Design and Development of Unmanned Aerial Vehicle and UAVs future prospects

Mythili[1] ,WasimFathima[2]
[1,2]ECE 3rd YR
RMD ENGINEERING COLLEGE
mythili4189@gmail.comwasimtahira@gmail.com

ABSTRACT.

In order to make aerial vehicles ore compact and unmanned, UAV (drones) were invented. This kind of aircrafts without any humans on board are mostly used by military as surveillance, communications relay. Aircrafts that are able of hovering and vertical flying can also be used for indoor missions like terrorist operations. Drones are also used by private organizations for aerial 3D maps, aerial photography etc. Drones can be used by everyone by owning a license. The major drawback of the drones is that it can reach high altitudes as that of aircrafts which can cause various confusions in mid-air. Drones can be used as a war-fare in military field. This presentation deals with the development of UAV, use of UAV in terms of positive and negative aspects and measures to prevent UAV from becoming a disgrace to human race.

Keywords- **Surveillance, hovering , vertical flying , war-fare**

I. INTRODUCTION

Unmanned Air Vehicles (UAVs) play a predominant role in the modern day warfare where emphasis is on surveillance, intelligence-gathering and dissemination of information. Within a few decades, these systems have evolved from performing a single role/mission to performing multiple missions like surveillance, monitoring, acquiring, tracking and destruction of target with the use of advanced technologies. UAVs serve as unique tools, which broaden battlefield situational awareness and the lowest tactical levels A distinct advantage of UAVs is their cost-effectiveness. They can be developed, produced [1], and operated at lower costs compared to the cost of manned aircraft. The relative savings in engines, airframes, fuel consumption, pilot training, logistics, and maintenance are enormous. The biggest advantage of UAVs, however, is that there is no risk to human lives. Unmanned platforms are the emerging lethal and non-lethal weapons of choice and have transformed the way the armed forces now prosecute operations. The probability of losing reconnaissance platforms to enemy fire is quite higher, thus making UAV a better option. UAVs are mainly used by an organization for aerial maps and photography. They are also used in the military as weapon carrier and secret war attack.

Fig. 1 Model of UAV

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II. EVOLUTION OF UAVs

UAVs evolved from a mere bomb dropping into a global hawk. The UAVs were first used by Austria in later 1800's as a bomb dropping balloon. After which UAVs were extensively used in World War 1 and 2.

A.BOMB DROPPING BALLOON

The Union and Confederate armies both used balloons for spying on the enemy during the U.S. Civil War, with pilot-observers onboard. At least one person—Charles Perley of New York City—imagined that they could also be used to deliver weapons [2]. His patent dated February 24, 1863 calls for a "divided basket" which would open like a clamshell when a timed fuse expired, thereby releasing a bomb. "A balloon can be made to pass over any object, and…any-sized bomb or missile of destruction can be carried up over the place to be destroyed," he wrote.

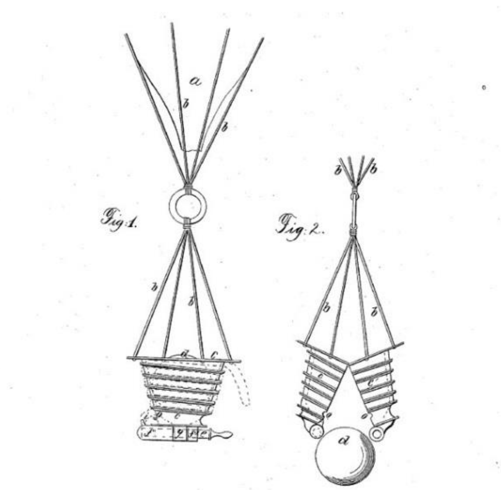

Fig. 2 BOMB DROPPING BALLOON

B.KETTERING BUG

The Kettering Aerial Torpedo, later called the "Kettering Bug," was a small biplane powered by a De Palma 4-cylinder engine and guided by gyroscopes, a barometer, and a mechanical "computer [3]." It flew in 1918 and had a range of up to 75 miles. The onboard computer counted engine revolutions (to gauge distance), then powered down the engine and jettisoned the torpedo's wings at a pre-determined distance (calculated before launch based on prevailing wind speed and direction). At that point the fuselage would crash into its intended target with an explosive payload onboard. The Bug was never used in battle

