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Uavs, Land use Planning, and Community Engagement the Potential of Drones in Urban Mapping and Relation to Community Integration

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Abstract: Unmanned Aerial Vehicles (UAVs), or drones, have faced a rapid change in many aspects of Urban communities and the planning profession, which results in growing potential uses and the computer software industry. Compared with currently available tools, like ArcGIS, UAVs offer the potential for superior low-cost data gathering, and the ability for physical access to hard-to-reach places like hazardous and high-risk natural disaster places, at the same time while delivering maintenance to areas that are difficult to reach. Drones are easier and faster to deploy than most alternatives like working teams, as they use powered batteries, it applies better to the environment, and is energy efficient. Drones have a higher accuracy rate even for a greater distance to a small single house. UAVs or drones have a limitation as well, like civil regulations in some regions, in addition to some vulnerable damage in severe weather conditions.

According to the new urban agenda, promoting sustainable development through public inclusion is a highly critical goal, fulfilling the inclusivity and insurance of all present and future inhabitants, to produce equal, accessible, affordable, healthy, safe, resilient, and sustainable cities. UAVs offer community participation and public self-resilience to vulnerable communities that are facing social, ecological, and environmental special impact conflicts. The research will present a framework for UAV integration with urban development and community engagement through an applied research method using an international case study in George Town, Penang, Malaysia.

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1- Introduction

UAVs or Unmanned Aerial Vehicles or Unmanned Aerial Systems (UAS), and Remotely Piloted Aircraft Systems (RPAS) are defined as small aircraft operated without an onboard pilot (Nex and Remondino, 2014). They are unique to the field of mechanical aviation. They can fly without a human operator on board to reach places a man can or cannot reach on foot and perform complex and unconventional aviation tasks. “UAVs come in a vast array of sizes, can hover in midair, do backflips, spins, and spirals” N. Jenkins 2015. UAVs can navigate easily and smoothly, define, and accurately locate objects, penetrate small and dangerous zones, and besides do more than this with advanced technology in cooperation with tools they carry like video recording apparatus “In recent years, the Unmanned Aircraft Systems/UAVs/Drones have become the most advanced technology developed and a perfect platform for aerial photography, remote sensing studies, topographical surveys, and mapping” (T. Preethi Latha, 2019).

UAVs are cheaper devices and systems compared to other tools like analytical air flights, demanding the expertise of skilled pilots and operators, as well as extensive support infrastructure in the form of airports and landing pads, aerial mapping and modeling, off-the-shelf UAV systems, are coupled with developments in automatic imagery analysis processing from the field of computer and software's vision which led to a surge in UAV applications over last decade (Colomina and Molina, 2014). UAVs are essential and offer enormous potential for surveyors and GIS professionals, it is possible to carry out topographic surveys of the same quality as the highly accurate measurements collected by traditional topographic surveys, consuming cost, the workload of specialists in the field, and time. "With $1000 (US), a smartphone, and some low-cost software, virtually anyone has video, imaging, and data-collection capabilities that rival or even exceed traditional planes and helicopters" (Marcel Williams, 2018). For planners, the task that would require a team of surveyors and highly specialized equipment now can be accomplished in a single 15-minute flight and a few hours of post-processing. The high-quality aerial imagery available from drones allows us to create detailed maps of large areas, terrain models, and 3D reconstructions of the built or natural environment.

Until recently, in most areas associated with aerial surveying, chartering a plane or helicopter was all about finding the best ways to conduct targeted aerial surveys and collecting cinematic aerial videos. However, requiring the expertise of skilled pilots and operators, as well as the overall supporting infrastructure in the form of airports and landing pads, aerial mapping, and modeling was never a cost-effective option. Only large, well-funded organizations, for example, governments or large corporations, can have these resources. Low-cost drones provide consumers with a viable solution, planners started to raise exciting possibilities, the task that used to require a team of surveyors, and highly specialized equipment could be now accomplished in a 15-minute flight and a few hours of post-processing process. Besides, that provides us with high-quality aerial photos, which are available from drones, and creates detailed maps of large areas and terrain models as well for 3D reconstructions of the built or natural environment.

