H.A.R.V. (**H**igh **A**ltitude **R**esearch **V**ehicle)

The capabilities a homemade unmanned aerial vehicle has and opportunities that it may provide for research, agriculture, entertainment, photography, business and more

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Abstract

For decades unmanned aerial vehicles (UAVs) have been used as a means for the military to perform specific tactical duties without the need of having a pilot on board a craft to maneuver in the air. In the mid-1800s Austria sent unmanned, bomb-filled balloons to attack Venice.[1] The U.S. Air Force has been using UAVs since they began planning the idea for the use of unmanned aircraft in 1959, from concern of losing pilots over hostile territory.

Since the early developments from the U.S. Air Force and other militaries throughout the world, UAVs or "drones" have developed into highly technical and advanced pieces of equipment using today's most advanced technologies in computers, sensors, camera equipment, and armaments. Beyond military applications of UAVs, numerous civil aviation uses have been developed, including aerial surveying of crops, acrobatic aerial footage in filmmaking, search and rescue operations, inspecting power lines and pipelines, counting wildlife, delivering medical supplies to remote or otherwise inaccessible regions and many other uses.[2]

Today UAVs are very accessible for the average person to obtain through an internet or hobby store purchase. One could even design and build their own drone through supply stores

[1] http://en.wikipedia.org/wiki/Unmanned_aerial_vehicle
[2] http://en.wikipedia.org/wiki/Unmanned_aerial_vehicle

that provide all the necessary equipment and devices that could provide the means to make the most basic of UAVs to having very advanced technologies for a fraction of the cost of a pre-manufactured UAV. This paper is a brief overview of the homemade H.A.R.V (High Altitude Research Vehicle) UAV made at home with easily obtained tools from your average hobby store or home supply store and components obtained from online stores, and the uses and capabilities that such an average homemade UAV may have.

Required Components

1 – Frame

4 – Electric Motors

4 – Electronic Speed Controls (ESCs)

1 – Flight Controller

2 – Right-Hand Rotation Propellers

1 – Power Distribution Board

1 – Battery

1 – Transmitter & Receiver

1 – Battery Charger

2 – Standard Rotation Propellers

Optional Components

Camera

Camera Gimbal

GPS

Lights

Flight Controller Ad-ons

Telemetry

Battery Alarm

I. Introduction

The first order of business when making a homemade drone is deciding a budget to determine the quality of components that are necessary for the build, how large or small your UAV can be and to decipher what ad-ons you may or may not be able to acquire for whatever

uses you may desire to have for the UAV. Next, would be deciding, based on budget, what you may want the UAV to do, such as using it for recreational use and have the capability to perform acrobatics or have a camera to take aerial photos and/or video footage. The H.A.R.V. was built in mind to be able to take aerial video and photos to study its capabilities to view land, structures, animals and even weather from higher altitudes than can be obtained from ground level. H.A.R.V.'s sole purpose during this research was to observe the capabilities such a UAV could perform in gathering data from the air to learn of what such a device could offer for the greater needs of those areas in agriculture and land management, construction and development, entertainment, marketing and business, as well as a whole host of other areas of industry, science, and business.

Throughout this research, H.A.R.V. has taken many flights, starting with several test flights to observe H.A.R.V.'s maneuverability and reaction to controls, performance in a variety of weather conditions, such as low and high wind conditions, and observance of its capabilities to take good quality video. A progression was made thereafter in following test flights to observe more of its footage taking capabilities. As for example, low to medium altitudes of steady camera footage was taken to observe low level structures, such as rooftops, sheds and light poles. Grasses and land conditions were also observed from lower to medium altitudes (altitudes considered: 10 – 50 feet). Mid-range altitudes of footage were taken to observe trees or facilities such as parks, properties, roads, and lakes (altitudes considered: 50 – 150 feet). Higher altitudes of footage were taken to observe wider-angled video of land, property, construction sites, roads, and even weather conditions (altitudes considered: 150 – 300+ feet).

II. Aerial photos

All of the following photos were obtained from the Mobius 1080P HD Action Camera on board the H.A.R.V.

