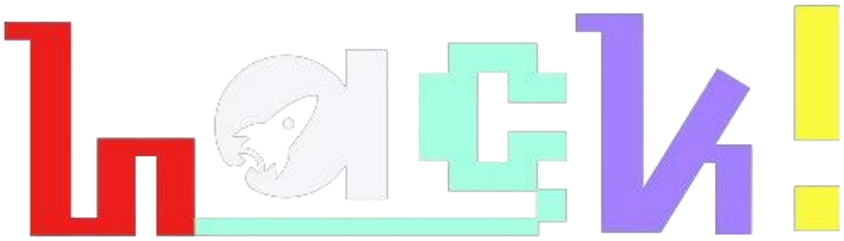


HackINSAN 2024

Project Report

DSC Boys | How Can We Integrate IT, GIS and UAV to improve our efficiency of daily tasks

Justin Poh Jun Ian (21)

Cheong Yi Jun (21)

Tay Pin Quan (21)

Teh Yi Cheng (21)

Source of Inspiration

In Malaysia, we have noticed that the construction is lacking the use of drones to monitor the workflow, safety of the construction site. The efficiency of the construction workflow is highly restricted. And, one of our team members has an experience where his family member uses drone to check the water leakage of the roof. Then, it inspires us to have an idea of using the drone on monitoring the construction site.

Introduction

In the dynamic world of construction and real estate, efficient project management and effective marketing are crucial for success. Our innovative solution leverages drone technology to revolutionize the supervision and promotion of construction projects. By integrating UAVs into the construction workflow, we enable managers to oversee the progress from an empty plot to a fully developed building, ensuring every phase is meticulously monitored. Drones provide unparalleled access to hard-to-reach areas, such as rooftops and high structures, enhancing safety and inspection accuracy. Moreover, as the project nears completion, drones can capture stunning aerial footage to create compelling promotional videos and showcase, showcasing the new real estate development in its best light. This multifaceted application of drone technology not only streamlines construction supervision but also elevates marketing strategies, setting a new standard in the industry.

Objective:
To enable efficient supervision of project progress
To enhance safety inspections
To create high-quality images for new real estate

Core Features:
Construction Progress Monitoring:

- Daily Photo and Video Capture
- Supervise workers

Safety and Maintenance Inspection:

- Hard-to-reach area Inspection
- Real-time feedback

Marketing and Promotion:

- Aerial Photography and Videography
- Virtual Tours

Detailed Construction Monitoring and Progress Tracking Using UAV

UAVs for Regular Inspections:

- Schedule frequent drone flights to monitor construction progress, check for compliance with plans, and identify potential issues.
- Utilize drones equipped with necessary sensors. For example, **high-resolution cameras**, **thermal imaging**, **LiDAR** and other sensors to capture detailed visuals and data.

Implementation:

1. **Drone Deployment and Flight Scheduling Preparation:**
    - Conduct an initial site survey to establish key inspection points and flight paths to avoid the drone crashes with the workers or buildings.
2. **Regular Inspections:**
    - Set up a schedule for regular drone inspections. For example, daily or weekly.
    - Capture high-resolution images, videos, and other sensor data during each flight for recordings analysis for future uses.
3. **Data Collection and Integration Data Upload:**
    - After each flight, upload the collected data to a central repository and use cloud storage solutions to facilitate easy access and sharing of data.
4. **Progress Monitoring and Analysis Visual Representation:**
    - Use time-lapse features to compare current data with previous inspections, highlighting changes and progress for comparison.
5. **Issue Detection:**
    - Utilize Convolutional Neural Networks (CNNs) and faster R-CNN Image to automatically detect and flag issues such as structural defects, safety hazards, and deviations from plans in the collected data.
6. **Remote Supervision and Supervisor Monitoring:**
    - Use drone footage and images to replace on-site visits, allowing them to monitor progress in real-time from any location, reducing the need for physical presence.
7. **Meeting and Reporting:**
    - Use these reports in meetings to discuss progress, address issues, and make informed decisions.

