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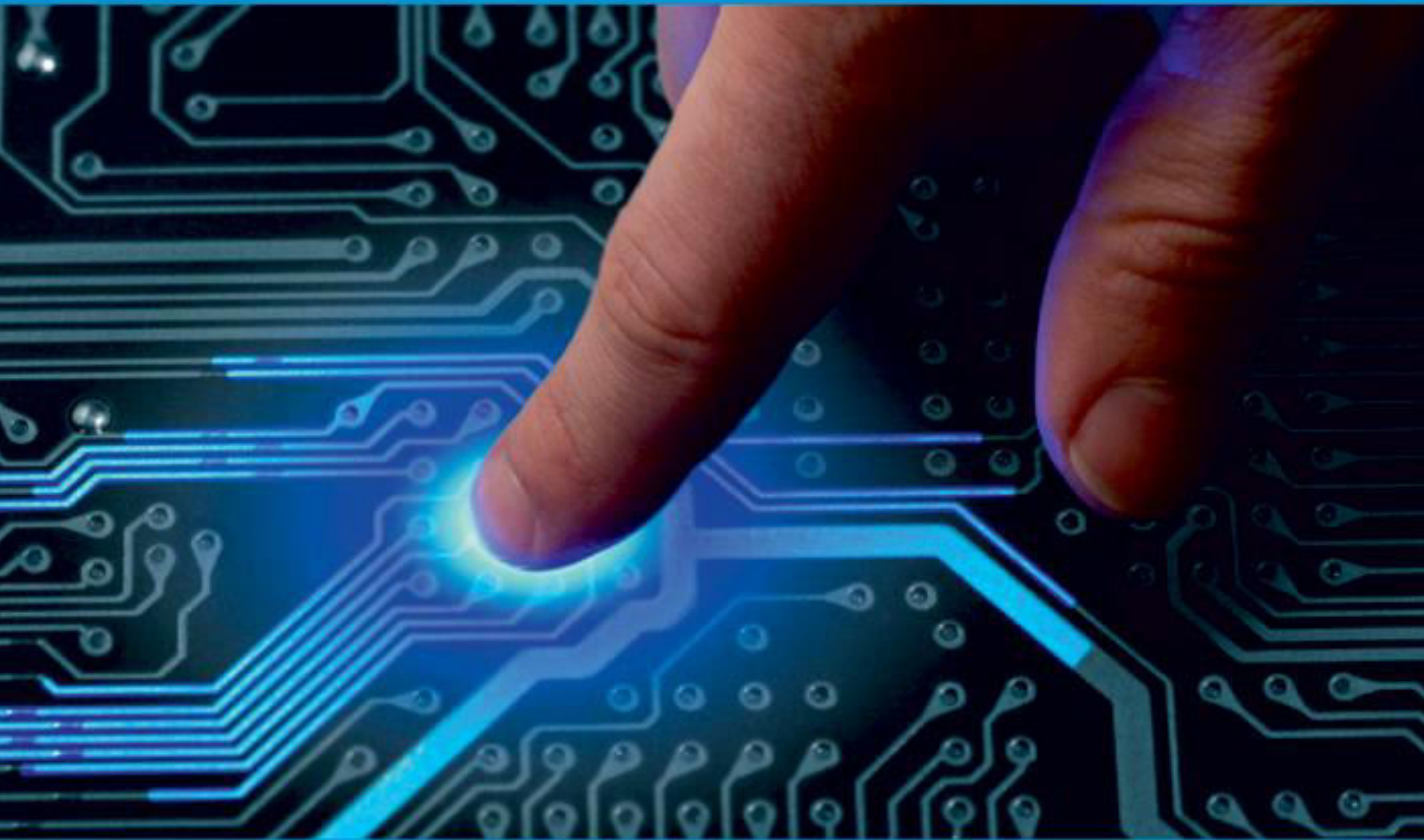

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Traffic Monitoring Quadcopter

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ABSTRACT: This paper "TRAFFIC MONITORINIG QUADCOPTER" presents the design and implementation of a detection of vehicles Quadcopter system. Our vehicle Counting Drone project represents a pioneering advancement in the realm of traffic monitoring and management. At its core lies a fusion of cutting-edge drone technology and state-of-the-art computer vision algorithms. Equipped with high-resolution cameras and intelligent image processing capabilities, our drones are designed to autonomously navigate through urban environments, capturing comprehensive footage of vehicular movement on roads and highways. This seamless integration of hardware and software enables our drones to accurately detect and count cars with remarkable speed and accuracy. vehicle-Counting Drone project holds immense potential for enhancing urban planning and infrastructure development.

