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A Review Report On Unmanned Aerial Vehicle

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ABSTRACT

UAV is the acronym for unmanned aerial vehicle. The can be controlled autonomously or remote controlled. In this paper we are focused to describe what UAVs are, there difference from cruise missiles and the main emphasis is on Nishant-India's first UAV. It was developed by ADE and DRDO and made its first flight in 1995.They are mainly used by Indian Army for military operations.

Keywords

UAVs, hydro-pneumatic launcher, wankel engine, indigenous engine, ADE, RPV

1. INTRODUCTION

Unmanned Aerial Vehicle also known as UAV or drone is an aircraft without any human pilot. Its flight is either controlled by remote control of pilot either on ground or in another vehicle or by autonomous computer onboard. Due to its launch by the pilot on ground, it is also called as remotely piloted aircraft by International Civil Aviation Organization (ICAO).

Historically, UAVs were simple remotely piloted aircraft, but autonomous control is increasingly being employed .The first notable autonomously powered UAV was Nazi-German V-1 flying bomb which was powered by pulsejet. Fig 1 & Fig 2 show examples of some UAV's.

An MQ-9 Reaper, a hunter-killer surveillance UAV
Fig. 1

A DJI Phantom UAV for commercial and recreational aerial photography

Fig. 2

UAV differs from cruise missile .Cruise missiles are not considered UAVs because, like many other guided missiles, the vehicle itself is a weapon that is not reused, even though it is also unmanned and in some cases remotely guided.

The term unmanned aircraft system (UAS) emphasizes the importance of other elements beyond an aircraft itself. The term UAS was since adopted by the United States Department of Defense (DOD) and the British Civil Aviation Authority (CAA). The term used previously for unmanned aircraft system was unmanned-aircraft vehicle system (UAVS). An unmanned aircraft system (UAS) includes ground stations and other elements besides the actual aircraft. A typical UAS consists of the following:

- unmanned aircraft (UA);
- control system, such as ground control stations (GCS);
- control link, a specialized data links

The term UAS was first officially used by the FAA in early 2005 and subsequently adopted by DoD that same year in their Unmanned Aircraft System Roadmap 2005–2030. The official acronym UAS is also used by the International Civil Aviation Organization (ICAO) and other government aviation regulatory organizations.

2. CLASSIFICATION OF UAVS

UAVs typically fall into one of six functional categories (although multi-role airframe platforms are becoming more prevalent):

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- Target and decoy – providing ground and aerial gunnery a target that simulates an enemy aircraft or missile
- Reconnaissance – providing battlefield intelligence
- Combat – providing attack capability for high-risk missions
- Logistics – UAVs specifically designed for cargo and logistics operation
- Research and development – used to further develop UAV technologies to be integrated into field deployed UAV aircraft
- Civil and Commercial UAVs – UAVs specifically designed for civil and commercial applications

They can also be categorized in terms of range/altitude and the following has been advanced as relevant at such industry events as ParcAberporth Unmanned Systems forum:

- Hand-held 2,000 ft (600 m) altitude, about 2 km range
- Close 5,000 ft (1,500 m) altitude, up to 10 km range
- NATO type 10,000 ft (3,000 m) altitude, up to 50 km range
- Tactical 18,000 ft (5,500 m) altitude, about 160 km range

Schiebel S-100 fitted with a Lightweight Multirole Missile

- MALE (medium altitude, long endurance) up to 30,000 ft (9,000 m) and range over 200 km
- HALE (high altitude, long endurance) over 30,000 ft (9,100 m) and indefinite range
- HYPERSONIC high-speed, supersonic (Mach 1–5) or hypersonic (Mach 5+) 50,000 ft (15,200 m) or suborbital altitude, range over 200 km
- ORBITAL low earth orbit (Mach 25+)
- CIS Lunar Earth-Moon transfer
- CACGS Computer Assisted Carrier Guidance System for UAVs

U.S. UAV demonstrators in 2005

The U.S. Military UAV tier system is used by military planners to designate the various individual aircraft elements in an overall usage plan. The Tiers do not refer to specific models of aircraft but rather roles.

In India also Defence Research and Development Organization (DRDO) has successfully designed and developed many UAV system that have been inducted into Indian Armed Forces. Aeronautical Development Establishment (ADE), Bengaluru is in the forefront, as the nodal agency, for development of UAVs for the service. One of the major completed projects is:-

3. NISHANT

Nishant is an Unmanned Aerial Vehicle (UAV) developed by India's ADE (Aeronautical Development Establishment), a branch of DRDO (Defence Research and Development Organization) for the Indian Armed Forces. The Nishant UAV was primarily developed for gathering information and intelligence over enemy territory and also for reconnaissance, training, surveillance, target designation, artillery fire correction, and damage assessment. The UAV has an endurance of four hours and thirty minutes. Nishant has completed development phase and user trials.

