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HEAVY DUTY AIR TRANSPORT VEHICLE (HDATV)

Akash a chavan[1], Nitanshu v borad[2], Jay deshpande[3],Hardik r darji[4]

[1](Department of Mechanical Engineering VIVA Institute of Technology India)
[2](Department of Mechanical Engineering VIVA Institute of Technology India)
[3](Department of Mechanical Engineering VIVA Institute of Technology India)
[4](Department of Mechanical Engineering VIVA Institute of Technology India)

Abstract : *There are various technologies emerging from Aeronautics and Aerospace fields which results into different problems being solved yet there are some which will be very beneficiary in near future for military as well as for civil purpose. We as students are working on a problem which will benefit in our near future. In our project we are designing an electric propelled HDATV (heavy duty air transport vehicle) which utilizes VTOL technology. The aircraft which we are designing consists of fuselage with two nacelles at the end of high placed fixed wing and two horizontal stabilizers and a vertical stabilizer along with it. The fuselage and the nacelles are lifting bodies that are configured to jointly form an aerodynamic lifting body which cooperates with the horizontal stabilizer to provide aerodynamic lift to the aircraft in forward flight. The nacelles houses two propellers which are highly pitched and powered by the BLDC Motors operating in counter-rotating directions. The nacelles will be designed to perform tilting operation in the direction of flight whenever necessary. The aircraft will be unmanned and controlled via radio controller. The main aim of our project is to demonstrate the use of electric VTOL technology and to perform basic tasks like avoiding obstacles, to carry loads and to perform some air manoeuvres.*

Keywords – *Vtol, Cad, Uav, Stol, Hovercraft, Airfoil, Amphibious Class.*

I. INTRODUCTION

The Wright Brothers invented and flew the first airplane in 1903, recognized as "the first sustained and controlled heavier-than-air powered flight". They built on the works of George Cayley dating from 1799, when he set forth the concept of the modern airplane (and later built and flew models and successful passenger-carrying gliders). Between 1867 and 1896, the German pioneer of human aviation Otto Lilienthal also studied heavier-than-air flight. Following its limited use in WW1, aircraft technology continued to develop. Airplanes had a presence in all the major battles of World War 2. The first Jet Aircraft was the German Heinkel He in 1939. The first Jet airliner, the de Havilland Comet, was introduced in 1952. The Boeing 707, the first widely successful commercial jet, was in commercial service for more than 50 years, from 1958 to at least 2013. In 1799, George Cayley set forth the concept of the modern airplane as a fixed-wing flying machine with separate systems for lift, propulsion, and control.

Cayley was building and flying models of fixed-wing aircraft as early as 1803, and he built a successful passenger-carrying glider in 1853. In 1856, Frenchman Jean-Marie Le Bris made the first powered flight, by having his glider "L Albatross artificiel" pulled by a horse on a beach. Then the Russian Alexander F. Mozhaisky also made some innovative designs. In 1883, the American John J. Montgomery made a controlled flight in a glider. Other aviators who made similar flights at that time were Otto Lilienthal, Percy Pilcher, and Octave Chanute.
Sir Hiram Maxim built a craft that weighed 3.5 tons, with a 110-foot (34 m) wingspan that was powered by two 360-horsepower (270 kW) steam engines driving two propellers. In 1894, his machine was tested with overhead rails to prevent it from rising. The test showed that it had enough lift to take off. The craft was uncontrollable, which Maxim, it is presumed, realized, because he subsequently abandoned work on it. World War I served as a testbed for the use of the airplane as a weapon. Airplanes demonstrated their potential as mobile observation platforms, then proved themselves to be machines of war capable of causing casualties to the enemy. The earliest known aerial victory with a synchronized machine gun-armed fighter aircraft occurred in 1915, by German Luftstreitkräfte *Leutnant* Kurt Wirtgen's. Fighter aces appeared; the greatest (by number of Aerial Combat victories) was Manfred von Richthofen. Following WWI, aircraft technology continued to develop.Alcock and Brown crossed the Atlantic non-stop for the first time in 1919. The first international commercial flights took place between the United States and Canada in 1919.Airplanes had a presence in all the major battles of World War II. They were an essential component of the military strategies of the period, such as the German Blitzkrieg, The Battle of Britain, and the American and Japanese aircraft carrier campaigns of the Pacific War.