Low photo shot during take-off of H.A.R.V.

The lower altitude fly-overs allows H.A.R.V. to take footage of grasses and land conditions otherwise not able to be seen from ground level to allow the possibility for land managers and farmers to make decisions based on gathered aerial data to better preserve the surrounding areas of land and crop.

Low altitude photos of grassy areas in a softball field (top 2) and water standing in soccer field (bottom)

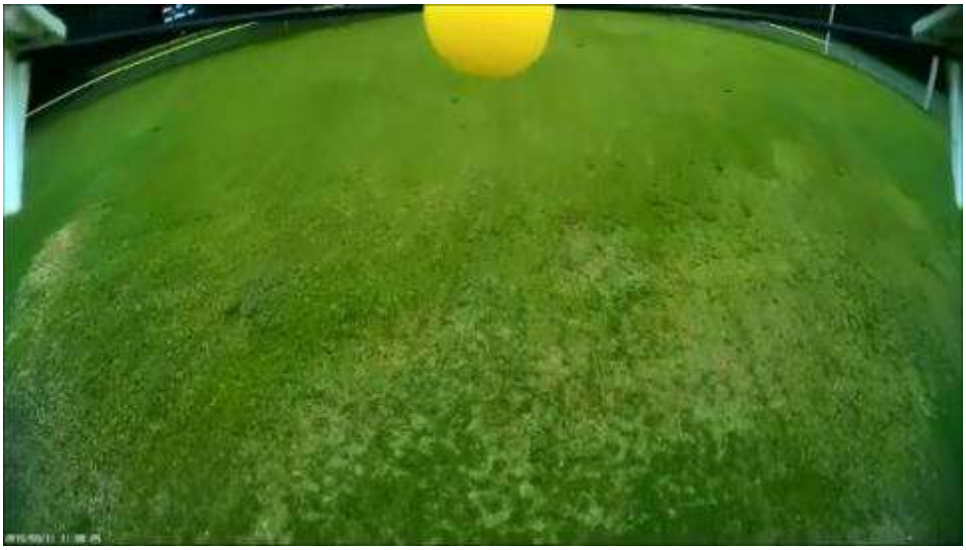

Photo at a "medium" elevation of a mowed field

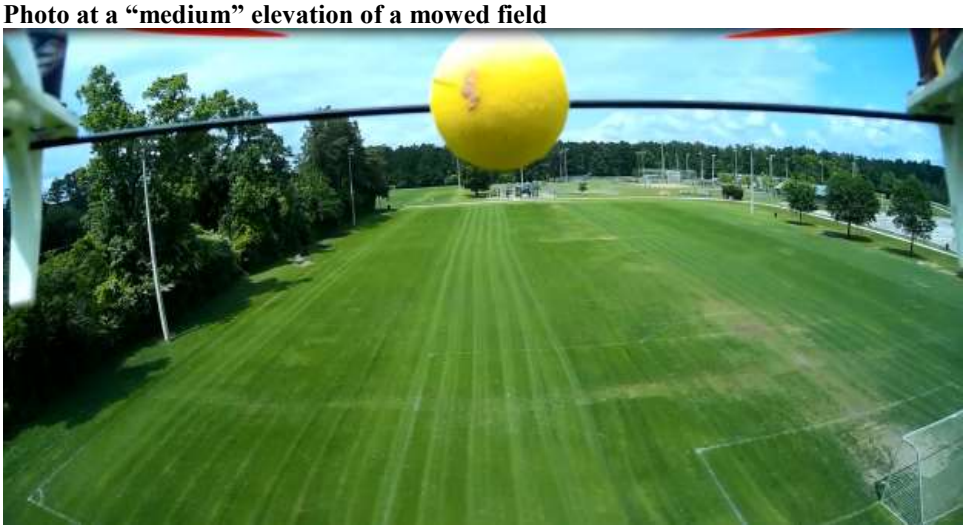

Photo at a medium altitude of a soccer field

Photo at a medium altitude of a soccer field

These lower altitudes had also shown potential for the ability to observe parts of structures that would normally require individuals to need ladders or some other form of equipment to gain a height advantage to assess structural integrities and conditions or otherwise perform routine inspections, such as with rooftops like the one taken by H.A.R.V.

