Advancements in Human-Carrying Quad Copter

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ABSTRACT :

This study presents the design and development of a human-carrying quadcopter, an innovative aerial vehicle aimed at addressing the growing demand for urban air mobility solutions. As cities become increasingly congested, the need for efficient transportation options is more critical than ever. The proposed quadcopter integrates advanced engineering principles, cutting-edge materials, and robust safety features to ensure reliable and safe human transport. This research outlines the aerodynamic design, structural analysis, and propulsion systems utilized to achieve optimal lift and stability while accommodating passenger weight. Key challenges, such as flight control, stability management, and regulatory compliance, are also addressed, highlighting the importance of advanced control algorithms and real-time monitoring systems. Preliminary flight tests demonstrate the quadcopter's performance capabilities, including takeoff, landing, and maneuverability, establishing a foundation for future development. The findings of this study not only contribute to the evolving field of aerial transportation but also offer insights for further innovations in human-carrying UAV technology, paving the way for practical applications in urban environments and emergency response scenarios.

Keywords:Quadrotorhelicopter or Quadrotor, drone's, vertically oriented propellers

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INTRODUCTION

The advent of unmanned aerial vehicles (UAVs) has revolutionized various sectors, including logistics, surveillance, and agriculture. Among these innovations, human-carrying quadcopters represent a groundbreaking development in urban air mobility, providing a potential solution to the increasing congestion and inefficiencies of traditional ground transportation systems. As urban populations grow, so does the demand for rapid and efficient transit options. This has sparked interest in aerial transportation technologies that can alleviate traffic woes and reduce travel times, while also offering an eco-friendly alternative to conventional vehicles.

The human-carrying quadcopter is designed to transport passengers in a safe and efficient manner, leveraging the versatility of quadcopter design principles to achieve vertical takeoff and landing (VTOL) capabilities. This aircraft combines advanced aerodynamics, lightweight materials, and state-of-the-art propulsion systems to ensure optimal performance and stability. Moreover, incorporating autonomous flight capabilities and intelligent navigation systems enhances its operational safety and efficiency, addressing some of the primary concerns associated with manned aerial vehicles.

Despite the promising potential of human-carrying quadcopters, several challenges remain to be addressed. These include ensuring compliance with aviation regulations, developing reliable safety systems, and overcoming technical barriers related to flight control and battery life. This study aims to explore these challenges while presenting a comprehensive design and development framework for a human-carrying quadcopter. By investigating aerodynamic performance, structural integrity, and propulsion efficiency, this research seeks to provide valuable insights into the practical implementation of this innovative aerial transportation solution.

Through a systematic approach that includes theoretical modeling, simulation, and preliminary flight testing, this study endeavors to establish a foundation for the future of urban air mobility. The findings will not only advance the understanding of human-carrying quadcopter technology but also contribute to the broader discourse on sustainable transportation solutions, positioning aerial vehicles as a viable option in the evolution of urban transit systems.

1.1ScopeofProject :

The purpose of this project is to engineering knowledge to develop a UAV at low cost based onspecifications as finalized in SOR. project will engage the members through proper design cycle whichwill include the implementation of the aircraft design knowledge, as well as other courses, use of thevarious CAD software that they have learnt for design and analysis of their project and make criticaldecisions regarding their design observing its performance as well as their constraints such as budget,manufacturabilityEtc.

Figure1: Quadcopterduring transition

LITERATURESURVEY

In this section the literature survey of weight carrying quadcopters is discussed. The experimentationsconductedbyvariousresearchersbyinfluencingtheunmannedaerialvehicles(UAV)processparametersonspecificweight carrying method's.

2.1Quadcopterhistory:

EtienneOehmichenwasthefirstscientistwhoexperimentedwithrotorcraftdesignsinthe1920s. Amongthesixdesignshetried,hissecondmulticopperhadfourrotorsandeightpropellers,alldrivenbyasingleengine. The Oehmichen used a steel-tube frame, with two-bladed rotors at the ends of the four arms. Theangle of these blades could be varied by warping. Five of the propellers, spinning in the horizontal plane,stabilized the machine laterally. Another propeller was mounted at the nose for steering. The remainingpairofpropellers wasfor forward propulsion.

