie-talkie system ensured uninterrupted communication, with no impact on the drone’s flight performance. The lightweight and reliable design allowed for consistent flight times of approximately 40 minutes.

While the system achieved its core objectives, there is potential for further development. Future enhancements could include integrating autonomous navigation, expanding the audio broadcast range, or improving battery life. These improvements would increase the system's applicability in more complex environments.

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Overall, the Aerial Public Announcement Drone has proven to be a reliable, innovative tool for real-time communication, demonstrating the practical uses of drones in modern communication and public safety

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