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DESIGN OF INTELLIGENT MONO COPTER

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ABSTRACT

UAV's having four propellers are always a threat to the society and having some security disadvantages. The main objective of this paper is to present the safest drone. Orbot is the modern method of copters and having single propeller powered with a brushless motor. The mono copter will be controlled and monitored through a GUI which is specially built for this. An onboard computer is used to control the copter powered by an Onion Omega2+onboard computer. The small, highly manageable system will receive the data through the camera, sensors and transfers it to the database in a real time manner. Ducted fan technology is the methodology used to lift the copter. In this system, an IOT based integration is used with the cloud for data storage and monitoring the status. It will have the ability to help the people thinking about their safety. We also designed to save some additional commands to work in offline with the help of smartphone or PC. Four valves are used to control the motion, which is connected to servo motors each. And it is integrated with artificial intelligence algorithm for making it work autonomously during the interruption of command from the control system. The copter is fully constructed by fiber coverings and can be able to work in little drizzles.

KEYWORDS: Brushless motors; Ducted fan; Valve; IOT; Cloud; On-Board Computer

I. INTRODUCTION

Orbot is a combination of flying machine and robotics. A large number of quadcopters & multi-copters are available and manufactured [1]. The main problem with the existing copters is that it's unsafe, it is large in size and it requires four or more motor & propellers for flying [8]. Moreover, it is not user-friendly; it has a short battery life and is of high cost [10]. So, the main purpose of this paper is to tackle the above problem by using the single propeller powered copter [4]. It takes advantage of two popular technique used in UAVs such as Ducted Fan technology and Internet of Things (IoT). Ducted Fan concept will be playing as a major role in lifting of Orbot. It was provided with sensing mechanism and controlled through Mobile app/Web App, Computer Wi-Fi seamlessly with sophisticated manner [3]. The intelligent Orbot can be used to measure different parameters for the surveying [5], surveillance, weather monitoring, firefighting, navigation, Ariel photography and military purpose [1]. And all

the sensor status and control are monitored through a centralized dashboard powered by Internet of Things (IoT). The first goal was to design the front end of the software through highly used platforms [7]. The second goal is to lift the copter and is done by a single brushless motor powered with Electronic Speed Controller (ESC) [9].

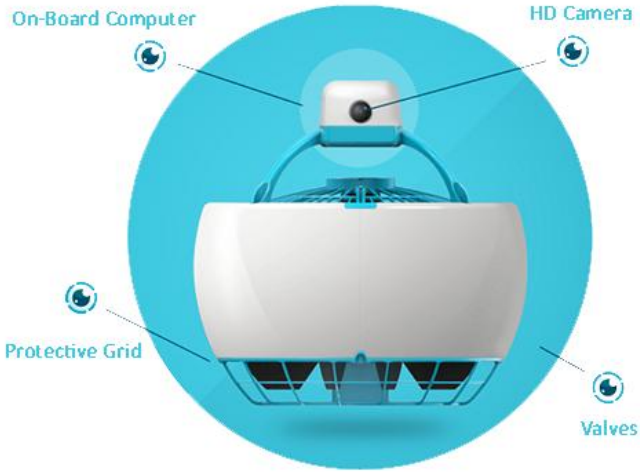

Fig. 1 Design of ORBOT

Valves are used in means of moving the copter front-back and right-left directions. The communications would be done by an online database server interlinked with the application [10]. It has the capability to carry the payload such as night vision camera, sensors (Temperature & Ultrasonic) [8].

II.RELATED WORKS

Quad copters are first emerged in the late 2000's and have obtained many structures in the modern world. There are also some single copters and coax copters are built over the world and facing many problems. Recently a team of five members also published their paper about the design and construction of a mono copter using GPS aided AHRS sensors [4]. Naser and Osama, members of IEEE has also surveyed about low altitude unmanned vehicles based on IoT platform and published their research in the Internet of Things Journal held at December 2016 [3]. The research analysis of the dynamic characteristics and the performance of PID controller of the copter was proposed in [11]. The GUI control design based on UAV genetic algorithm(GA) was proposed by T. Mori [12].