METHODOLOGY

In a quadcopter drone, two of the motors rotate in a clockwise direction and the other two motors in ananticlockwise direction. The speed of the motors is controlled by the electronic speed controller. If thetwomotorsontherearsideofthedronerotate athighspeeds,thenthedronemovesinaforward direction.Ifthetwomotorsonthe frontsideofthedronerotateathighspeeds,thenthedronemovesinabackwarddirection. If the two motors on the left side of the drone rotate at high speeds, then the drone moves in arightwarddirection.

Introductionwith System BlockDiagram:

Ablockdiagramisahigh-levelandspecializedflowchartusedinengineering.Itisusedtodescribeand improve existing systems or to design new ones. The block diagram's structure provides a high-leveloverview of important working relationships, key process participants, and major system components.Belowis theoverview ofthe majorquadcopter componentsrepresented asablock diagram

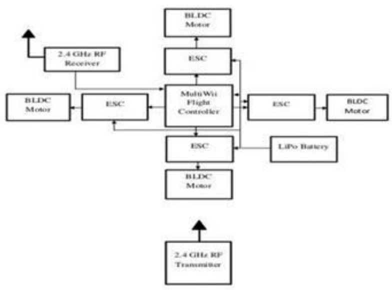


Figure2:Blockdiagramof aQuadcopter

TechnicalSpecification:

Thedrone'stechnicalspecificationisnothingmorethanadocumentthatthroughtechnicaldatamakesaclarifieddescription forthe drone's specificuse,functionality, orperformance

Figure3:Blockdiagramof adrone'sspecificuse,functionality

DesigningofQuadcopterbody:

Aquadcopterisamulti-rotordronethathasfourarmshavingabrushlessdcmotoroneacharm.Quadcopter drone arms are designed in fusion 360 software. Hence this is a delivery drone, the middlepartofthebodyhastobestrongtocarrytheloads.so,asheetmetalbodyhastobeusedforthe upperandbottom parts of the drone connecting four arms. The drone planned for the current work is initiallymodeledin fusion 360software.Figure 2 showsthe design frameof thedroneinfusion 360 software.

Figure4 Modeling and rendering ofaQuadcopterDronein fusion360

Fabrication:

3D printing is also known as additive manufacturing, and it is the process of building a 3d objectfromaCADmodel.Thearmsofquadcopter dronedesignedinfusion360software,AdditivemanufacturingofquadcopterarmsbyusingPLA(PolylacticAcid)Filamentin3Dprinting.RepetierHostsoftwareis usedforslicing and Creality Ender 3.0is used forprinting parts.

Parameter	Value
Shell Thickness	2 mm
Top and Bottom Thickness	2 mm
Infill Patern	Grid
Support Pattern	Grid
Fill Amount	15%
Print Speed	25 mm/s
Travel Speed	60 mm/s
Layer Thickness	0.2 mm

Table:1Printingparameters

AssemblyandFlightTesting:

3D printed arms of quadcopter assembled to the sheet metal body of the drone. Figureshows thefabricationofthesheetmetalbody.ABrushlessDCmotorisconnectedtotheelectronicspeedcontroller(ESC). Motors are placed on edge of the arms and ESC is placed in the middle of the arms. A powerdistributionboardisusedtodistributethe powertoallcomponents.APMflightcontrolleris placedinthemiddleofthe droneand it's connected tothereceiver, ESC, GPS module, and powermodule.

Figure:5FinalAssessment oftheRobot

Hardware components: Most of the parts on a quadcopter are dependant on each other and whenchoosing one part it puts a new set of demands on another. The one most important characteristic to outis the weight if the Quadcopter, since that in turn puts demand on all parts except the ones handlingcalculationsfornavigation.

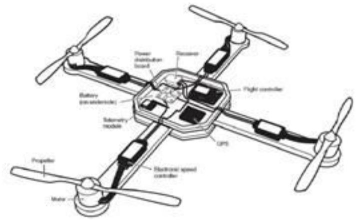


Figure: 6 Overallstructureof the Drone

1.Motor: The motors together with the propellers are needed to provide enough thrust to lift the Quadcopterwiththegrippingmoduleandapayloadofupto20%ofthetotalweight.Sincetheaimistofollowa2:1thrust to weightratio, the total minimumthrust needed to beat least1.5 kg.

