| e-ISSN: 2319-8753, p-ISSN: 2320-6710| www.ijirset.com | Impact Factor: 7.512|

|| Volume 9, Issue 5, May 2020 ||

Design and Analysis of Ducted Fan Micro Aerial Vehicle

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ABSTRACT: A micro aerial vehicle (MAV) is a class of unmanned aerial vehicles (UAV) that has a constraint in size and self-governing automatic control unit. Micro Air Vehicles (MAVs) conveniently operate with compact sized and low weight components, thus enable to operate against high wind velocity and capture high quality image data. For a new design of MAV system require to integrate multiple controlled components, accomplishing the overall performance of MAV mission. In this project a new design of ducted fan MAV was modeled with a size limited below 20cm. The vertical take-off and landing (VTOL) type was configured with fixed wing of newly design compact MAV to overcome the issues of low Reynolds number aerodynamics issue. The aerodynamics performance such as coefficient of lift (CL) and coefficient of drag (CD)was determined and validated with existing model of VTOL type UAV. The conceptual model of ducted fan micro aerial vehicle (DMAV) was designed in CAD software and aerodynamic analysis such as CL and CD was analyzed using CFD- fluent software. The dynamic pressure over the DMAV was determined and found that the value is within the limit and also the flow visualization for full-scale model of ducted fan MAV was stimulated for various angle of attack such as 5º, 10º, 15º and predicted the CL and CD for the performance characteristics of the newly designed model DMAV.

KEYWORDS: DMAV, UAV, coefficient of lift, coefficient of drag, angle of attack and CFD.

I. INTRODUCTION

An unmanned aerial vehicle (UAV), known in the mainstream as a drone and also referred to as an unpiloted aerial vehicle and a remotely piloted aircraft (RPA) by the International Civil Aviation Organization (ICAO), is an aircraft without a human pilot aboard. Unmanned air vehicles with a largest linear dimension no greater than 6 inches. Micro air vehicle is a class of UAV. Micro air vehicles (MAVs) are intended to operate in close proximity to a point of interest without being detected and should provide surveillance teams with critical information. Small vehicle size is intended to lower the total system cost when compared to larger military UAVs and will also allow these aircraft to be man portable. A typical MAV mission consists of flying 1km to a point of interest, loitering in close proximity for 1/2 hour, and then returning. The aircraft must be able to fly in turbulent winds up to 25 mph, perform tight turns near buildings, and climb repeatedly to 350 feet altitude. Currently, there are no MAV designs which meet these criteria and many technical issues must be resolved before a successful MAV can be produced. This project addresses the issues of how propulsion and configuration influence the mission capability of MAV's. A numerical optimization procedure is used to find the smallest aircraft that meets the mission performance constraints given the assumed propulsion, aerodynamic, structural, and payload models. Our study concludes with several observations on the influence of vehicle size on mission capability. Our experience has shown that with present technologies the maximum capability of an MAV system is realized with aircraft in the 50 to 100 cm

II. RELATED WORK

Daisuke Kubo and Shinji Suzuki (2008) [1] "Tail-Sitter Vertical Takeoff and Landing Unmanned Aerial Vehicle Transitional Flight Analysis", Journal says about the vertical takeoff and landing features and advantages during the flight path. Zamri Omar [2] have investigated Vertically Takeoff and Landing (VTOL) type Unmanned Aerial Vehicle (UAV) control system and its working, also it explains about the designing of the ducted fan type UAV and its important nomenclature regarding the aerodynamic properties and components selection for UAV. Mohd. Shariff Ammoo and Md. Nizam Dahalan [3] have studied about technological review and design study of Micro Aerial