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# HUMANOID FLYING ROBOT USING QUADCOPTER

**Mr. Santhosh s[1] , Akshaya Kumar[2], Nandakumar D N[3], Mallappa S Paragond[4], Muttanna A Muttur [5]**

[1]Assistant Professor Dept. Of ECE, Alva's Institute of Engineering and Technology

Affiliated to VTU, Belgaum, Approved by AICTE, New Delhi, Recognized by Government of Karnataka

Moodbidri, 574225, Dakshina Kannada.

[2345]Students, Department of Electronics and Communication Engineering, Alva's Institute of Engineering and Technology,Affiliated to VTU, Belgaum, Approved by AICTE, New Delhi, Recognized by Government of Karnataka

Moodbidri, 574225, Dakshina Kannada.

**Abstract:** As we know, already humanoid robots are existing in developed countries. In this paper we introducing the concept of humanoid flying robot using quadcopter. If we observe insects are very interesting, in case of introducing the behaviors of insects to the humanoid robots its more impact to the various fields like flight navigation, field of view, locomotion. Humanoid flying robot human like shape with capable of flying, it is the replication of both flying insects and human. Humanoid flying robot have normally two legs & harms, torso, head, but here we are using quadcopter. With the help of quadcopter, the robot can absolutely do the same work of human and also robot can fly. hope this project will bring the new era to this world.

**Keyword :** Insects, humanoid robot, Quadcopter.

## I. INTRODUCTION

A humanoid flying robot is defined as a programmable machine which can imitate the actions as well as the appearance of humans with capability of flying also. We know that humanoid robots can be familiar in daily life because of its human liked configuration, we can see in everywhere. But in this paper, we are going to add extra to fly like a bird with human shape body. In order to produce humanoid robot reaching movements obeying the rules of human kinematics by using paradigm[1].Humanoid flying robots roughly have the same shape as humans, they are strongly different in their mechanical structure, their sensing and actuation capabilities and the way they process data, and flying capability using propellors, body actions However, despite these differences we want to show in this paper that it is possible to make these machines move in a human-like way by applying computational principles of human and flying.

This paper may give the answer for the question like "After years of research on rolling and walking robots, something can come in mind, why cannot flying robot?[2].

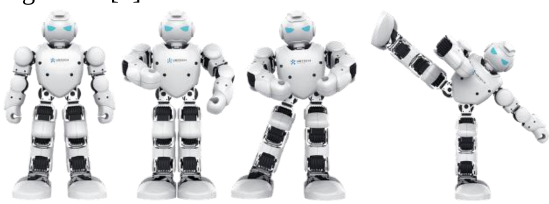

Fig (1): humanoid robot.

In the late of 1920s, three humanoid robots were appeared in the world. Its already 100 years completed, as we know that humanoid robots are using in industrial, army, hotel, etc. Day by day technology is improving, therefore we are taking a 1step forward to improve the humanoid robot to flying humanoid robot. Usually, the characteristics of the humanoid robot is self-maintenance, autonomous learning, avoiding harmful situation to people, property and itself, Safe-interacting with human beings and the environment, Legged locomotion, arm control and dexterous manipulation, we can see the all features in ASIMO humanoid robot [3].

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## II. DESIGNING AND BUILDING A HUMANOID FLYING ROBOT

There are some different procedures we have to use for designing an FHR compared to humanoid robot. First thing is flight capability, to provide more mobility flight is most important. Here we are discussing brief information about available FHR's design [4].

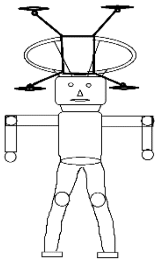

Fig (2): FHR using quadcopter.

Quadcopter FHR as shown in fig (2). By using quadcopter in humanoid robot, we can work it has FHR. Depends upon robot wight, hight, etc… the quadcopter may decide the features. A quadcopter basically, the movement on the remote-control sticks, sends signals to the central flight controller. This central flight controller sends this information to the Electronic Speed Controllers (ESCs) of each motor, which in turn directs its motors to increase or decrease speed. In order for a quadcopter to rise into the air, a force must be created, which equals or exceeds the force of gravity. This is the basic idea behind aircraft lift, which comes down to controlling the upward and downward force [5].