PROPELLORS:

A propeller is a type of fan that transmits power by converting rotational motion into thrust. Apressure difference is produced between the forward and rear surfaces of the airfoil-shaped blade, and afluid (such as air or water) is accelerated behind the blade. Propeller dynamics can be modelled by bothBernoulli'sprincipleandNewton's third law.

It is also the main part of the quad copter for flying, there are two types of propellers used in the quadcopter they mostly left-hand propellers and right-hand propellers. 25 Left hand propellers are also callednormalpropellersandthey aremountedto themotor which ismoving incounterclockwise direction.

MULTIROTOR CONTROLBOARD

TheKK.2multicontrollerisaflightcontrolboardforremotecontrolmulticopterswith2,3,4and6rotors.Itspurposeistostablisetheaircraftduringflight.Todothisittakesthesignalfromthethreegyros ontheboard (roll, pitch and yaw) and feeds the information into the Integrated Circuit (Atmega IC). This thenprocesses the information according the the KK software and sends out a control signal to the ElectronicSpeedControllers (ESCs)which areplugged ontotheboard andalso connectedto themotors.

Specifications:-

Size: 50.5mm x 50.5mm x 12mmWeight: 21 gram (IncPiezo buzzer)IC:Atmega324 PA Gyro:InvenSenseInc.

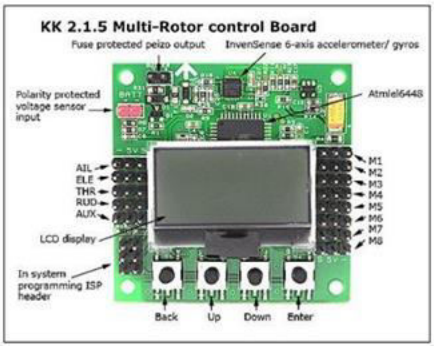


Figure:7Multi-rotorcontrolboard

ELECTRONICSPEEDCONTROLLER(ESC

AnelectronicspeedcontrolorESCisanelectronic circuitwiththepurposetovaryanelectricmotor's speed, its direction and possibly also to act as a dynamic brake. ESCs are often used on electricallypowered radio controlled models, with the variety most often used for brushless motors essentiallyproviding an electronically generated three-phase electric power low voltage source of energy for themotor.

Wehaveused60Aelectronicspeedcontrollersto controleachbrushlessmotorsinthisexperiment whichcanconstantly supplyrequired currentto drivebrushless motors.It hasfollowing specifications:

ConstantCurrent:60A

BurstCurrent:80A

BRUSHLESSMOTOR

Brushless DC electric motor (BLDC motors, BL motors) also known as electronically commutatedmotors (ECMs, EC motors) are synchronous motors which are powered by a DC electric source via anintegratedinverter/switchingpowersupply, whichproducesanACelectricsignaltodrivethemotor(AC,alternating current, does not imply a sinusoidal waveform but rather a bi-directional current with norestriction on waveform); additional sensors and electronics control the inverter output amplitude andwaveformand frequency(i.e. rotorspeed).

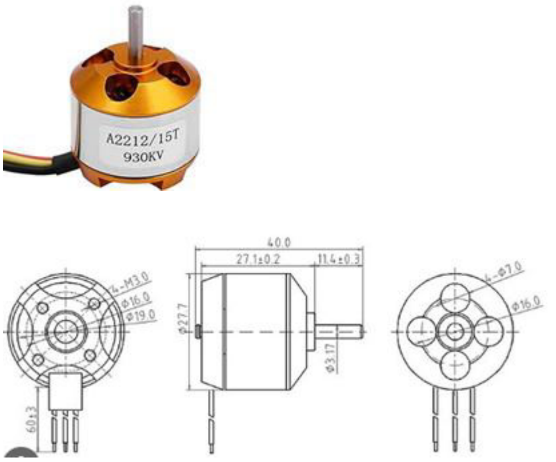


FIGURE: 8BrushlessMotor

LITHIUMPOLYMER(LI-PO)BATTERY

LiPo batteries (short for Lithium Polymer) are a type of rechargeable battery that have become verypopular because of their power to rate ratio. In other words, more electricity in a lighter package.Obviously, this is ideal for anything you’re trying to get to fly. Another advantage is that LiPo’s have ahighdischargerate –which means they candeliver large amounts ofpowerat once.