III. PROPOSED SYSTEM

Orbot was powered by a brushless motor which has 1600Kv capacity to lift. It is connected with one propeller which is placed on the top of it. The advantage of the brushless motor is power, great dynamic response, low acoustic noise, better speed versus torque characteristics and longer life. There are four servo motors are used in Orbot which are specifically used for the controlling of valves. With the movement of valves, the copter can able to move in all four directions. And the brushless motoris connected to ESC to provide a control of its speed. The onboard computer is

the heart of the system and has the microcontroller and 1gb RAM. The use of the computer is as it has high RAM memory. Also, the copter needs extra memory to work with offline commands. For that, an additional memory of 2GB is added with it. On-board computer also has some advantages as it is platform independent.

The ESC's are used as per the requirements of the motor. Here, 30A ESC's are used to control the speed of the brushless motor. The propeller is the major component of any copter and our Orbot consists of only one propeller of length 20cm. They are responsible for lifting and landing of the copter.

A.Wi-Fi module

The Wi-Fi module is used as the media for communication between machine and user. It also connected with external cloud database which stores the command and information received by the copter. Gyroscope, Pressure, Ultrasonic sensors are also used. Night vision Camera is used here to send images and videos to the database. Lithium polymer batteries are the most preferred batteries due to its light weight and more power than any other lithium-ion batteries. They offer more discharge rates and high weight/storage ratio.

Fig. 2 Wi-Fi Module

B. Flight-Dynamics

The copter's motion control is defined in three angles of rotation named as Pitch, Yaw, and Roll and shown in fig 3. There are four valves are placed below the brushless motor and controlled by servo motors. These servo motors can be able to move the valves up to 180-degree motion.

Due to the motion of the valves, the copter can be able to move in all the four directions. Two opposite valves are connected pairwise. When one pair of the valve is rotated Orbot acquires the right and left movements. Similarly, the other pair will control the front and back movement.

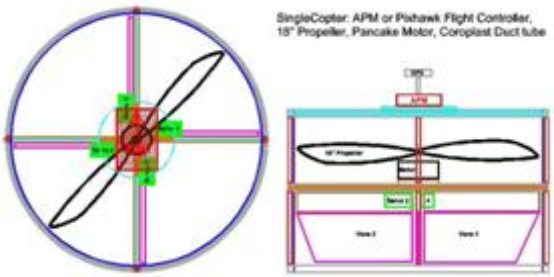

Fig.3 Angle of motion

C. Ducted fan technology

The ducted fan technology is a propulsion arrangement similar to a propeller fixed in a cylindrical duct or shroud. Here the technology is adopted with single propeller placed on it. So, it is more powerful than propeller as well as ducted fan methods. Ducted fan technology has more advantages than a normal propeller method and shown in Fig.3.

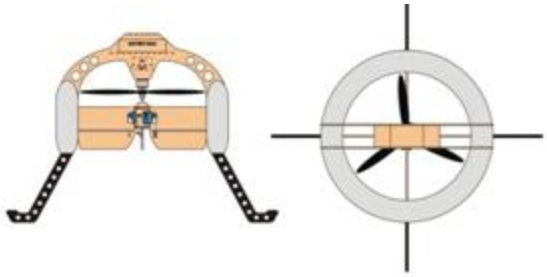

Fig.4 Ductile fan method

D. Block Diagram

The block diagram is classified into three sections. In Fig. 5 the assembly of components and explains about the connections between the system through IOT.