Use Case Scenarios:

Scenario 1: Monitoring Construction Progress

Managers and supervisors can use drones to monitor the progress of construction. Photos taken by the drones are uploaded to the database daily. This helps supervisors easily track worker performance and clearly document daily progress with visual proof.

Scenario 2: Safety and Maintenance Inspection

There are some corners that can't easily be reached by construction workers and places that can be seen more clearly from the top. The drone has advantages in this scenario. It can be easily operated by supervisors to check those places, snap photos, and provide feedback for further action.

Scenario 3 : Marketing and Promotion

Drones can be used to take stunning aerial images and videos of real estate properties, capturing the full scope and beauty of the development from unique angles that are not possible with ground-based photography. These high-quality visuals can be used in marketing.

Benefit and impacts:
Key Benefits of using Drone monitoring over Human monitoring

1. Safety

- **Access to Hazardous Areas**: Drones can easily access dangerous or hard-to-reach areas, such as high structures, roofs, and confined spaces, without putting human workers at risk.
- **Reduced Risk of Accidents**: Minimizes the need for workers to perform tasks in hazardous conditions, reducing the risk of falls, electrocution, and other accidents.
    - In fact, worker injuries cost the industry an estimated $167 billion in 2021 alone. These costs can increase your insurance prices and reduce profit margins.

2. Efficiency

- **Speed**: Drones can cover large areas quickly and complete inspections in a fraction of the time it would take for human workers.
- **Frequent Inspections**: Enables more frequent monitoring and inspections due to reduced time and resource requirements.
    - 120 acres per hour for a 60x improvement in surveying efficiency
    - Reference: Propelleradmin, & Propelleradmin. (2024, April 5). *Drones in Construction – Why They Are Beneficial and How to Use Them*. Propeller. https://www.propelleraero.com/blog/drones-in-construction-why-they-are-beneficial-and-how-to-use-them/

3. Accuracy and Precision

- **High-Precision Data**: Equipped with high-resolution cameras, RTK (Real-Time Kinematic) modules, and advanced sensors, drones provide precise and accurate data.
- **Consistent Results**: Drones ensure consistent data collection, minimizing human error and subjectivity.
    - Across the construction industry rework, conflict resolution, and looking for unavailable project data costs construction companies $177 billion annually.

4. Cost-Effectiveness

- **Lower Long-Term Costs**: Although the initial investment in drone technology may be higher, operational and maintenance costs are lower in the long run compared to human labor.
- **Reduced Labor Costs**: Decreases the need for large inspection teams and reduces travel, accommodation, and safety gear expenses.

5. Accessibility

- **Difficult Terrain**: Drones can easily navigate rough, uneven, or inaccessible terrains that may be challenging or impossible for humans.
- **Remote Monitoring**: Enables remote monitoring and inspections, allowing teams to oversee multiple sites without being physically present.

Cost Analysis:

Cost for drone example:

Drone model	Cost
DJI Avata 2 Fly More Combo (Single Battery)	RM 3,999.00
DJI Air 3 Fly More Combo (DJI RC 2)	RM 6,589.00
DJI Mavic 3 Pro Fly More Combo (DJI RC)	RM 12,399.00

Based on website price, the price range of popular drones selling in the market are mostly between RM4.000.00 - RM13,000.