Moreover, since drones have low operating costs, which are often just energy for battery charge and pilot time, the data can be refreshed frequently, enabling more responsiveness and planning decisions promptly. Drone technology is also advancing at a perfect pace, Innovators continually pioneer new applications for drones from data collection to delivery.

Planners and specialists started to study traffic, parking, and public places, so there is a drone in a position a few hundred feet over a dense part of the city for a specified period if its battery allows. Through setting a coordinate, the drone can return to the specified location at a different time of the day or day of the week to compare snapshots and scores taken in one or several locations across the city. It produces accurate traffic studies in several cities simultaneously, cars also can be counted manually or ideally monitored using a computer vision algorithm. The decision should also be sufficient to count pedestrians and cyclists, providing insights into dangerous intersections or help locate new traffic lights and pedestrian walkways. Using the same approach, a drone monitors a particular public space at regular intervals, and the resulting videos can demonstrate how a site might function or fail as an individual site within its city context. "UAVs also make use of LIDAR and data derived from these active sensors capable of providing detailed 3D pint clouds from which detailed building structural information can be defined for urban planning and development measures" (T. Preethi Latha, 2019). As a stable platform.

1.1 The Disadvantages of Drones

Drones have a limitation, like some soft legalization in different countries, still not allowed to use UAVs for personal uses even research. Drones still have some problems with legalities in different countries as they could reflect some lake like privacy and spying. The drone is also vulnerable to accidental air collisions, and time labs. Drones in case of damage could cause damage to people and materials too, and at the same time questionable for physical safety especially using drones near airports. The drone could cause impacts birds too.

1.2 Relation to Community Engagement

Drones or UAVs have various applications that could connect people to interact with the process that drones execute, in addition to the result also that came out of the aerial process.

2. UAVs applications relating to mapping tools and different types of hazards measures

3D modeling: that can safely fly close to large structures and record images from a variety of angles, a drone is an ideal device for documenting skyscrapers, city blocks, and historic sites. The approach is like producing elevation models but involves taking more images at oblique angles in addition to direct overhead shots. Depending on the complexity of the area being modeled and the model's fidelity, the drone may make multiple passes, taking images at different angles for each pass. Applications like Pix4D can generate a series of waypoints and camera positions for autonomous flights. Once images are collected, photogrammetry software correlates the images, identifying common points. These points collectively produce a "cloud" that the software interpolates to generate the model. Elevation surveys: Climate change and sea-level rise underscore the importance of modeling flooding, landslides, and other risks tied closely to topography. Via a technique known as photogrammetry, drone images can form the basis for an accurate elevation model.

Elevation surveys, Climate change, and sea-level rise underscore the importance of modeling flooding, landslides, and other risks tied closely to topography. Via a technique known as photogrammetry, drone images can form the basis for an accurate elevation model. An algorithm identifies common points in pictures taken from slightly different positions. Because of perspective, points closer to the drone, for example, higher areas will appear to move more than points that are farther away. Based on how much these common points move from image to image and how far the drone itself has traveled, planners can extract elevation values. The ensuing terrain models can be accurate to 10cm or less and can help to determine flood, landslide, or avalanche risks, suitability for building, volumetric studies, and countless other applications.

Standard-issue mapping, and drone images when stitched simultaneously, can form the basis for a myriad of different mapping projects and applications. Land use classification is a common task for geographers and planners, for example, identifying which urbanized areas, which areas are green space, waterways, and so on. While commonly executed using satellite imagery, planners applied the same techniques to drone imagery, but at a higher resolution. Individual vectors, for example, geometry-based, layers of specific types of features form the core of most city GIS. The pixel-based images collected from drones can form the basis for extracting and classifying these features.