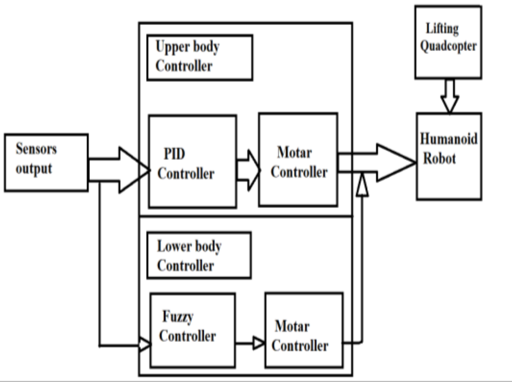


Fig (3):Block diagram of humanoid flying robt.

Human beings have been blessed with 5 sensos of our own, they are Sight, Taste, Smell, Touch. Likewise we use some sensors in this project.

### 1.1 Sensors Output

Sensors are input devices, they interpret information from the real world and convert into a signal that can be process. Sensor output is nothing but the response by the sensor to the change in environment condition as per the working of the sensor.

### 1.2 Upper body controller

Usually, upper body consists of two arms with shoulder, elbow, wrist and hands, head, neck joint, thorax and torso joint as shown in fig (4). The link between the arm and torso is shoulder joint. It means gleno-humeral joint with three degrees of freedom (DOFs). It induces us to describe shoulder range of motion with three DOFs [6]. The elbow has two degrees of freedom. Drive units consists of motor and hormonic drive transmissions are not in the arm, but they are located in the thorax of the robot. Therefore, the mass and also the necessary design space of the arm are strongly reduced, and this gives good dynamics characteristics and a slim form of the arm. Both wrists also have two degrees of freedom, and its rotational axes intersect in one point. For both degrees of freedom, the motors are fixed at the support structure of the forearm. Encoders are used to realize the angular measurement in the wrist at the motor and quasi-absolute angular sensors directly at the joint. 6-axis force and torque sensor are fitted between the wrist and hand to measure the load on the hand.

  

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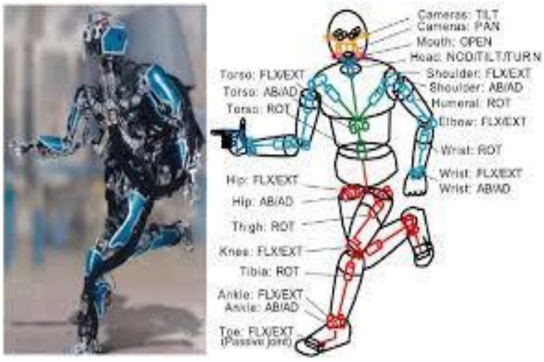


Fig (4) upper body controller.

The torso is divided into two parts, the thorax and torso joint below it. It allows motion between remaining upper body and holonomic platform. Torso joint kinematics does not exactly replicate the complex human kinematics of the hip joint.

### 1.3 Lower body controller

Lower body consists of upper leg, lower leg, foot with a toe, and incorporates the following joint: leg knee, ankle and toe as shown in fig (5). These are all actuated over its entire ROM and actuated bi-directionally. The lower leg function is to connect the ankle to the knee with high stiffness and to fix the actuation of the ankle axes. The advantage high placement of the motors is the ROM of ankle. Motors and transmission need space that's why the closer to the actual axis, these are, the more they affect the ROM, and maybe even obstruct part of the ROM [7].

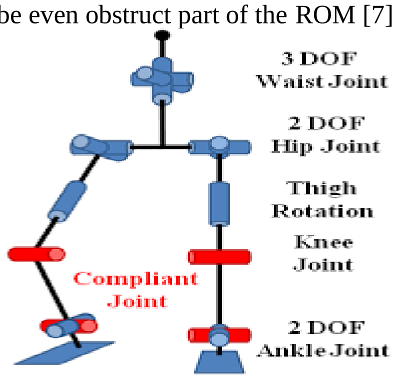


Fig (5) lower body controller.