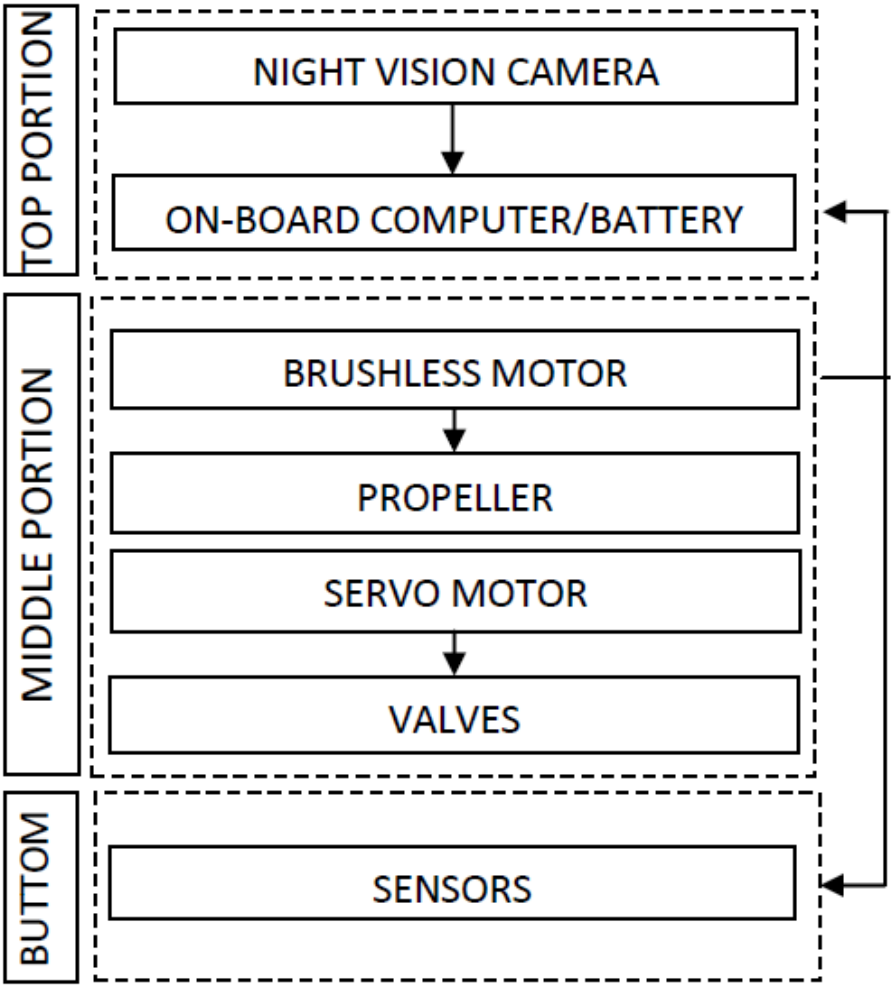

Fig.5 Assembly of Orbot

The outer body splits into four equal parts by considering the four directions. They are constructed with carbon fiber material. The top and bottom of the copters are made separately. Each side has one valve, one servo motor and one ultrasonic sensor attached to it. The On-Board computer is placed on the top of the fan with separate covering. Gyroscope, Temperature, and Pressure sensors are placed on the bottom with separate layer. Night Vision camera can be located on the top or bottom based on user's preference. The parts are covered with same fiber material. So, it can be able to fly in little rain and there are no short circuits. The battery is placed on the computer. 3D printers are used to design & print the

material in individual parts. These parts can be connected through clips and nuts made for it. All the parts and their dissections are shown in Fig.5.