KEYWORDS: Drone, Quadcopter, traffic monitoring,

I. INTRODUCTION

Vehicle Counting Drone project represents a pioneering advancement in the realm of traffic monitoring and management. At its core lies a fusion of cutting-edge drone technology and state-of-the-art computer vision algorithms. Equipped with high-resolution cameras and intelligent image processing capabilities, drones are designed to autonomously navigate through urban environments, capturing comprehensive footage of vehicular movement on roads and highways. This seamless integration of hardware and software enables the drones to accurately detect and count vehicles with remarkable speed and accuracy.

One of the key strengths of this vehicle-Counting Drone system is its versatility and scalability. Unlike traditional traffic monitoring methods that are often constrained by fixed surveillance points or manual data collection processes, our drones offer unparalleled flexibility and coverage. They can be deployed swiftly to any location, providing dynamic monitoring capabilities across vast stretches of road networks. Whether it's analyzing traffic congestion in bustling city centers, monitoring traffic flow during events, or conducting traffic surveys in remote areas, our drones offer a cost-effective and efficient solution adaptable to various scenarios.

Moreover, beyond its immediate application in traffic management, Vehicle-Counting Drone project holds immense potential for enhancing urban planning and infrastructure development. By generating comprehensive datasets on traffic patterns, vehicle volumes, and congestion hotspots, our system equips city planners and policymakers with valuable insights for optimizing transportation networks, improving road safety, and mitigating traffic-related challenges. Furthermore, the real-time nature of our drone-based monitoring enables proactive decision-making, allowing authorities to respond swiftly to traffic incidents, reroute traffic, or implement traffic control measures as needed. In essence, this project not only offers a glimpse into the future of traffic management but also underscores the transformative impact of drone technology on shaping smarter, more efficient cities.

II. RELATED WORK

The technical paper by S. Javaid, A. Sufian, S. Pervaiz and M. Tanveer, "Smart traffic management system using Internet of Things," 2018 20th International Conference on Advanced Communication Technology (ICACT), Chuncheon, Korea (South), 2018, pp. 393-398, doi: 10.23919/ICACT.2018.8323770. introduces the concept of traffic management smarty.

Traffic management system is a cornerstone of a Smart city. In the current problems of the world, urban mobility is one of the major problems, especially in metropolitan cities. Previous traffic management systems are not capable enough to tackle this growth of traffic on the road networks. The purpose of this paper is to propose a smart traffic management system using the Internet of Things and a decentralized approach to optimize traffic on the roads and intelligent algorithms to manage all traffic situations more accurately. This proposed system is overcoming the flaws of

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previous traffic management systems. The system takes traffic density as input from cameras which is abstracted from Digital Image Processing technique and sensors data, resultantly giving output as signals management. An algorithm is used to predicts the traffic density for future to minimize the traffic congestion. Besides this, RFIDs are also used to prioritize the emergency vehicles like ambulance, fire brigade etc. by implementing RFID tags in such vehicles. In the case of emergency situations, such as fire explosion or burning of something, fire and smoke sensors are also deployed on the road to detect such situations. Moreover, a mobile application is connected to a centralized server which intimates to nearby rescue department about fire explosion with the location to take further action. In addition, the native user can ask about future traffic condition at a particular node. The proposed system is validated by constructing a prototype and deploying it in a city of Pakistan. A web application is also there to provide useful information in graphical formats to the higher authorities of the smart city which is fruitful in future road planning. keywords: {Roads; Servers; Sensor systems; Cameras; Fires; Surveillance; Emergency Vehicle Management; Internet of Things (IoT); Smart Traffic Management System; Traffic Prediction; Traffic Signal Management}.

In the current context of smart city, specifically in the industrial and market zones, the traffic scenario is very congested most of the time particularly at the peak time of business hours. Due to increasing growth of population and vehicles in smart and metropolitan cities people face lot of problem at the major traffic points of the business towns. Not only it causes travelling delays, it also contributes to environmental pollution as well as health hazards due to pollution caused by vehicle fuels. To keep away from such severe issues many radiant urban communities are right now implementing smart traffic control frameworks that work on the standards of traffic automation with prevention of the previously mentioned issues. The fundamental concept lies in collection of traffic congestion information quickly and passing the alternate strategy to vehicles as well as passengers with on-line traffic information system and effectively applying it to specific traffic stream. In this context, an enhanced traffic control and monitoring framework has been proposed in the present article that performs quick information transmission and their corresponding action. In the projected approach, under a Vehicular Ad- hoc Network (VANET) scenario, the mobile agent based controller executes a congestion control algorithm to uniformly organize the traffic flow by avoiding the congestion at the smart traffic zone. It exhibits other unique features such as prevention of accidents, crime, driver flexibility and security of the passengers. Simulation carried out using Ns2 simulator shows encouraging results in terms of better performance to control the delay and prevent any accident due to profound congestion up to a greater extent.