### 1.4 PID CONTROLLER

A proportional-integral-derivative controller is a control loop mechanism. It continuously calculates an error value as the different between the desired setpoint and a measured process variable. And applies a correction based on proportional, integral, derivative terms.

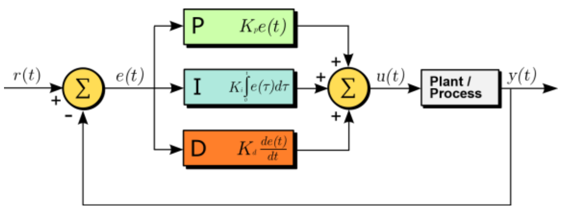


Fig (6) block diagram of PID controller in feedback loop.

Fig (6) shows the principle of how these terms are generated and applied. Which shows a PID controller, continuously calculates an error value e(t) as the difference between a desired setpoint SP=r(t) and a measured process variable. PV=y(t): e(t)=r(t)-y(t), and applies a correction based on proportional, integral and derivative terms. The controller attempts to minimize the error over time by adjustment of a control variable u(t), such as the opening of the control value, toa new value determined by weighted sum of the control terms. The term P is proportional to the current value of the SP-PV error e(t). term I accounts for past values of the SP-PV error and integrates them over time to produce the I term. Term D is the best estimate of the future trend of the SP-PV error, based on its current rate of change.

Mathematical form: -

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$$u(t) = K_p \left( e(t) + \frac{1}{T_i} \int_0^t e(\tau)\, d\tau + T_d \frac{de(t)}{dt} \right),$$

### 1.4 Fuzzy controller

A Fuzzy control system is fuzzy logic; a mathematical system that analyzes analog inputs values in terms of logical variables that take on continuous values between 0 and 1.

Fuzzy controllers are very simple conceptually. They consist of an input stage, a processing stage, and an output stage. The input stage maps sensors or other input, such as switches, thumbwheels, and so on, to the appropriate membership functions and truth value. Fuzzy logic starts with and builds on a set of users supplied human language rules. The fuzzy system converts these rules to their mathematical equations this simplifies the job of the system designer and the computer. And results in much more representations of the way systems behave in the real world.

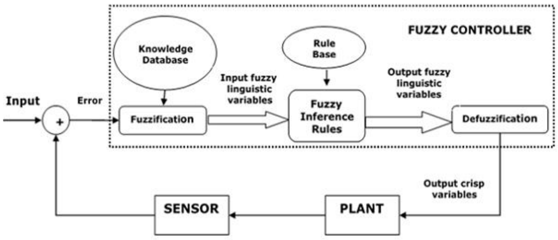


Fig (7) architecture of fuzzy controller

Some major components of fuzzy controller as shown in the fig (7).

Fuzzier: the role of fuzzier is image processing, telecommunications, and consumer electronics.

Fuzzy knowledge base: it stores the knowledge about input and output fuzzy relationship. It also has the membership function which defines inputs variables to the fuzzy rule base and the output variables to the plant under control.

Fuzzy rule base: it stores the knowledge about the operation of the process of domain.

Inference engine: it acts as kernel of any FLC (Fuzzy Logic Controller).

Defuziffier: the role of defuziffier is to convert the fuzzy values into crisp values getting from fuzzy inference engine [8].

### 1.5 Motor controller

A motor controller is a device or a set of devices that can co-ordinate in a predetermined the performance of an electric motor. A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and electrical faults [9].

### 1.6 lifting quadcopter

A lifting quadcopter is type of helicopter with four rotors. Although quadrotor helicopter has long been flown experimentally. Each rotor produces lift and torque and its center of rotation, as well as drag opposite to the vehicle's direction of flight. Lifting quadcopter generally have two rotors spinning clockwise and two counter clockwise. Flight control is provided by independent variation of the speed and hence lift and torque of each rotor. Pitch and role are controlled by varying the net center of thrust [10]. In the early days of flight, quadcopters were seen as a possible solution to some of the persistent problems in vertical flight. Torque induced control issues can be eliminated by counter rotation, and relatively short blades are much easier to construct. fig (8) shows the lifting quadcopter.