FIGUER:9Li-PoBattery

Specifications:
•BatteryConfiguration:11.1V2200mAh3cell
•BatteryCapacity:2200mAh
•MaxContinuousDischarge(C-rate/current):20CMaxBurst(3Sec)
(C-rate/current):45C
AnRFModule(RadioFrequencyModule)isausuallysmallelectroniccircuitusedtotransmitand/orreceiveradiosignalsononeofanumberofcarrierfrequencies.RFModulesarewidelyusedinelectronicdesignowing to thedifficulty of designing radio circuitry.

Figure:10 Frequencytransmitter
Receiverspecification:
Channel:6
Frequencyband:2.4GHz
Powerresource:1.5V*4’’AA’’battery
Programtype:GFSK
Weight:25G
Schematic of reaction torques on each motor of a quadcopter aircraft, due to spinning rotors.
Rotors1and3spininonedirection,whilerotors2and4spinintheoppositedirection,yieldingopposingtorquesforcontrol.

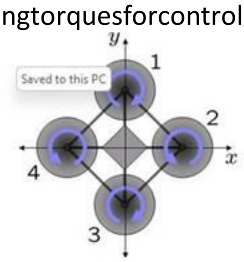
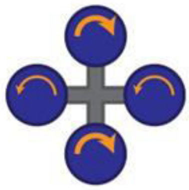


Figure:11Spinningdirection



Workingprincipleandworking
In this study, the aircraft was assumed to be a drone, which means it also stores the energy in the batteryduring the flying period. In this way, both flying the drone by using solar energy and storing the energyin the battery in order to extend the flight time can be achieved. The principle in which the drone worksonit is NEWTONS
THIRD LAWOFMOTION.

Figure:12Pitchmotion

RESULTS

The testing done includes both the testing with different Payload, the testing of the Quadcopter. So inorderfor thetesting to go on many things haveto be donewhich includes

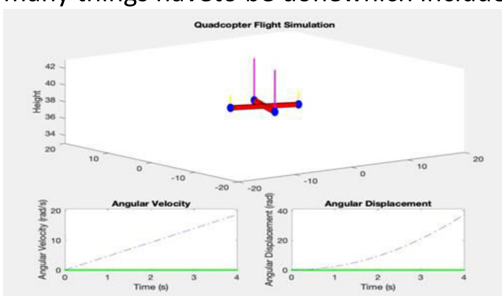


Figure:13testingwithdifferentPayload
ApplicationPerformanceManagement(APM)hastostabilizeandwhenthisisdoneyouhearthepeepsoundtelling you that theQuadcopterisready.
Afterthatthe APMisarmed.
Thethrottleis increasedslightly.
Thenonthetransmitter it shouldbeinchannel 1
Afterit is switched tochannel 2 which

autonomouslyfly.
Afterthatthe returntolaunch modehelpsit returntoorigin

CONCLUSION

In conclusion, this study has successfully explored the design and development of a human-carrying quadcopter, emphasizing its potential as a transformative solution for urban air mobility. Through comprehensive analysis and testing, the research has demonstrated that integrating advanced aerodynamic principles, lightweight materials, and innovative propulsion systems can result in a safe, efficient, and reliable aerial vehicle capable of transporting passengers. The findings reveal that while significant challenges, such as regulatory compliance, safety assurance, and technical limitations, must still be addressed, the advancements made in flight control algorithms and autonomous navigation systems are paving the way for practical implementation. Furthermore, this research underscores the importance of continued innovation and collaboration among engineers, regulators, and urban planners to facilitate the adoption of aerial transportation technologies. As urban populations continue to grow, the need for efficient transit solutions becomes increasingly urgent. The insights gained from this study not only contribute to the development of human-carrying quadcopters but also enhance the overall understanding of aerial mobility systems, potentially influencing the future landscape of transportation in urban environments. Future research should focus on further optimizing performance, enhancing safety measures, and exploring integration with existing transportation infrastructures to fully realize the capabilities of human-carrying quadcopters in modern urban settings.

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