III. PROPOSED DESIGN

This project leverages state-of-the-art drones equipped with advanced cameras to capture real-time traffic data from vantage points above the roadways. These drones autonomously navigate through urban landscapes, capturing comprehensive footage of traffic flow, congestion hotspots, and road conditions. This aerial perspective provides unparalleled insights into traffic dynamics, enabling more informed decision-making by transportation authorities and urban planners. In our modern world, urban traffic congestion poses significant challenges to efficiency, safety, and environmental sustainability. To address these issues, an innovative solution is to harness the power of unmanned aerial vehicles (UAVs) equipped with Arducopter technology to revolutionize traffic monitoring and signal management.

This design combines cutting-edge drone technology with intelligent software algorithms to create a seamless and proactive approach to traffic management. The Ardu-copter-equipped drone serves as the eyes in the sky, capturing high-resolution images of traffic conditions from above. These images are then transmitted to a sophisticated software system, which utilizes advanced computer vision and machine learning techniques to identify and analyze vehicle movement and congestion patterns in real-time.

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A. *Design Considerations:*

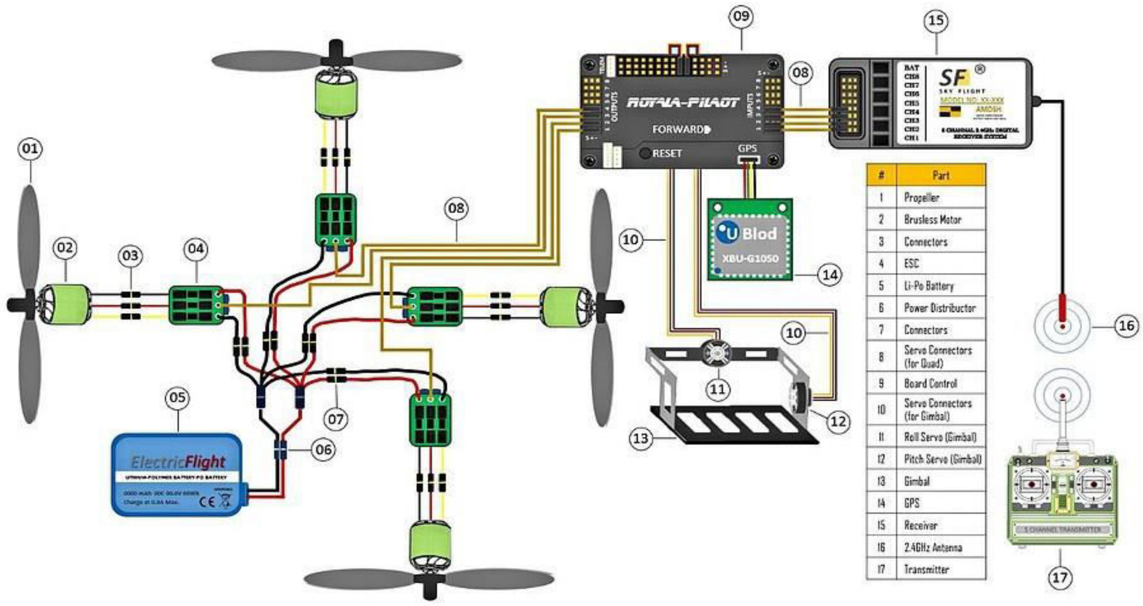

Fig .1 Block diagram of quadcopter using arducopter

Parts of the Drones Drones have many parts; a drone consists of 10 parts.
1. Quad-copter frame It is a structure (frame) into which all other drone parts fit.
2. Motor Motors are essential in making drones as they generate the force to rotate the propellers and propel the drone
3. Electronic Speed Controller (ESC) It is an electronic control board that varies the speed of the motor. It also works as a dynamic brake.
4. Flight Control Flight control creates a log of the takeoff location that guides the drone and thereby the need to return to the takeoff location. This has become known as the 'back home' feature.
5. Propeller Drones can fly with the help of propellers; propellers are designed to create a difference in air pressure.
6. Radio transmitter It is used as a channelized transmitter and communicator with drones.
7. Battery, electronics, and power distribution cables This battery acts as the power source for the drone. It supplies power to all electronics through power distribution cables.
8. Camera For video footage, a camera is attached to the drone and used to shoot, save and send video.
9. Landing gear It is used to land the drone safely. An experienced user can balance the motor speed for a safe landing in emergencies.
10. First-person video The control device interface (transmitter)is more expensive than the screen, giving the user an interactive 3D viewing experience. First Person View (FPV) gives an ultimate feeling as if the user thinks he is flying.