Surveying disaster zones, Portable and battery-powered, camera drones are often the earliest available tools for disaster assessments. Planners could send robots to inspect areas that would be otherwise impossible or too risky to search by hand. Live video transmission can help locate survivors, while planners can use automated image-collecting potentials to create maps and surveys of the affected area, which help to direct dispatch resources first. As well, practitioners use drones to deliver immediately needed supplies.

3. UAVs application for community engagement

Activism by telling a story, and if used and employed creatively, drone video can be a premium storytelling device. If a governmental or non-governmental organization wants to increase awareness of, for example, mangrove habitats that are on the verge of extinction in many parts of the world, such as what is happening in the Red Sea due to salinity, they can deploy a drone over these habitats and record all the negative consequences that are visible due to pollution and climate change, and photographing what cannot be collected in one picture, regrouping and disseminating it to people in different images to raise their awareness of the issue. One could easily imagine a similar approach for deforestation, desertification urban sprawl, ghost cities, or megaprojects of dubious merit.

Promotion, especially as productive use, drones could be gathering video for city social media, reports, or documentation of significant events. Cities are increasingly aware of the importance of their brand, which is determined in large part by popular images and videos. Drone videos could also draw attention to new initiatives, such as an overhead flyover that highlights new solar installations or a project to paint commercial roofs white. Aerial video could also play an enormous role in city-led zoning and planning initiatives, helping community members visualize proposed changes or a new project in its broader city context.

According to the UN urban Agenda, “inclusivity and [the insurance] that all inhabitants, of present and future generations, without discrimination of any kind, can inhabit and produce just, safe, healthy, accessible, affordable, resilient, and sustainable cities”, the drone could advance community integration and participation, at the same time, the drone could be self-resilience of vulnerable neighborhoods facing ecological, social and spatial conflict.

The drone could collect new data to inform, for example, displaced people and urban communities about the increasingly dangerous hazards of flash flooding in the stricken areas. A drone could retrieve visual tools with clear aerial images in addition to 3-dimensional models, which could also communicate and present environmental hazards to the population and engage local people in land use planning tasks. Using community participatory approaches, drones in such cases could foster community-based strategies for further implementations and mitigate some of the largest risks to the social and spatial well-being of the most affected families. As well, as encourage local communities to use emergent technologies and more technical knowledge with the ability to be fully part of the development and climate adaptability process. (Fig. no 1)