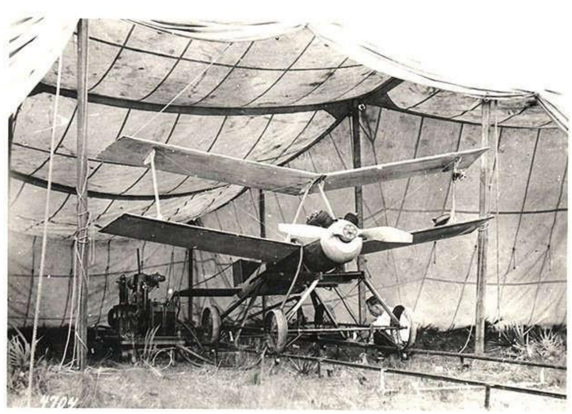

Fig. 3 KETTERING BUG

C.FIRST RECONNAISSANCE DRONE

Reginald Denny's Radioplane Company, which was acquired in 1952 by Northrop Aircraft Incorporated, led the way in post-World War II UAV development. While most of the drones designed and produced during this period were used for target practice, 1955 saw the U.S. Army's first reconnaissance drone [4], the Northrop Radioplane RP-71 Falconer (designated the SD-1 by the Army), based on a target vehicle design. Launched by two rockets and recovered by parachute, the Falconer carried a still film camera and could transmit crude video.

Fig. 4 FIRST RECONNAISSANCE DRONE

D.RQ-1 PREDATOR

The RQ-1 Predator, probably the best-known modern UAV, made its first test flight in 1994. Produced by General Atomics Aeronautical Systems—based on a design by Abraham Karem, a former engineering officer for the Israeli Air Force—it was designed for "long loiter" reconnaissance work. The RQ-1 has evolved, and today its variants patrol the U.S.-Mexico border, collect air samples for scientific research, and unleash Hellfire air-to-ground missiles on military targets.

Fig. 5 RQ-1 PREDATOR

III. UAVs IN CIVILAN WELFARE

A.AGRICULTURE

Using drones for crop surveillance can drastically increase farm crop yields while minimizing the cost of walking the fields or airplane fly-over filming. Using our Precision Vision™ Crop Health Imaging system, you can view composite video showing the health of your crops. The Benefits of Agriculture Drones

Increase Yields
Find potentially yield limiting problems in a timely fashion.

Save Time
While all farmers know the value of scouting their crops few actually have time to cover the acres on foot.

Return on Investment
Over the past 10 years the grower has seen $900-$1,100 gross sales per acre. With the Pacesetter on our own operation we have seen an average increase of 10% leaving the grower with just a 250 acre payback period on the Pacesetter in commercial corn.

Ease of use
Agriculture drones or UAV products can be very complex to set-up and operate, but with our preset standards we allow new operators to have confidence in operating from the ground

Crop Health Imaging
Seeing the true health of your field in a color contrast allows you to see how much sunlight is being absorbed by the crop canopy.

Failsafe - The Drone Flies Home
As an added safety net with the flip of switch your Precision Drone will return to its original takeoff location

Fig. 6 AGRICULTURAL UAVs

B. SURVEILLANCE

Surveillance drones or unmanned aerial systems (UASs) raise significant issues for privacy and civil liberties [5]. Drones are capable highly advanced surveillance, and drones already in use by law enforcement can carry various types of equipment including live-feed video cameras, infrared cameras, heat sensors, and radar. Some military versions can stay in air the hours for hours or days at a time, and their high-tech cameras can scan entire cities, or alternatively, zoom in and read a milk carton from 60,000 feet. They can also carry wifi crackers and fake cell phone towers that can determine your location or intercept your texts and phone calls. Drone manufacturers even admit they are made to carry “less lethal” weapons such as tasers or rubber bullets.

Thanks to a provision in the FAA Modernization and Reform Act of 2012, drones use in the United States is set to expand rapidly over the next few years. The Act includes provisions to make the licensing process easier and quicker for law enforcement, and by 2015, commercial entities will also be able to apply for a drone authorization.

In January 2012, EFF sued the Federal Aviation Administration (FAA) under the Freedom of Information Act to determine which public and private entities had applied for authorization to fly drones. In response to the lawsuit, the FAA has released lists of the 60 public entities and 12 private drone manufacturers that have sought permission to fly drones in the US. The agency has also released several thousand pages of records related to the entities’ drone license applications.

The FAA has yet to provide information on how these drones will be used. EFF has also partnered with MuckRock, the open government organization, to conduct a “drone census” with the goal of determining just that. We have provided an easy-to-use form that ordinary citizens can use to file a public records request with their local police agency to ask what type of surveillance the agency plans to conduct with drones, if any, and what type of privacy protections it is providing its citizens.