Ardu-Pilot Mega(APM) 2.8 Multicopter flight controller 2.8: The APM 2.8 flight controller is a popular open-source autopilot system used primarily in drones (UAVs) and other unmanned vehicles as shown in the figure 2 below.

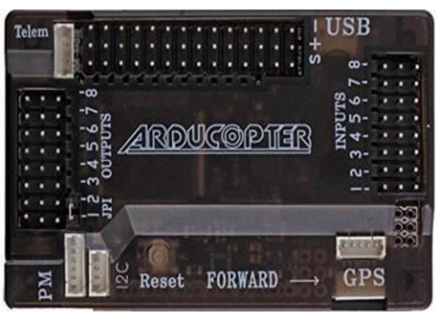

Fig.2 APM 2.8 Flight controller

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The APM 2.8 board provides autopilot functionality, enabling autonomous or semi-autonomous control of unmanned vehicles. It uses various sensors to gather data about the vehicle's orientation, altitude, speed, and other relevant parameters. The APM 2.8 board typically includes a variety of sensors such as an accelerometer, gyroscope, magnetometer, and barometer. These sensors help the autopilot system stabilize the vehicle, maintain its position, and execute pre-programmed flight paths. The APM 2.8 board supports various communication protocols, including USB, telemetry radios (like 3DR Radio), and sometimes Bluetooth or Wi-Fi modules, allowing for real-time communication with ground control stations or mission planners. Users can customize and program the APM 2.8 using the Arduino IDE (Integrated Development Environment), allowing for customization of flight modes, control algorithms, and mission planning.

FLYSKYCT6B is a popular 6-channel radio transmitter and receiver system designed for RC (Radio Control) hobbyists, particularly those who fly drones, airplanes, helicopters, or drive RC cars and boats.

Fig 3. Flysky CT6B

Transmitter (TX):

Channels: The Flysky CT6B transmitter supports up to 6 channels, allowing users to control various functions of their RC vehicle or aircraft, such as throttle, steering, pitch, roll, yaw, and auxiliary functions.

LCD Display: It typically includes an LCD screen that provides real-time feedback on the transmitter's settings, battery level, signal strength, and other important information.

Receiver (RX):

The Flysky CT6B comes with a matching receiver unit that receives signals from the transmitter and relays them to the RC vehicle's onboard electronics, such as ESCs (Electronic Speed Controllers) and servos.

The receiver usually has multiple channels corresponding to the transmitter's channels, allowing for precise control over the vehicle's various functions.

Lithium Polymer (LiPo) rechargeable battery with a capacity of 2200 milliampere-hours (mAh).

ESP32-CAMis a small-sized camera module based on the ESP32 microcontroller.

Fig. 4. ESP32 CAM

The ESP32-CAM is built around the ESP32 microcontroller, which is a powerful and versatile chip known for its Wi-Fi and Bluetooth connectivity, as well as its low power consumption. It features an OV2640 camera sensor, which is capable of capturing JPEG images and streaming video. The camera module typically has a resolution of 2 megapixels (1600x1200 pixels).The ESP32-CAM includes built-in Wi-Fi connectivity, allowing it to connect to Wi-Fi networks and communicate with other devices over the internet or local network. This feature enables applications such as remote monitoring, surveillance, and IoT (Internet of Things) projects. The ESP32-CAM module provides GPIO (General Purpose Input/Output) pins, allowing it to interface with various sensors, actuators, and other peripheral devices. This flexibility enables users to create custom projects and integrate additional functionalities as needed. The ESP32-CAM can be programmed using the Arduino IDE (Integrated Development Environment) or other development platforms such as MicroPython or ESP-IDF (Espressif IoT Development Framework). This allows users to write custom firmware to control the camera, capture images, stream video, and implement additional features. Many ESP32-CAM modules include an integrated

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microSD card slot, allowing users to store captured images and video locally without relying on external servers or cloud storage services. The ESP32-CAM typically operates on a 3.3-volt power supply. It can be powered via a USB connection or an external power source, depending on the application requirements.