Estimation cost comparison between human and drone monitoring (Annually)

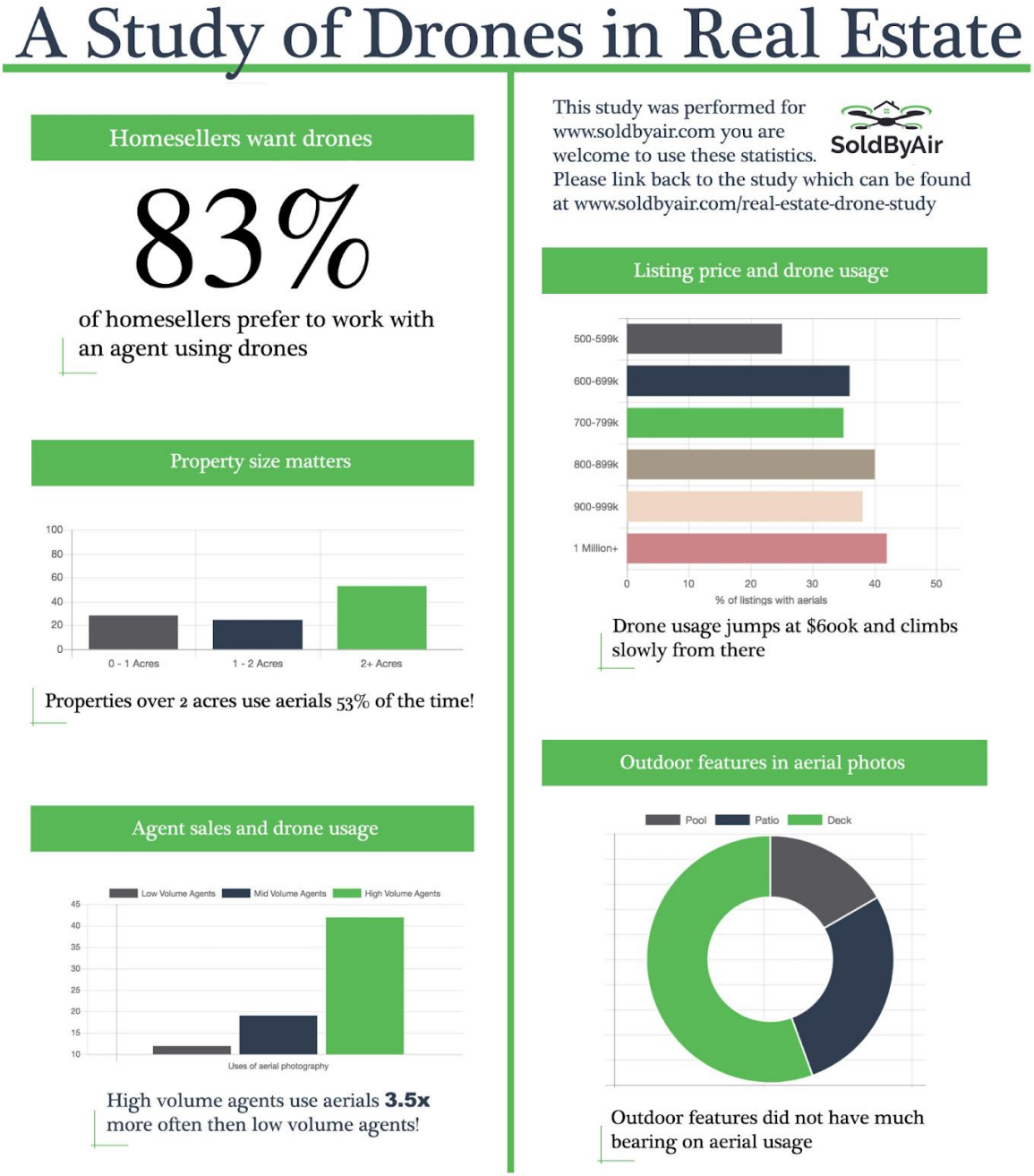
Cost Component	**Human Monitoring**	**Drone Monitoring**
Personnel Costs	RM50,000 - RM80,000 (salary, benefits)	RM5,000 - RM7,000 (pilot training, fees)
Equipment Costs	RM5,000 - RM10,000 (tools, safety gear)	RM4,000 - RM13,000 (drones, batteries)
Operational Costs	RM5,000 - RM8,000 (travel, accommodation)	RM1,000 - RM2,000 (maintenance for drones)
Total Annual Cost	RM60,000 - RM98,000	RM10,000 - RM22,000