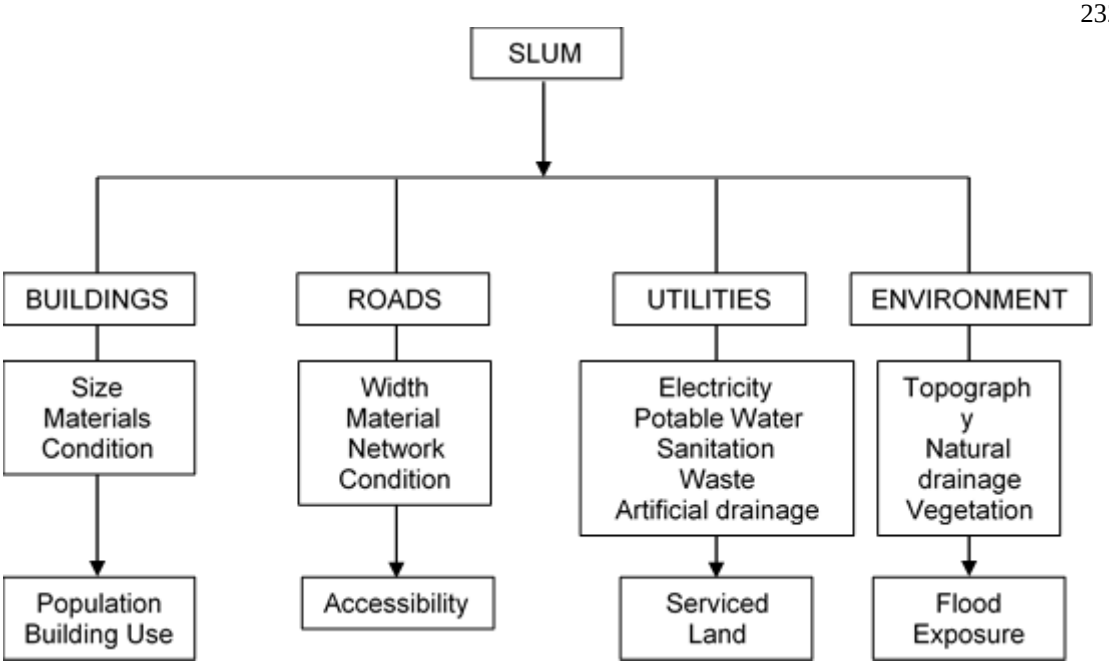

Fig. 1: Hierarchy of slum characteristics that can be identified through aerial imagery with sufficientspecial resolution. The general object type is the second row, which makes up a neighborhood, information which can potentially be derived from remotely sensed data third is raw, and information that can be inferred with the support of auxiliary data, the bottom row. (Margaux. G. Caroline, 1989)

For informal settlements, urban sprawl, and incremental housings, drones could contribute to detailed surveys in cooperation with local people inputs, varying from the survey of the individual cases and different types of groups by speed and size of expansion or speed of physical growth. In that sense, the drone could produce graphs that captured the process of room expansion, family size changes, and income level changes over time. Besides, studies of individual house plans that show changes in the physical space over time, and analysis of detailed information from the overflights quickly identify several of the basic types of dwelling growth, modest growth stories, and successful multi-story expansion. (Fig No. 1) Due to the analysis of the outcome, planners could develop effective tailored urban intervention policies that meet the needs of local people and governmental issues, as well, as assist in locating representative samples for a detailed survey. Over time, the ease and low cost of using drones will allow frequent overflights to track growth over regular intervals more inclusively.

In heritage sites, and in case of lacking information and research data, especially about local people activities and relation to the site, the drone could help in urgent need of revival and upgrading data of most importantly methodical process of the documentation about heritage management, urban planning, history, and local urban body. According to data collected by drones, planners could develop to help the community using on-ground maps and plans, creating the community's vision for development and enabling local actors to build also the capacity to empower local people to improve living conditions. Besides, ensure all citizens have access to equal opportunities and do not face discrimination due to the use of technology. The drone provides through such cases, strengthens resilience in cities by reducing disaster risks, improving connectivity, and supporting innovative and green initiatives and plans for safe, accessible, and green public spaces.

4. Methods: Case study - George Town, Penang, Malaysia

Drone Application in Promoting Local Community Integration in World Heritage Site Planning

George Town, Penang is a Malaysian city founded 200 years ago due to the growing trade and cultural interactions between the East and West. The fabric of this city reflects the influences of migration among Asian, European, and Arabic countries. This history led to the emergence of a multicultural identity represented by both tangible and intangible forms of cultural heritage. UNESCO declared George Town a World Heritage Site on July 7, 2008, in recognition of the city's rich cultural heritage (SERI, 2009).

Although the UNESCO World Heritage status has been critical to restoring and preserving the tangible, for example, the architectural heritage of the city, it has also had unintended consequences for residents. Research conducted in 2015 explored the economic, social, and architectural challenges that George Town residents have faced since the city achieved Heritage Site status. Also speculated was how the UNESCO designation might help to preserve local heritage, and improve economic development, all while improving livability for local people in the heritage area. Through surveys, the study found that a rise in rents due to increased foreign investment and the high cost of materials and labor for architectural preservation have caused residents to move away from the heritage area, leading to security concerns. A lack of transparency between local government and citizens, well as a lack of local awareness of George Town's cultural heritage, have exacerbated these challenges. (Fig. No 2)

