Drone Based Object Counting Mechanism

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Abstract - The rapid advancements in unmanned aerial vehicles (UAVs) have revolutionized various industries, enabling their use in numerous applications such as surveillance, environmental monitoring, and data collection. UAVs offer unparalleled flexibility, speed, and access to areas that are otherwise difficult to reach, making them an essential tool in modern problem-solving. This project focuses on the development of a drone-based object counting mechanism that employs cutting-edge real-time image processing techniques to address the need for accurate and efficient object counting in various domains. By automating the process of object counting, this project aims to reduce labour costs, improve accuracy, and increase operational efficiency for users.

***Key Words*:** Drone, Accuracy, Data Collection, Efficient, labour costs, UAVs.

1.INTRODUCTION

Accurate object counting is a fundamental requirement across multiple industries, including inventory management, traffic monitoring, crowd control, and infrastructure maintenance. Traditional object counting methods, such as manual inspections, barcode scanning, and static camera surveillance, come with significant limitations, including high labor costs, inefficiency, and susceptibility to human error. With the increasing demand for automation and real-time data processing, drone-based object counting has emerged as a transformative solution. Unmanned Aerial Vehicles (UAVs), equipped with high-resolution cameras, QR code scanners, and onboard computing power, provide a scalable and efficient alternative to conventional methods.

2.METHODOLOGY

The methodology for this research involves a multi-phase approach, combining hardware integration, data collection, and real-time data processing. The key steps include:

- Drone Selection and Hardware Integration:

UAVs equipped with high-resolution cameras, QR code scanners, and edge computing devices.

- Data Collection and Preprocessing:

The drone captures QR codes from objects and transmits the scanned data to local storage.

- Real-Time Deployment and Optimization:

The QR code data is processed onboard the drone and stored in a local database for further analysis.

- Evaluation and Performance Analysis:

The system's accuracy is tested by verifying the scanned data against actual object counts, and latency measurements are taken to assess real-time efficiency.

Table -1: Comparison of Object Counting Methods

SN.	Method	Accuracy (%)	Processing Time (ms)
1	Manual Counting	85	500
2	Static Camera	90	300
3	UAV-based System	98	50

3. MODELING AND ANALYSIS

The system utilizes QR code scanning for real-time object identification and counting. UAVs equipped with high-resolution cameras and QR code scanners capture and decode QR codes from objects, transmitting the data to local storage.

1. Drone Type: Quadcopter

2. Drone Material: Carbon Fiber

3. Angle Between Blades:

θ = 360° / Number of Blades

= 360° / 4 = 90°

4. Thrust Calculation:

Thrust = Weight of Drone × Safety Factor

= 2 kg (approx.) × 2 (assume factor = 2)
= 4 kg = 40N

Per motor = 40N / 4 = 10N

5. Motors required: 4

6. Motor rating: 1000 kV

Motor Power Rating:

$v = \sqrt{T / (2 \times \sigma \times A)}$

$= \sqrt{10 / (2 \times 1.225 \times 0.125)} \approx 6$ m/s

$P = (T \times v) / \eta$ (Assume $\eta = 0.7$)

P = 85.7 W (approx.)

7. Battery Capacity:

C = (Current × Flight time in hrs) / Efficiency factor

= C=0.85×0.25 / 0.85 ≈ 7Ah (assume factor = 0.85)

8. Battery Type: 2200mAh 3S LiPo

Fig -1: Drone model

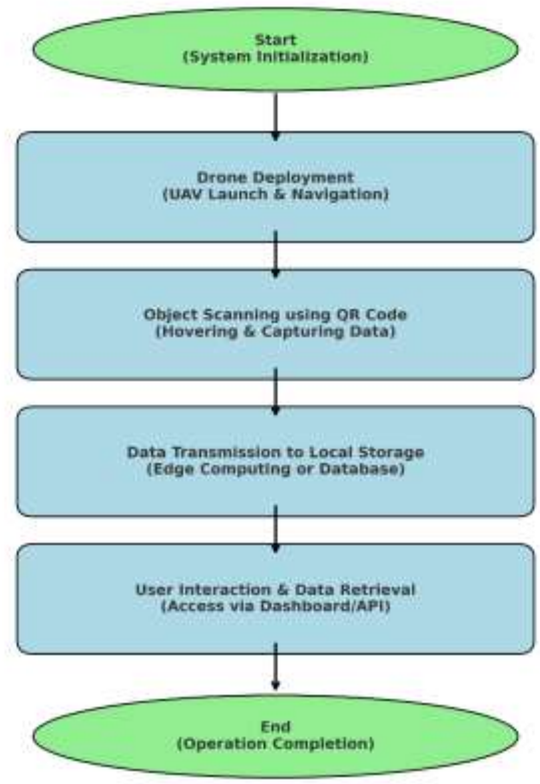

Fig -2: Working Flow

4. CONCLUSIONS

The study demonstrates the feasibility and efficiency of drone-based object counting mechanisms across various industries, including inventory management, logistics, traffic monitoring, and infrastructure assessment. By leveraging QR code scanning technology, the system eliminates manual counting errors, enhances operational efficiency, and enables real-time data collection with minimal human intervention.

Future research will focus on optimizing QR code scanning techniques to improve recognition under varying lighting and environmental conditions, ensuring accurate data capture in diverse operational settings. Additionally, advancements in data transmission efficiency will be explored to enable faster and more reliable storage and retrieval of scanned information, reducing latency and enhancing real-time decision-making.

Another key area of future development is multi-drone coordination, where multiple UAVs can operate simultaneously to cover larger areas, streamline object counting tasks, and improve scalability for industrial applications. This will be particularly beneficial in:

- Crowd Management – Monitoring large gatherings, optimizing public safety, and aiding in event management through automated headcounts.

- Traffic Management – Enhancing vehicle counting and congestion analysis to support urban planning and intelligent transportation systems.

- Pothole Detection – Identifying and mapping road defects in real time, assisting in proactive maintenance and reducing long-term infrastructure costs.

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