Fig (8) lifting quadcopter

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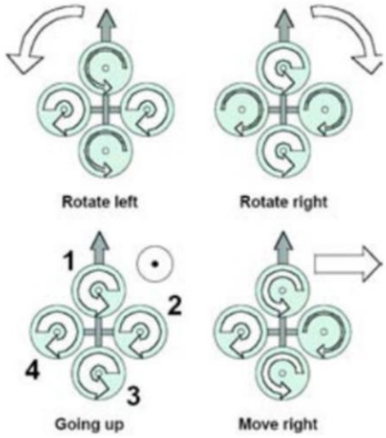


Fig (9) direction of motion of the lifting quadcopter.

The different about quadcopters from other vertical takeoff and landing that in order to control pitch, yaw, and role the pilot uses variable thrust between the four motors. Fig (9) shows that illustrate which motors a pilot would have to speed up or slowdown in order to maneuver. If we wanted to move far right, we would declare right motor, accelerate far left and keep the two motors parallel to direction of motion at a constant speed.

### 1.6.1 Flying and Lifting

Before getting into specifics how the robot fly, it is more important to understand what is drag, thrust and are.
Drag: it is essentially a mechanical force that opposes the motion of any object through a fluid. It is also called as aerodynamic drag [11].
Aerodynamic on quadcopter is generated due to the difference in velocity between the quadcopter and air.
Thrust: thrust is force generated by the propellers of the quadcopter, in order to work against one of the forces that need to be overcome: the drag. Note that the thrust force is not the main force responsible for getting the quadcopter up in the air. Instead, it is the force that lets the quadcopter travel within the air, which is the fluid, overcoming its drag resistance.
Lift: the lift is the force that acts against the weight of the craft, taking up in the air. Lie we cover in the quadcopter blade rotation and lift post. The following are the responsible for lift in a wing. 1.Newtons third law-generates a lift in a wing at the bottom, since the mass of air is pushed down and back (lift and drag). 2. Bernoulli's explanation is incomplete but the pressure difference between the air at the top and at the bottom due to coanda effect generates a lift towards the lower pressure at the top [12].

## III. CONCLUSION

In this paper we were investigated and introduced about Humanoid flying robot using quadcopter. Even it is difficult, it will be the best project for this century if it is done. This paper about Design and building of humanoid flying robot, overall structure of the body and lifting mechanism.

## IV. REFERENCES

[1] "A Brief Review of recent advancement in humanoid robotics research", by Pavan Raju, Dr. Sunil Sikka, Mr. Ankit Garg. Mr. Manoj Pandey.
[2] "Designing a flying humanoid robot (FHR)", by Martin D. Cooney, Francesco Zanlungo, Shuichi Nishio, 10.1109/ROMAN.2012.
[3] "Design of a flying humanoid robot based on thrust vector control", by yuhang li, yuhao zhou, junbin huang, zijun wang, shunjie zhu, kairong wu, li zheng, jiajin luo, rui cao, yun zhang.
[4]. W.S. Ng, and E. Sharlin, "Collocated Interaction with Flying Robots", RO-MAN 2011, 2011.
[5]. Ian R. McAndrew, Elena Navarro, and Ken Witcher "Propeller Design Requirements for Quadcopters Utilizing Variable Pitch Propellers".
[6] "Upper Body of a new Humanoid Robot - the Design of ARMAR III", Albert Albers, Sven Brudniok, Jens Ottnad, Christian Sauter, Korkiat Sedchaicham.
[7] "Mechanical design of a humanoid robot's lower body", M.H.P. Dekker D&C 2010.063.
[8] "Design and application of digital fuzzy controller", by S sanchez-solano 1997.
[9] "Review of developments in BLDC motor controllers along with study of four-quadrant operation and active Power Factor correction", by Dhaneesh Krishna T V, Samskriti, K.P Vittal.
[10] "A new UAV-based Module lifting and Transporting Method", by jinouk choi, Dongbin Kim.
[11] "Flying wing/Flying Fuselages", by Richard M. wood, Steven Bauer.
[12] "The lifting force of an airplane wing when flying horizontally at high speeds". By Alexander Braginsky.