5. Discussion

5.1 Heritage in George Town and possibilities for drone applications

Using drone footage to capture the physical built environment as well as the human economic and social traffic facilitated and translated relationships between investors, local stakeholders, and others. Drone images helped to:

- Map change, deformation, and socio-economic displacement.
- Read the effect of interventions and changes on urban deformations and formations.
- Demonstrate the effect of indirect displacement.
- Determine rough figures of demolished heritage.
- Trace and document different timing behavior inside the heritage area and draw the relationship between urban shape and the problem of security inside different zones of the core and buffer areas.
- Offer the flexibility to map and redraw heritage buildings and their surroundings.
- Document people's behavior around these buildings throughout the day.
- Determine possible areas government grants could be applied depending on urban formation for heritage areas and local people's activities.

Results of local people interviews show that people feel livability issues in the core and buffer zones are not adequately addressed. Four challenges appear to be most pressing to residents: cost of living and affordability; security concerns; government transparency; and lack of awareness about cultural heritage. Affordability is a top concern for residents of George Town, government investments and high-rise investments affect their work and housing affordability. Since George Town received

WHS status in 2008, the types of jobs available and the price of rent have changed. Land values in the World Heritage area have increased, attracting foreign investors interested in tourist services, such as hotels and restaurants. The increased land value and rent for residents made the option of selling their workplaces and houses more attractive than investing in preserving the buildings' architectural heritage.

Figure 2: A group of photos was taken by the drone to discover the urban tissue of the city in one hour, Researcher (2017).

Therefore, many residents sold their land to foreign investors, who quickly converted them into tourist-centered businesses. Drone mapping helped us to read the effect of these interventions and changes on urban deformations and formations, read the effect of indirect displacement as shown in maps, determine rough numbers of the demolished heritage and housing places, and draw the line between the old and new besides the core and buffer zone.

The increase in foreign investment and competition in the tourism sectors, and the resulting decrease in affordability, have shaken local business owners' confidence. A drone helped in documenting and understanding the limitations between foreign and local people sectors at the same time understanding how the business displacement happening by taking different photos and videos at the same and different times for frequent events and accidents like what is shown in maps. (Fig. No 3)