Privacy law has not kept up with the rapid pace of drone technology, and police may believe they can use drones to spy on citizens with no warrant or legal process whatsoever. Severalbills are currently going through Congress, which attempt to provide privacy protections to Americans who may be caught up in drone surveillance. As the numbers of entities authorized to fly drones accelerates in the coming years—the FAA estimates as many as 30,000 dronescould be flying in US skies by 2020—EFF will continue to push for transparency in the drone authorization process and work to ensure the privacy of all Americans is protected.

Fig. 7 SURVEILLANCE UAVs

C.AERIAL MAPPING & PHOTOGRAPHY

Mapping zones/areas etc. are an important part of Geographic Information Systems, and one which is simplified primarily by the use of microdrones. Compared to conventional aircraft, using a microdrone to carry out such mapping tasks is much easier and more efficient. Several macros are integrated into the mdCockpit application software, which take away much of the effort in planning a mapping job. Using a particular macro, the flight path over a specific area can be generated automatically

Fig. 8 TAMUL WATERFALL PIC FROM A UAV

D.OTHER MAJOR APPLICATIONS OF UAVs

- Remote sensing and photogrammetry
- Surveying & mapping of earthquakes
- Surveying & mapping of plane crashes
- Surveying & mapping of storms and hurricanes
- Tidal mapping
- Mapping of industrial zones
- Mapping of excavation sites
- Surveying & mapping of flooding
- Surveying & mapping of train crashes
- Photogrammetry
- Mapping of the spread of algae
- Forestry surveying
- Mapping of Vegetation
- Precision agriculture
- Surveying & mapping of landslides
- Surveying & mapping of tsunamis
- Agriculture - GIS applications

- Arctic research - surveying
- Geophysical mapping
- Mapping of coastal areas
- Surveying & mapping of catastrophes
- Surveying & mapping of mudslides
- Surveying & mapping of volcanic eruptions
- Agriculture – mapping plant growth
- Mapping shifts in sandbars
- Mapping sandbar measurements

IV. UAVs IN MILITARY WAR-FARE

Military Roles for Unmanned Aerial Vehicles Manned aircraft has dominated the twentieth century, but technological advances are leading to the development of UAVs that will be able to perform military missions that once were reserved for piloted aircraft. There are a number of roles that UAVS could perform in future military operations. Transportation. While it is very unlikely that UAVs will transport passengers in the near future, a more realistic possibility is that UAVs could transport cargo, especially in the relatively small quantities that would apply in tactical situations. The current state of technology may be sufficient to create remotely piloted [6] or autonomous helicopters that are capable of delivering supplies and ammunition to troops in the field, as long as specific instructions and restrictions guide these UAVs. Intelligence, Surveillance and Reconnaissance. A more practical is to use UAVs for intelligence, reconnaissance and surveillance option missions, which would take advantage of the fact that UAVs have long loiter times, can be positioned flexibly near potential targets, and are small and relatively difficult to detect. The long endurance of UAVs is particularly important for surveillance when these operations could be conducted over days. In this sense, UAVs could relieve manned platforms of the need to maintain the high operational tempo for the extended periods that are the norm in modern military contingencies. The U.S. military in surveillance missions uses a number of UAVs. The U.S. Air Force has used the Global Hawk for surveillance missions, and the U.S.

Army and Navy developed the Outrider UAV for tactical reconnaissance.26 The Congressional Budget Office recommended that UAVs should be bought in order to reduce the Armyís purchase of Comanche reconnaissance helicopters, which would save several billion dollars.27 Meanwhile, the U.S. military is developing UAVs that can fly autonomously and broadcast real-time information, which the U.S. Army will use for reconnaissance, jamming, chemical or biological detection, and placing remote sensors on the battlefield.28 Attack Fixed Targets. The U.S. military has developed UAVs that demonstrated the ability to launch weapons against air defense sites. As 18Ö Unmanned Aerial Vehicles early as 1972 a Ryan Lightning Bug drone successfully launched an AGM-65 Maverick electro-optical missile against a radar control van.29 It is conceivable that UAVs could detect whether states are involved in manufacturing or storing weapons of mass destruction, and attack those facilities. The U.S. Air Force Scientific Advisory Board suggested that to attack these facilities, the United States should develop ìdual-equippedî UAVs with multi-spectral sensors and weapons.