II. VERTICAL TAKEOFF AND LANDING

Vertical take-off and landing vehicles came into existence due to experiments carried out during the years 1950 – 1970 and almost all came out to be failures. Sometimes it used to have short run before the take-off hence they were also called STOL, Short run Take Off and Landing vehicle. The flight control and stability of VTOL/STOL is very difficult and is of prime area of research presently in this field. VTOL emerged gradually over the years and depicts the current advancement in the field of aerospace. It has basically three configurations up till current development in this field, wing type configuration, helicopter type configuration and ducted type configuration. Wing type has fixed wings with vector thrust engine or moving wings with engine, ducted type has ducted rotor which helps to provide lift, helicopter type has rotor mounted above it to provide lift. Initially the VTOL developed were of wing type configuration, primarily for military purposes and were man operated but later their importance was known and more and more advanced designs of it came into existence. The latest ongoing research in this field is hoverbike which is a hybrid machine. It uses ducted rotors to attain required lift in order achieve its objectives. It can be either manned or unmanned. Its concept emerged from the Hovercraft which has hybrid capability and used ducted fan to hover and manoeuvre. Designing with single engine has problems of stability and the design with multi engine has problem of managing multi engines effectively. The need of the hour is to design a quiet, low cost, low weight, high power to weight and effective control for VTOL and optimize its performance. However, there are many innovative solutions in the form of aforementioned hybrid constructions, giving interesting flight properties. Each type of UAV has its own advantages that predispose it to perform specific tasks. Many UAVs such as MQ9-Reaper, RQ-2 Pioneer, RQ-5 Hunter, and RQ-4 Global Hawk were designed as fixed-wing type, andtheir advantage is flight duration and thereby the area of operational activities. Their disadvantage is the need to take-off and land from the runway, which significantly limits their functionality. Another critical problem associated with fixed-wing UAVs is that these vehicles are often not appropriate for operating effectively in limitedairspace. In turn, multirotor have the capability of vertical take-off and landing (VTOL), which increases their operational flexibility. But this construction is unfortunately associated with a high energy demand, which makes the flight relatively short. A promising trend is development of a vertical take-off and landing (VTOL) fixed-wingplane or so-called hybrid UAV or VTOL aircraft, which combines the advantages of both designs.

Over the past 53 years, inventors have attempted to create a vehicle that could be flown in the air as well as driven on land. According to an article in the February 1989 issue of Smithsonian Magazine, more than 30 designs for flying cars have been submitted to the U.S. Patent Office since 1936. These early designs combined elements of the automobile with those of the airplane. Since the fuselage of the craft was large, usually the size of a passenger compartment of a car, a huge, powerful engine and large wings were needed to generate enough thrust and lift to make the craft airborne. On the ground, the huge engine was unnecessary and thus inefficient, the exposed propeller (if one was used) was a safety hazard, and the large wings had to be removed and stored prior to driving the craft on the road. The present invention is an aircraft that can be used as a land vehicle efficiently and without modification. A major difference between the present invention and the prior car/plane