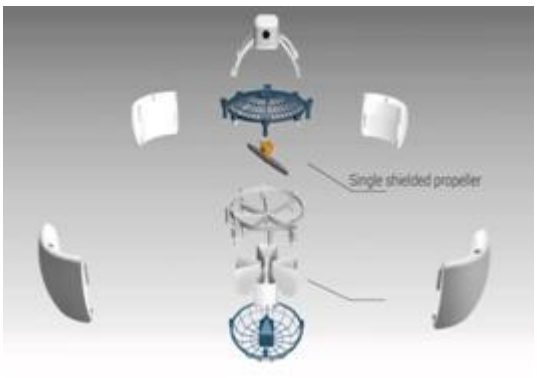

Fig.6 Dissected view of Orbot

E. System Architecture

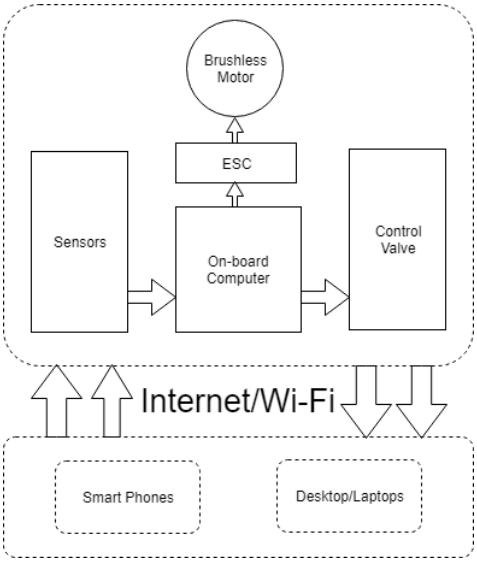

Fig. 7 System Architecture

System architecture explains the whole function of the system from navigation to the end user monitoring. Proposed system uses a single propelled high power brushless motor to lift the copter. The motor is powered with 30A ESC (Electronic Speed Controller) controlled by the on-board computer implemented in it. Omega 2+ is the on-board computer used here. It consists of a powerful 64-bit processor with a 512MB of RAM which enables to control and process the whole functions of the copter in a sophisticated manner. Multiple sensor are been attached to the system with the help of analog to digital convertor due to the microcontroller only have a single analog and 8 digital ports, so for to convert the analog to digital ADC chips are been used. And the control valves are used to perform the motion operation of the copter, which are made of fiber and attached to servos each. All the sensing of sensor data and processing is done in the On-board computer. The on-board computer performs mainly 3 functions such as sending the sensor data to the cloud through internet, controlling the servos and brushless motor and hosting of a local dashboard for navigation in local area network. The medium of communication of proposed system is done through internet. Here Ubibots cloud server is used for the storage of sensor data and it provides its own dashboard for the monitoring, analysis of data and to control the copter wirelessly in wide area network(internet). And for local area network the microcontroller itself creates its own server and hosts a local web based dashboard to the user providing the same as functionality of cloud dashboards.

IV. RESULTS & DISCUSSION

The front end of the application is used by HTML, CSS, JavaScript languages. Html and CSS are used to design the GUI. JavaScript is to link the GUI with cloud database.

Backend consists of PHP language for connection between front end and the cloud. The cloud server doesn't have a direct connection with the copter only it has the connection with the GUI.An online open source database is available for developers in free of cost. So, it can be useful for data storage and communication.

Fig. 8 Temperature and sensor module

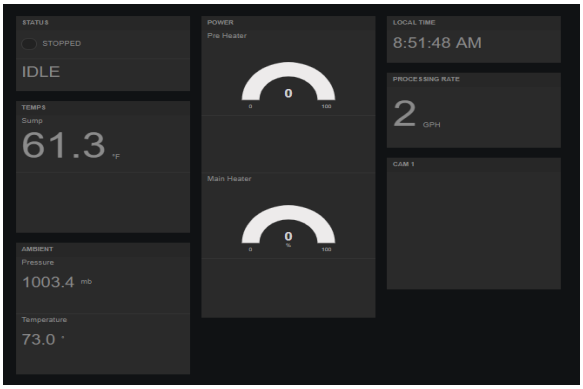

Fig. 9 Graphical User Interface

Fig.8 and Fig.9 explain the results obtained from Orbot. It has advantages such as Safe to handle, User-friendly, easy to control, Mobility & Portability, Cost-effective, Water resistant.

V. CONCLUSION

In the past, the structure of UAV's was tilted in shape. It may damage the objects in the surroundings. Existing system contains minimum three propellers, which will increase the size and less safe. The main goal of this paper is to make a safest, efficient drone with a single propeller. The goal is achieved by using one brushless motor and four servo motors. The significant character of Orbot is its motion control. It is designed by four separate valves. IOT will also be included in the implementation. However, some of the disadvantages are listed above. This work has been enhanced by updating the factors which are needed by the defense, special features for fire rescue missions and for governmental purposes.

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