This surveillance UAV would fly in concert with UAVs that are armed with precision, guided penetrating weapons or weapons, which employ kill mechanisms that prevent the spread of these materials. UAVs can be used to attack highvalue, fixed ground targets in military operations. Once military commanders give the location, type of target, and desired weapons effects to the UAV, it would determine the proper way to attack the targets with a remote operator or some form of automation. Attack Mobile Targets. The concept of attacking mobile targets with UAVs is quite popular, and involves using sensors on high-altitude, longendurance UAVs in conjunction with aircraft. The fundamental problem with using UAVs is the difficulties of detecting and identifying targets in modem combat operations. For now, the problems of finding and destroying the right targets in combat operations mitigate against using UAVs for attacking mobile targets. If equipped with surveillance and reconnaissance sensors as well as munitions, low observable UAVs that operate at high-altitudes for long periods could be used to detect theater and cruise missiles. The relatively long endurance of these vehicles, when coupled with the ability to detect and identify targets, could make remotely operated UAVs a viable option for this mission.

Air-to-Air Combat. In the foreseeable future, technology will permit UAVs to conduct offensive and defensive combat operations against aircraft, cruise missiles, and ballistic missiles. If military commanders could use advanced UAVs to intercept aircraft, they would be able to shift manned aircraft to other combat missions. If we look to the longer term, it may be technologically feasible to develop UAVs that can replace the current generation of combat aircraft with vehicles whose performance and survivability exceeds that of piloted vehicles. Furthermore, UAVs could be used to attack facilities that produce or store weapons of mass destruction as well as attack critical fixed and moving targets.30 While Unmanned Aerial VehiclesÖ19 some form of remotely piloted vehicle may be valuable in air combat, many concepts that rely on degrees of automation, exceed current technological capabilities. Combat Support Missions. A related idea is to use UAVs for the electronic support operations that are performed by strike aircraft and bombers, which involves using UAVs in conjunction with aircraft to target and jam fire-control radars. This category of UAV could function as a decoy that duplicates the radar, infrared, and radio signatures of fighter aircraft to increase their survivability. Once UAVs detect the location of enemy air defenses and transmit that data to manned attack aircraft, these or other UAVs could deliver weapons to destroy enemy air defenses, as noted earlier.

Fig. 9 WAR-FARE UAV

V. MECHANISM OF UAVs

A.AERODYAMIC DESIGN

ADE has expertise in aerodynamic configuration design, performance evaluation, and analysis of a UAV using advanced computer-aided design (CAD) tools; powerful computational fluid dynamics (CFD) tools based on Reynolds-averaged Navier-Stokes (RANS) equations, LES and domain name system (DNS) techniques; wind tunnel testing with the state-of-the-art data acquisition systems; and flow visualisation using PIV, PSP, and laser techniques. Design and development of multi-element airfoil to achieve highlift resulting into enhanced endurance of UAV has been achieved. CFD capability includes advanced software like Panel code; Euler code; RANS code; Nielson code for store separation characteristics at transonic speeds; propeller design code based on calculus of variation; airfoil design and analysis code; aircraft database generation code; and design optimisation code.

B.AEROSTRUCTURE DESIGN

ADE is involved in the total aero structure design including configuration design, equipment layout, sizing of components, and conventional and Finite Element (FE) analysis of airframe components. Expertise has been developed in the fields of aero-elastic studies, impact studies, power plant configuration, and Slosh analysis. Modules are iteratively designed using advanced tools. Structural design and evaluation using composites have been extensively used. Gimbaled payload assembly (GPA) is a high precision optomechanical system used for reconnaissance purpose. A much optimised design has been achieved using latest CAD tools including Pro-engineer and ADAMS.This has been widely used in Nishant and Rustom Projects. All the electronic packages for the UAV programme have been developed in-house carrying out thermal, shock load, and dynamic analyses. Thermal imaging, shock response spectrum test, and environmental test have been conducted as per MIL standards.

C.PROPULSION

Indigenisation of Gas Turbine and Rotary Engines. Development of a jet engine involves a coordinated effort among the designers, certification agency, and the users. Coordinated efforts of ADE have resulted in the development of an indigenous certified airworthy jet engine [Pilotless Target Aircraft Engine (PTAE)-7], which meets all mission requirements of the Lakshya including high altitude tests. Indigenous development of a rotary engine is critical for ADE's UAV programme. A 55 hp rotary, watercooledWankel engine has been designed and developed by ADE, NAL and VRDE, and integrated jointly with Nishant. The performance of the engine has been proved in flight trials.

Engine Health Monitioring

ADE has set up test-bed facilities for testing gas turbines, and rotary and internal combustion engines of UAVs. An online data acquisition and health monitoring system (DAHMS) has also been developed by ADE to monitor all engine parameters during engine testing on ground and integration runs. DAHMS displays parameters in red when these engines exceeded their maximum limits during testing. The basic approach of the DAHMS is to collect data of all engine parameters from all the fault-free engine runs at various engine speeds. A baseline signature Engine Health Monitoring model has been developed using statistical tools to predict the average and the standard deviations of each engine parameter. Engine test run data acquired online is then compared with the baseline signature of the engine. The online engine parameters are displayed with reference to the baseline signature model indicating the health of the system.