inventions is that the present invention is all one structure so it provides efficiency in the air as well as on the ground. Ducted fans are used instead of exposed propellers so safety is not compromised. Half of the engines can be shut down for fuel conservation and efficient operation of the aircraft while being driven on land. Additionally, the outboard segments of the short wings are hinged to be folded easily, and thus do not have to be removed from the craft prior to driving. Another feature of the present invention is that it is capable of vertical take-off and landing (VTOL) by vectoring the fan thrust from the ducted fan engines. Previous VTOL efforts have relied on fixed orientation of the duct centrelines vertically for hover and then re-directing their thrust with vanes for transition into forward flight. This method was used with rigid re-directing vanes that would stall the airflow at angles above 15 degrees. This rigid vane approach resulted in a limited ability to generate a significanttransverse force for acceleration. The alternative has been VTOL aircraft that have tilted the entire duct or the exposed propeller, whichever was used, in order to vector the thrust. A tiltable duct or propeller requires complex structural, electrical and mechanical connections. Furthermore, the tilting duct or propeller experiences off-axis flow into the inlet during transition into forward flight, resulting in flow separation at the upstream inlet lip. The rotation of the duct or propeller is inherently slow to react and cannot be modulated to provide the fast response time that is required for longitudinal control. Additionally, the tilting duct is not an efficient annular aerofoil, and therefore additional wing area must be provided for aerodynamic lift. This greater wing area resultsin additional drag. After doing Various studies on the above topics and going through various research papers wefinally understood the topic and decided to pursue it as it has big potential in future civil and military purposes and can help in transportation of goods and people going from one place to another.it is also plus point for tourism as well as aviation industry. Pilots are going to benefit from it for longer period of times as for engineersit will be hands-on development and design of such an incredible machines which will create a large amount of employment opportunities in near future which will be a very big boom for economic India.

III. METHODOLOGY

3.1 Topic Selection & Needs

In Aviation Industry, every company or firm needs to design and build a plane which has various advantages such as high effiency,less fuel consumption, more thrust to carry equipment's and loads and most important budget friendly and easy to guiding and handling. So considering all the requirements and data we are trying to build aircraft which can fit in above mentioned criteria's.

3.2 Literature Survey

Before starting any project, accurate and reliable information is necessary to get ourselves acquainted with the topic. Experience also plays an important part while pursuing such topic. In this section, we refer some research papers, various journals and reference books for proper guidance.

3.3 Designing and Simulation

In this part, we sketch some rough models of our plane to see how the early stage of the plane will look. Based on the theoretical assumptions and certain assumed data we design our basic 3D CAD model on any modelling software, by doing this we get a some perception of how the model will look in real world environment. After that we start to find out the C.G and other different characteristics using XFLR software. Then we perform simulations on the model using ANSYS or any Simulation software to find out different stresses, aerodynamic forces, reactions acting on the plane and try to see where the failure will occur in the model. Then we manufacture a small Prototype of our model using AM.

3.4 Market Survey

After completing design phase we do market survey to find out various components and other electronic parts for our model. It is necessary step because it helps to estimate the budget of our project, availability of parts and their cost estimation (BOM).

Parts Procurement and Manufacturing

Once the Market Survey Is done, the next process is the ordering of required parts and to start manufacturing according to the design.

Assembly and Final Testing

In this Section, We start to manufacture and assemble all the ordered parts according to our design and mathematical calculations. This process gives birth to our final model.
In order to check whether it works or not, a testing is carried out to see the performance of it and gives a final Go/No-Go for successful working and testing.Atlast we give a fresh coat of Paint for Aesthetic purpose.