Literature Review:

1. *Using Drones for Real Estate: Benefits, Use Cases and ROI (with pictures)*. (2023, October 27). DARTdrones. https://www.dartdrones.com/drones-for-real-estate/
2. Housecall. (2016, June 10). *Drone Photography is Changing Real Estate. . .Are You Keeping Up?* RISMedia\'s Housecall. http://blog.rismedia.com/2016/drone-photography-changing-realestate/
3. Dwyer, S., & Dwyer, S. (2016, December 22). *Drones for Real Estate Marketing: Are They Worth It?* RISMedia. https://www.rismedia.com/2016/12/20/drones-real-estate-marketing/
4. *How to Carve Out a Real Estate Video Marketing Niche*. (2020, September 22). www.nar.realtor. https://www.nar.realtor/magazine/broker-news/network/how-to-carve-out-a-real-estate-video-marketing-niche

Return on Investment in Using Drones for Real Estate

According to the calculations done by RISMedia, listing agents who use drones for real estate could see an increase in listings as high as 73% and deal closing increases as high as 68%. Sold by Air offers that, "83% of home sellers prefer to work with an agent using drones." With these kinds of numbers, agents can potentially see returns which add up to tens of thousands of dollars per year.



Also, according to MLS statistics, homes with aerial images sold 68% faster than homes with standard images. Video tours that incorporate drone footage are also a great way to make the property stand out and to attract new listings. According to the National Association of REALTORS® (NAR), 73% of homeowners say that they are more likely to list with a real estate agent who uses video to market their home; however, only 9% of agents create listing videos. Besides that, an Australian real estate group reported seeing a 403% increase in traffic for listings that included video as compared to listings without. In America, implementing drone photography into the real estate marketing plan is the demographic shift to a more tech-savvy generation. According to a 2020 report by the National Association of Realtors, 38% of the homebuyers in America in 2020 were millennials. This is the biggest cohort of any generation.

Reference: Adlina. (2024, June 7). *Dron dalam Pemantauan Pembinaan*. CIDB HQ. https://www.cidb.gov.my/eng/drones-in-construction-monitoring/

Study of Traditional Monitoring And Drone Monitoring On Construction Site

According to a McKinsey Global Institute report, the construction sector suffers annual losses totaling a staggering $1.2 trillion due to inefficiencies and waste. Similarly, large construction projects often exceed their expected completion time by 20% and surpass budget estimates by up to 80%. Moreover, reliance on traditional methods, the lack of technological adoption, and insufficient operational transparency across a fragmented stakeholder landscape contribute to the problem.

Key Differences Between Traditional Monitoring And Drone Monitoring

Aspect	Traditional monitoring	Drone monitoring
Process execution	Slow, manual collection	Real-time monitoring, swift decisions
Data accuracy	Variable, prone to error	Highly accurate, aerial imagery
Coverage area	Limited by accessibility	Extensive, including hard-to-reach areas
Progress visualization	Static images, reports	Dynamic aerial imagery, 3D models
Adaptability	Limited adaptability	Real-time adjustments
Environment assessment	Limited capability	Comprehensive monitoring
Cost	Higher, labor-intensive	Reduced costs, initial investment

Drones improve the safety of the workers. They facilitate the inspection of hazardous areas remotely. This reduces the risk to workers and prevents injury-related project costs. In fact, worker injuries cost the industry an estimated $167 billion in 2021 alone. These costs can increase your insurance prices and reduce profit margins.