H.A.R.V. was capable of taking even closer footage of a rooftop allowing a first person view (FPV) of the roof without actually having to send a person to the top.

Closer view of a roof top

With these types of capabilities a reduction of the risk of injuries could be prevented by businesses that would otherwise send individuals to inspect these areas by ladder or other devices. Business owners would be able to reduce time for the inspections and possibly reduce cost to the client for not having to send a person that would otherwise take longer for preparation to access and observe these areas.

The mid-range altitudes could provide aerial footage of local parks, recreational areas or schools that could be promoted by the local city or state governments and school districts to the people.

Photo of a school playground

Photo of a park with softball fields and facilities

Theses mid-range altitudes include taller structures and objects such as large buildings, trees and light poles. Sending a UAV first before using equipment to send someone up to those heights to inspect areas that do not need close observation could cut time and cost.

Photo of a tree top

Photo of a light pole

Photo of a light pole

The higher altitudes provide much broader views of the surrounding lays of land and property. The onboard Mobius camera on H.A.R.V. provides wide-angled views of surrounding areas. These higher altitude photos and footage could also be beneficial as a promotional tool to land developers and real estate brokers for properties and subdivisions. The opportunity for higher aerial views could also benefit as local city promotional tools for skyline photo shoots and aerial street views or as tools to view ongoing construction like the construction done on Houston roads, overpasses and toll roads for a view from a unique vantage point for the participating construction and civil engineering companies participating in such projects.

Higher elevation view of surrounding buildings and horse ranch and stock tanks in background

Higher elevation view of trees in a large park area

Photo of softball fields and surrounding soccer fields and parking lot

Photo of parking lot and surrounding soccer fields and distant surrounding neighborhood subdivisions

At these higher elevations H.A.R.V. was capable of obtaining aerial photos and footage of an incoming spring thunderstorm system heading in an east to north easterly direction through Houston and the surrounding regions. Capabilities of this nature could prove to be beneficial if not only helpful in obtaining weather data in the field for meteorologists and storm trackers. Being able to view systems from much higher altitudes and running live feed video from a UAV could give a bird's eye perspective to the formations of thunder clouds, rain clouds or even possible tornadic activity and their aftermath. Of course these would have to be obtained by a UAV capable of flying in slightly turbulent conditions from a greater distance such as a fixed wing craft equipped with a zoom lensed camera. H.A.R.V. flew in the calm before the storm that April day the following photos were taken and was able to capture thunderstorm cloud formations from a safe distance.

Higher altitude photo of rain clouds forming in distance
April 16, 2015, this area of Tomball, TX received 2.47 inches of rain after this photo was taken

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More photos taken by H.A.R.V.

III. Conclusion

There are a variety of uses that a UAV could provide for the civilian sector if used responsibly. In recent news concerns over privacy and safety have been expressed within stories on spying with the use of drones and a threat to national security with a drone landing on the White House lawn in January of 2015. Those concerns are legitimate and regulations of UAVs are continuously being discussed within the courts on such devices, but there are many more uses that these "drones" could provide that could be deemed as extremely beneficial and helpful as long as there are responsible users or pilots just as with any other craft or device that is operated and regulated.

Along with more research, continued education and promotion of such craft on the far out weighted benefits that they can provide versus the few bad apples that are noted more often in news and media, UAVs could greatly help areas in business and marketing campaigns via elaborate film making, benefit agriculture and horticulture by giving a bird's eye perspective on surrounding crops to better care for those crops to produce a better yield, and help ranching and land management to take better care of the animals and conservation of the environment and waters. There are also areas of use for UAVs in search and rescue operations and police enforcement operations that would normally require the use of helicopters which could greatly cut down cost as well as increase safety of the pilots. The list could obviously continue and with continued innovation in the UAV field, increased technologies in cameras, GPS and other ad-on devices for UAVs the span of their uses could continue to grow.