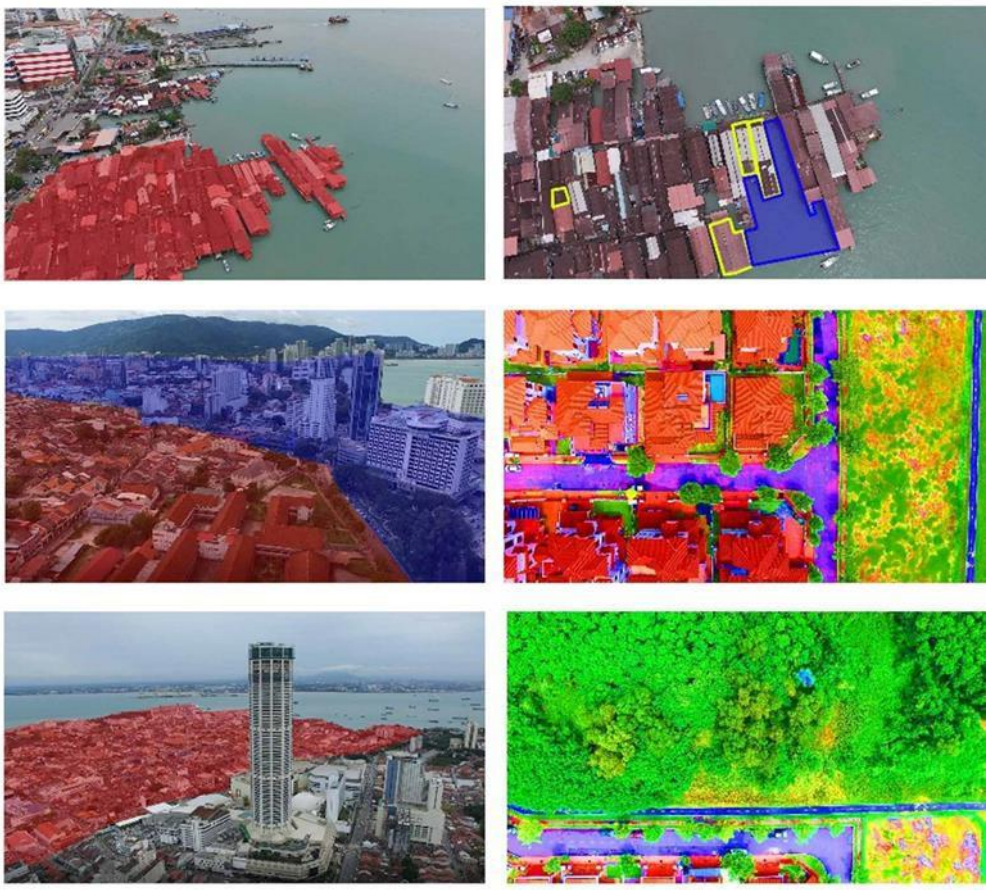

Figure 3: Drone outcome analysis and relation to heritage site UNESCO reservation, Researcher, 2017.

Dilapidated and vacant premises impact the perceived safety of the heritage area. Over half of the respondents indicated some security concerns about the complete heritage area, while 20 percent rated security in the heritage area as bad. Further discussion with residents showed that security concerns at night and in the buffer, zone were especially troubling. A drone helped in tracing and documenting different timing behavior inside the heritage area and drawing the relationship between urban shape and happening displacement and the problem of security inside different zones of the core and buffer areas.

For effective public participation to occur, the public must first be provided with adequate information to understand heritage conservation issues and the planning process, and then be given the chance to participate effectively. As a result of drone mapping, we were able to connect different zones with different races and understand how they interact during a day-long. Then we were able to propose some activities that encourage participation and cooperation in various sectors and zones inside and attached to heritage areas. To improve livability for residents, the government—in collaboration with civil society—should create incentives to attract business owners to lease currently vacant buildings. One strategy for the adaptive reuse of these buildings is to turn them into small studio spaces, small shops, or markets for selling local foods and crafts. Drone gives the availability to map and redraw these buildings and their surroundings, at the same time document people's behavior among these buildings during daylong. (Fig. No. 4)

For both investors and local developers, restriction of land grants should be combined with the research required for restoration, conservation work, or any other requirements. A drone helped to

determine where could these grants be available depending on urban formation for heritage areas and local people's different activities.

Figure 4: Group of analytical photos that indicate typology and pattern in addition to people's activities inside the city. Researcher, 2017

6. Recommendation

Recommend drones to be used in urban surveys especially in places with sensitive situations and request rapid collective and gathered data to be available for immediate reactions and plans.

In this situation and case study drones data and analysis of it as an outcome, validate improving public participation in the planning for the heritage area to better address livability concerns, raise awareness of cultural heritage and provide opportunities for residents to influence decision-making in the early stages of planning. Also recommended was the creation of an executive committee to coordinate heritage area planning among the various stakeholders.

7. Conclusion

Drone practice can combine the benefits of satellite imaging (spatial understanding from bird-eye view mapping) with community engagement and maximizing sensor information gathering and community involvement, reflecting and indicate for socio-economic issues. Drones as well, facilitate mapping and then planning from top-down or down-top views with the affordability and accessibility for difficult places to reach like severe topography and morphological areas. Drone and mobile tools facilitate collateral planning for medical services and educational purposes, especially for the community, with appropriate monitoring systems and tools, it could give planning development solutions for the long-term engaging different organizations with society. Compared to drones with other similar tools, the drone is cheaper and easy to learn and use, given that satellite images are very expensive for most users.

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