Essay: Literature study for possibilities of drones in Sub-Saharan Africa

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***Abstract*—The application of drones is an effective approach for regional development in Sub-Saharan Africa. To have a more round view of its capabilities, this essay gives an overview of various tried solutions in healthcare, agriculture, and environment management. The project in Rwanda showed success and is an exciting example of drone system applications in medicine delivery. It could also reveal the potential of drone technology applications to build a brighter future in Sub-Saharan Africa.**

I. Introduction

"How can drones help Sub-Saharan Africa?" is an interesting question because it allows us to combine new technologies with a developing area in the world. This essay brings a view from three different aspects of this question, healthcare, agriculture, and environmental. It shows different possibilities for applications and technologies, and it concludes with some general findings for possible further research.

II. Healthcare

A. Applications

This section explores some of the different applications for drones in healthcare. For example, tracking mosquitoes which can carry Malaria [1] or other diseases [2]. Other examples include delivery of blood [2], HIV therapies, and vaccines [3]. Which is deployed in Rwanda and makes Africa nowadays the continent that is the most developed in the area of drone deliveries [4]. This new application is not only limited to the developing world, but developed ones can also use this application of drones. For example, for Sweden, it can save up to 15 minutes when providing emergency help for people with cardiac arrest [4]. Drone deliveries in Rwanda work with a one-way air-drop. However, in Madagascar, Malawi, and Senegal, a pilot is running for bi-directional transports, meaning also picking up things from in the field [5].

B. Used technologies

This section describes the different drone-based technologies in healthcare that create possibilities for use cases in Sub-Saharan Africa. For example, projects that could use Landsat satellite for imaging before can now have a more reliable, cheap, and high-quality solution [1], by using a quadcopter like DJI Phantom with a camera like Sony Exmor [1]. This complete setup costs less than $1000 [1]. Another project found that using a drone for the cost of $100-$500 can hold a dynamic payload, including anti-mosquito payloads [2]. Some other possibilities of using such a drone can be a distributed network for drones, so they can communicate where they are and improve efficiency [2]. Some drones used at a "production" level are from Zipline, which has a drone that can fly 160KM (roundtrip) at a speed of 128KM/H and a cargo of 1.75KG [4]. However it is currently operated at a radius of 75KM [3] [4]. It will take approximately ten years before the west has these things too [4]. These drones could also be used with AR like Google glass, to help uninformed bystanders perform certain actions to people in need [4]. Different types of drones can be applied to from fixed-wing to quadcopter or a hybrid solution [5], which can result in having ranges of 60-100km with payloads between 1kg till 6kg. Besides this, the drones can be electric ones, which can fly autonomously but with monitoring [5], to have a reduction in human resources required and still have the required precision.

III. Agriculture

A. Applications

The application of drones in agriculture is not new; it started in the 1970s in Japan with pesticides [6]. But nowadays there are more applications for drones in agriculture, for example monitoring food production [6], crop yield [6] [7] [8] or maize [8]. Another list provided by [6] has use cases for drones in agriculture; for pesticides, herbicides, fungicides, seed planting, irrigation, and monitoring. Both [6] and [9] too note the possibilities for drones and pesticides. Additionally, in [6] a mention of livestock monitoring as one of the possibilities is made. Imaging would provide a way for technically accomplishing these use cases [10]. However, there are limitations on the applications: "[...] UAV is advantageous for relatively smaller areas and that a break-even point exists at five hectares beyond which other platforms are preferable. " [7].

B. Used technologies

Spraying drones cost $9000-$10000 [6], which is higher than those in healthcare. However, this most likely has to do with specialized equipment required for spraying on the produce. Another paper [7], described replacing the Landsat satellite by using two consumer-grade cameras, one of them modified for NIR with an Enduro quadcopter for mobility [7]. This example used consumer-grade products just as in the healthcare projects that could imply a lower cost. The same project used GPS for the drone, but the cameras did not use GPS but used an overlap of 60-80% in taking pictures [7]; this requires less expensive cameras but does allow autonomous flights. Another project used GoPro hero 4 cameras, for NIR and RGB pictures, these cameras, did not have GPS enabled, but GPS for the drones [8], just as with the previous example. Another project used the Landsat Thematic mapper and a Phantom 2+ drone [10]; this shows an example in which drones do not replace other solutions but support use cases for multiple data sources.

IV. Environmental

A. Applications

Environmental purposes include detecting wildlife [11], monitoring for poaching activities [12], soil erosion [13], crocodiles [14], coastal erosion and flooding [15], animal population [16] and locating illegal logging [16]. Besides this, drones can replace Landsat for forest monitoring [17]. A lot of different industries are affected by drone technology, for example, photo, real estate, utility construction, education, manufacturing, emergency and insurance [9]; this means that there are many opportunities to work with drones in the environmental aspect.

B. Used technologies

Technologies that can be used for environmental drones include imaging or video [11][12][14][17][18], Thermal video [12], NolIR Cameras [18] which can be used in conjunction with neural networks [11] to analyze the data. There are also reports that lidar systems are still orders of magnitude more expensive than a camera, for forest use cases with drones [17]. Besides this, GPS can be used to track the position of drones [12]. According to [13], fixed-wing drones are the most common form of drones; this could have to do with "Fixed-wing UAVs may be more suited to topographic surveys over larger spatial scales due to their longevity in flight." [13]. For example, [12] used a fixed-wing drone that could fly 10km and for 50minutes. This electric drone had manual and automatic possibilities, besides this, it could be launched by hand and fly at 15-50km/h depending on the wind [12]. However, multi-rotor drones can also be used [13], for example DJI Phantom 2 quadcopter [17] or DJI Phantom 3 [14]. Rotor drones are often more stable at higher wind speeds then fixed-wing UAVs, which means that they can fly more often [13]. However, the flight duration is often more limited than those of fixed-wing design [13]. Also, the Raspberry Pi with a multiplexer chip can be used for imaging and using multiple Pi cameras [18]; this can reduce the weight and cost of using multiple controllers or having special cameras.

V. Conclusion

In the cases studied of drone applications for development, there lay high potentials and great opportunities. Drones can offer faster access to remote places and provide monitoring functionality to communities and wildlife to satisfy the need. Furthermore, cost-cutting for production use is essential for the further spreading of the applications of the technology.

For further study, firstly, there could be more applications in healthcare and agriculture-related areas as the examples in these areas are significantly outnumbered compared to the environment examples. Secondly, with the successful example of Rwanda's healthcare drones, a drone network could be built across countries. Thirdly, the application of multi-directional deliveries also has excellent potential. Finally, different types of cargo delivery could be explored, for example, AR for first-aid package dropping.

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