C.UAV SIMULATOR

A real-time simulator has been developed at ADE to support the design and development phase of the Rustom-1 as well as for training the external pilot during take-off and landing. During the design phase of the UAV, the simulator is used for verifying the claw for takeoff/landing and cruise. In effect, the handling quality of the air vehicle can be evaluated itinerantly. The dynamics for ground handling, undercarriage and nose wheel steering are simulated and integrated with claw. In the external pilot training mode, the pilot can be trained for carrying out precise takeUAV Simulator off and landing under all weather conditions including crosswinds. In the system design, PCs are configured to meet the specific requirements. All the PCs are rack mountable and individually configured with LINUX OS to meet the processing and graphic requirements. RT LINUX serves as RTOS in the host computer. The visual cues and audio cues are generated using digitally recorded engine noise. Commercial-of-theShelf (COTS)-based data acquisition system provides an interface between the various sub-systems and EP controls.

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A three-channel visual system designed and developed using high performance PCs, with advanced graphics processors, provide the requisite visual cues for the external pilot. The visual scenery is projected seamlessly on a cylindrical screen with a field of view of 180 in azimuth and 40 in elevation. Distributed computing architecture has been used for the simulation of various sub-systems of the Rustom-1 simulator. The system architecture is modular and configured around a suitable mix of PCs and custom-built hardware (wherever required). The inter subsystems communications are effected through deterministic realtime communication link. Functional independence and real-time communication are the key factors in arriving at optimal system architecture.

D.FLIGHT TESTING

Evaluating an air vehicle for its performance is the most important stage in its development. Testing of aerial targets is carried out at DRDO's Integrated Test Range (ITR), Chandipur. For tactical UAVs, a range in Kolar, Karnataka, has been established and a new aeronautical test range at Chitradurga is under development. These ranges are equipped with latest equipment for tracking and evaluation of UAVs. The design and development of UAV systems is a multidisciplinary like radars, EO thermal scanning, CCTV for tracking and evaluation of UAVs

VI. UAVs CIVIL USUAGE LAW

In India UAVs are not used by everyone only those who possess valid DGCA license can be able to use the drones in outer field. Eventhough many mishaps happen some drones are capable of reaching the altitude as reached by aircrafts and hence it leads to crashes of flights . Also the flight signals may clash with the aircraft signals.

VII. DRONES IN FUTURE

A.DRONE RACING AND FIGHTING

Drones also have entertainment value. Their destructive properties can be channeled in such a way that allows humans to compete in combat without directly harming one another. Some groups have already started looking to "drone combat" as a sporting event.
At this year's Maker Faire, an event that celebrates self-made projects of all kinds, several drones entered a makeshift arena and fought until there was only one left standing (or flying, as it were). Take a look and see for yourself.

B.ADVERTISEMENTS AND DELIVERIES

When Amazon announced plans to develop package-delivering drones last year, people went nuts. Not a year later, we asked our readers how they would react if they saw a drone hovering over their property, and most replied by saying they'dshoot it down. Perhaps the world isn't ready for drone deliveries just yet, but the shipping industry is just one of many industries that could see boosts in efficiency as drones become more widely adopted. Imagine a world where you could order an item online and have it delivered to your door in under thirty minutes.And then there's Russia, where an Asian restaurant employed drones for marketing purposes. These drones, which were equipped with advertisement fliers, were flown around the city of Moscow and displayed their ads to office workers just before lunch hour. Due to its apparent success, this "drone-vertising" tactic may become a new trend for Russian marketers.

C.DISASTER AND RELIEF

The logistics of emergency response are often muddled by physical factors. It's never easy to search for survivors in cases like flooding, wildfires, or nuclear fallout, particularly because these types of emergency situations require aid workers to put their own lives at risk.Adoption of drone technology could be a step towards putting that behind us. Drones can be built to withstand extreme temperatures and radiation, plus aerial cameras can provide better perspectives when searching for victims in areas of low visibility or lots of debris.
Moreover, drones can be commissioned to deliver medicine, vaccines, and care packages to people from a distance. In fact, a team led by George Barbastathis is currently developing a smartphone-deployed drone that can be operated by healthcare workers.

VIII. CONCLUSION

Though UAVs have positive as well as negative uses. It's better to use drones in a positive aspect such that it brings prosperity to the human race . Though technology has grown to a greater extent it is advisable that we humans don't run behind it. So let's take necessary steps to prevent the usuage of drones in a positive way

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