IV. SOFTWARE REQUIREMENTS

Mission Planner software serves as a pivotal tool in the domain of unmanned aerial vehicle (UAV) operations, facilitating mission planning, execution, and monitoring with its comprehensive suite of features and functionalities. Mission Planner was initially developed by Michael Oborne as an open-source ground control station software tailored for ArduPilot-based autopilot systems.
Flight Parameters Adjustment: Mission Planner offers a comprehensive set of configuration options for adjusting flight

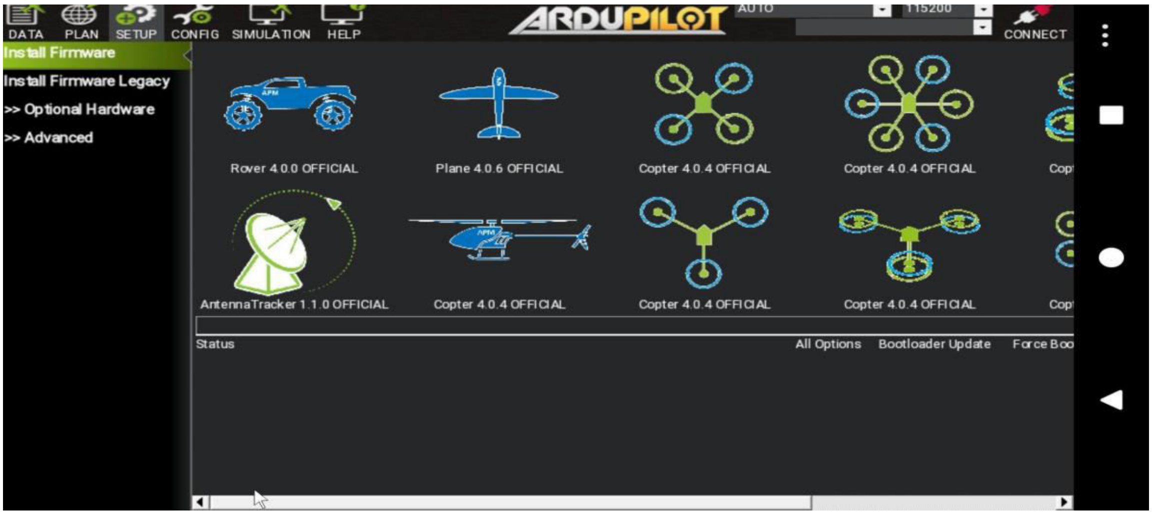

Fig. 5. Mission Planner for Drone parameters configuration

parameters such as PID gains, stabilization settings, and control response curves. Users can fine-tune these parameters to optimize vehicle performance and stability for specific flight conditions and mission requirements.

The software guides users through step-by-step calibration procedures for calibrating sensors such as accelerometers, gyroscopes, compasses, and airspeed sensors. Calibration routines ensure accurate sensor readings and reliable operation under varying environmental conditions.

Fig. 6. Mode Setting configuration using Mission Planner

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V. RESULTS

Fig. 7 Proposed designed Hardware Drone

VI. CONCLUSION AND FUTURE WORK

The APM 2.8 flight controller emerged as the cornerstone of this project, providing a robust and versatile platform for autonomous flight control and mission management. Its suite of features, including waypoint navigation, altitude hold, and fail-safe mechanisms, empowered our drone with unparalleled precision and reliability in various operating environments.

The integration of the ESP32-CAM as the primary capturing device revolutionized approach to aerial imaging and data acquisition. Equipped with a high-resolution camera and onboard processing capabilities, the ESP32-CAM facilitated the capture of stunning visuals and real-time video streams with remarkable clarity and detail.

This project's significance extends far beyond technical prowess; it embodies a convergence of multidisciplinary expertise and collaborative effort. In security and surveillance, this drone offers enhanced situational awareness and rapid response capabilities, safeguarding critical assets and infrastructure. In agriculture, it enables precision farming practices, optimizing resource utilization and crop yields while minimizing environmental impact.

Moreover, this drone holds promise in disaster response and humanitarian efforts, facilitating search and rescue operations in inaccessible terrain and delivering essential supplies to remote communities. Its applications in environmental monitoring, infrastructure inspection, and educational outreach further underscore its versatility and societal relevance.

Looking ahead, the future scope of this drone project is boundless. Continued innovation and refinement will enhance its capabilities, opening new frontiers in aerial robotics and data-driven decision-making. Collaboration with industry partners, academic institutions, and regulatory bodies will accelerate the adoption of drone technology and its integration into existing workflows and systems.

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