IV. FIGURES AND TABLES

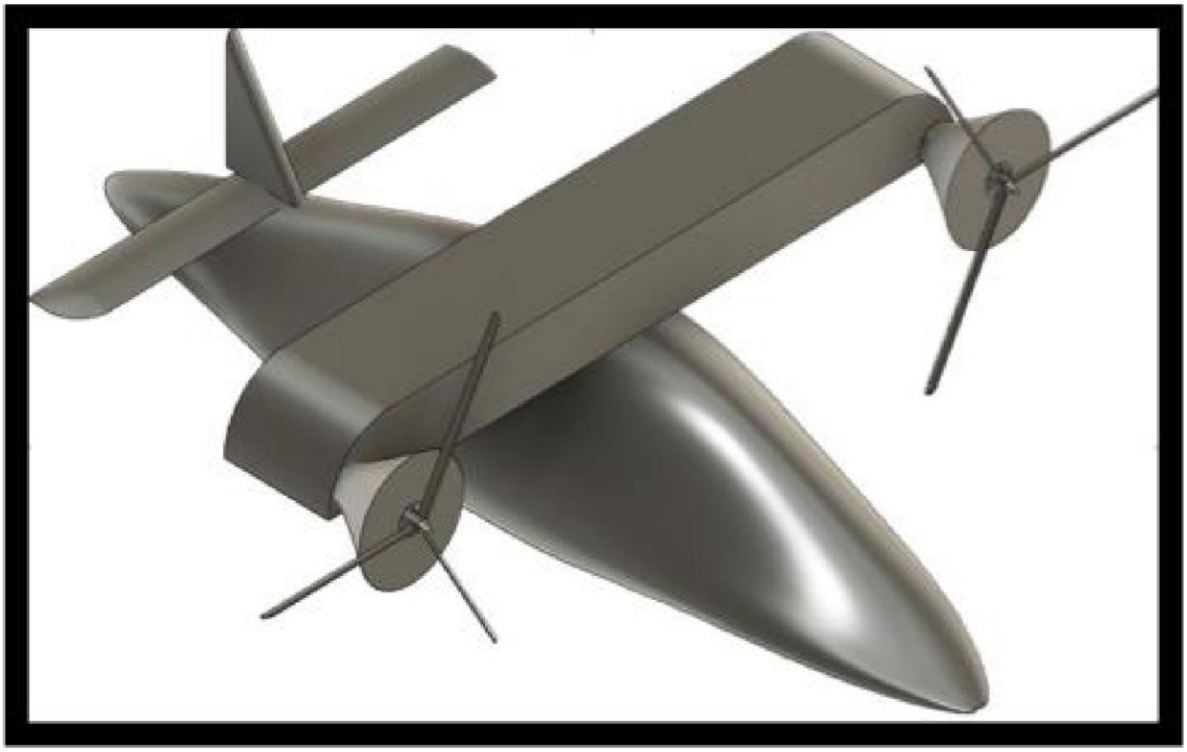

Fig 1 : CAD MODEL OF HDATV

Fig 2 : CONCEPT MODEL

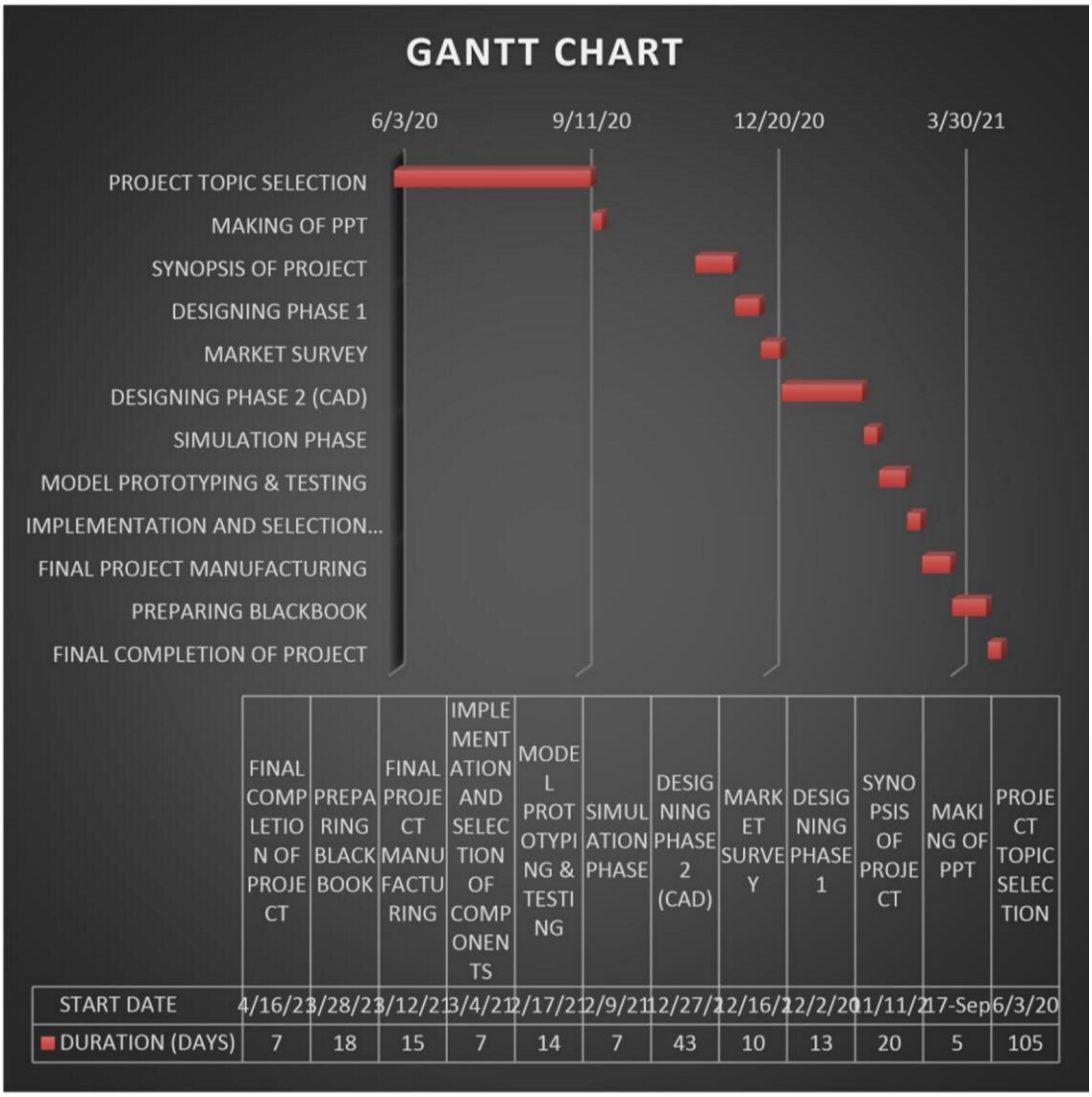

FIG 3 : GANTT CHART OF HDATV

Fig:1

V. CONCLUSION

Air transport is an important enabler to achieving economic growth and development. air transport facilitates integration into the global economy and provides vital connectivity on a national, regional, and international scale. it helps generate trade, promote tourism, and create employment opportunities aviation industry known as the driving force of global technology of development and innovations. Engines and aircraft are become lighter, quieter and more efficient. emerging technologies are reshaping with robotics, artificial intelligence, the internet of things, unmanned aircraft systems and the push for hybrid and electric airplanes. HDATV will create new method of transport of cargo and flying to various different places and cities. it will also be a pilots playground to test the aircraft and also to increase the hours of plane handling and increasing the experience along with it. The general public opinion and the view is going to change towards the aviation sector and also adapting the new type of technology will be breath-taking. the aircraft which we are making can take-off from aircraft carriers and any stringent locations for covert operations. this helps reduce the risk of compromising missions by safe drop-off to the battle fronts rather than high altitude parasailing. It also has the also ability to perform various manoeuvres not possible with a conventional plane; a significant advantage for aircraft in combat situations. by going green it will also save fuel and also time of travel along with it. our main goal it to make the aircraft efficient, safe and ready for future tasking and endeavours with ease. Alternative fuels can significantly change the current scenario of

aviation in support of the environmental protection. The vast investment in Artificial Intelligence (AI) and Big Data could be seen as a promising way of increasing safety, efficiency and sustainability. These technologies can help improve aviation infrastructure and airspace utilization. This wave of innovations in aviation will surely impact the wider transport sector as well as the 2030 Agenda for Sustainable Development. The future of mobilityis literally taking off!

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