Reference: *The Role of Athletic Trainers in Construction Site Injury Prevention -- Occupational Health & Safety*. (2023, September 21). Occupational Health & Safety. https://ohsonline.com/Articles/2023/09/21/The-Role-of-Athletic-Trainers-in-Construction-Site-Injury-Prevention.aspx?Page=2

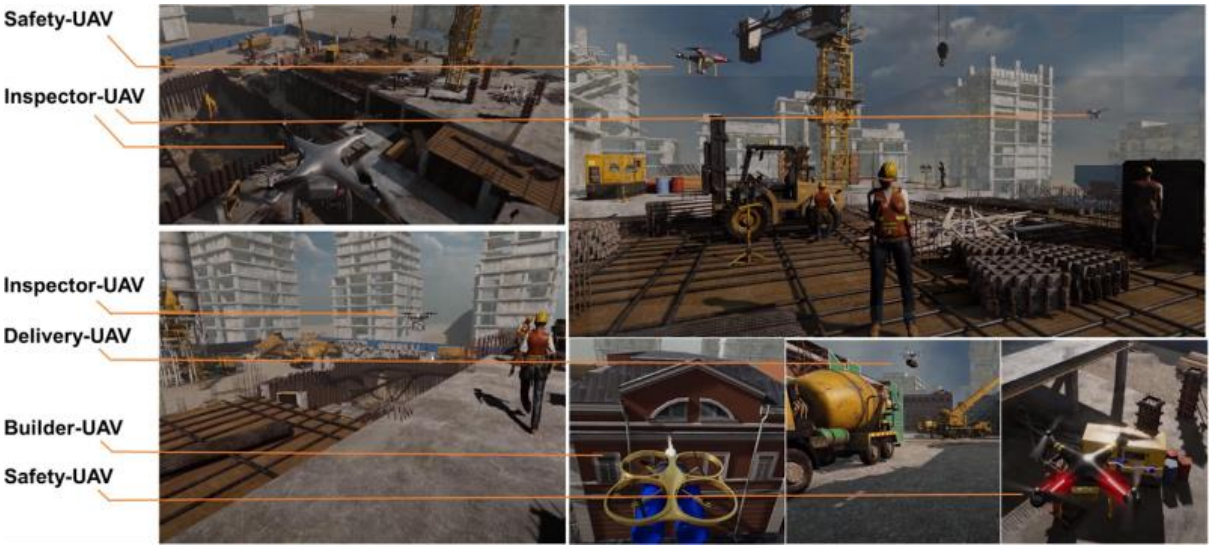


Figure:

Reference: Jeelani, I., & Gheisari, M. (2021). Safety challenges of UAV integration in construction: Conceptual analysis and future research roadmap. *Safety Science*, *144*, 105473. https://doi.org/10.1016/j.ssci.2021.105473

Development Process

After the problem statement was announced, our team brainstormed for the idea of how to help Madana IT to improve the efficiency of construction monitoring and progress tracking using UAV. Yi Jun defines the project scope, objectives and the use case scenario. Justin determines the detailed construction monitoring and implementation of how UAV helps on progress tracking. Yi Cheng analyzes the cost of implementation needed and benefits and impacts of our solution to Madana IT. Pin Quan did the case study of uses of UAV in construction monitoring and determined the key differences between traditional monitoring and drone monitoring.

Challenges Encountered

Time Management

We encountered time constraint problems due to lack of an idea that can be implemented.

Strategy**: Getting help from the mentor and break down the project into smaller, manageable tasks with clear deadlines.**

Lack of Ideas

We encountered a lack of an idea that can be implemented due to not understanding the problem statement thoroughly.

Strategy**: Seeking help from the mentor and seeking advice for our ideas.**

Key Learnings:

DSC boys have gained memorable experience through the 24-hour Hackinsan. We have learned brainstorming and teamwork skills during the hackathon. These two skills are extremely important, as the first can enable us to come up with brilliant ideas and the latter allows us to work together to perform well on those ideas. Every one of us has improved our problem-solving ability, worked well as a team, and given our best to our ideas.

Future Directions for Project:

Our project was planned to be proposed to government departments and all property companies. In the future, we hope to develop more ways to efficiently use drones, especially in 3D modeling and environmental analysis. In the future, we are going to have a collaboration with techexpo to increase the size of our team.