The 380 kg Nishant UAV requires rail-launching from a hydro-pneumatic launcher and is able to be recovered by a parachute system. It launches at a velocity of 45 m/s is carried out in 0.6 second with 100 kW power and subsequent launches can be carried out in intervals of 20 minutes. Nishant is one of the few UAVs in the world in its weight-class capable of being launched by ship and recovered by using parachute, thus eliminating the need for a runway as in case of conventional take-off and landing with wheels.

Indian Army has placed an order for four Nishant air vehicles and ground systems after successful user evaluation trials.

3.1 DRDO Nishant Overview

Role: -Military UAV

Manufacturer:-ADE, DRDO

Designer:-ADE, DRDO

First flight:-1995

Primary user:-Indian Army

Produced:-12+

Unit cost:-$4.47million

3.2 Development

To meet the Army's operational requirement of a RPV (remotely piloted vehicle), it was decided in September 1988 that the Defence Research and Development Organization would undertake serious steps for development of the UAV. The Nishant RPV made its first test flight in 1995. In July 1999, for the first time the Indian army used its newly developed Nishant UAV system in the guerilla fight against forces backed by Pakistan in Kashmir. Nishant, which had been developed for battlefield surveillance and reconnaissance

needs of the Indian Army, was test flown again in early 2002. Nishant completed its 100th flight by June 15, 2002. The Indian Army has placed an order for 12 Nishant UAVs along with ground support systems. Nishant Unmanned Aerial Vehicle (UAV) developed by DRDO for Indian Army was successfully flight tested near Kolar on 20 June 2008. Nishant has completed development phase and user trials. The present flight tests are pre confirmatory trials before induction into services. On Sunday, 5 April 2009 DRDO launched a test flight of the Nishant UAV. The main goal was to test the performance of the Wankel engine used on the UAV. The Wankel engine is a type of internal combustion engine using an eccentric rotary design to convert pressure into rotating motion. Over the commonly used reciprocating piston designs, the Wankel engine delivers advantages of: simplicity, smoothness, compactness, high revolutions per minute, and a high power-to-weight ratio. The engine is commonly referred to as a rotary engine, although this name applies also to other completely different designs.It was test flied for about 35 minutes in a village near kolar and it attained an altitude of about 5,900 ft. The wankel engine was developed by DRDO in association with NAL, a CSIR laboratory, VRDE, Ahmednagar and ADE, Bangalore. DRDO was satisfied with the test results. The performance of the engine during the flight met the requirements of the first flight of an engine in the air vehicle. This 55 hp indigenous engine is expected to replace the present imported engine of Nishant. The critical core engine, including the special cylinder composite nickel–silicon carbide coating and special aluminium alloy castings, was designed and developed by NAL. VRDE developed engine peripherals such as the ignition and fuel systems and ADE developed flight testing. The reconnaissance UAV, which has completed its user trials with the Indian Army, is expected to be handed over to the army shortly. Some of the important features of nishant are:-

- Day/night capability training vehicle
- Battlefield reconnaissance & surveillance,
- Target tracking and localization
- Artillery fire correction
- All terrain mobility
- Target designation (using integral laser target designator)
- Endurance: 4 h 30 min

Nishant UAV again underwent crucial confirmatory user trials at Pokhran in April 2010. On 3 February 2011 Nishant UAV successfully completed confirmatory trials conducted by the Indian Army at Pokhran, Rajasthan.A wheeled version of the Nishant UAV, named panchi, is under taxi trail as of September 2014, will be flight tested soon.

3.3 Ground support systems

- Mobile hydropneumatic launcher (MHPL)
- Ground control station (GCS)
- Antenna vehicle/Ground Data Terminal(GDT)
- Avionics preparation vehicle(APV)
- Mechanical maintenance vehicle
- UAV transportation vehicle
- Power supply vehicle

Launch: Mobile hydropneumatic launcher system

3.4 General characteristics

- Crew: None
- Payload: 45 kg ()
- Length: 4.63 m (15.2 ft)
- Wingspan: 6.57 m (21.6 ft)
- Height: ()
- Empty weight: 380 kg (840 lb)
- Powerplant: 1 × RE-2-21-P or RE-4-37-P,

3.5 Performance

- Maximum speed: 185 km/h
- Cruise speed: 125 km/h to 150 km/h
- Range: 160 km (100 mi)
- Service ceiling: 3,600 m (up to 11,800 ft)

3.6 Variants

- Nishant catapult
- Panchi (Nishant Wheeled launcher (MHPL) system
- Recovery: Parachute + landing bags

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