Aerial Assistance by Robots

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ABSTRACT
With the development of newer and more developed technologies in assisting humans by robots the most advanced and efficient way is by air. Robots cannot assist humans in all times since there are times where robots that move in floors cannot help in complex and rough terrain, hence the only way to assist humans everywhere is through air, Thus robot that can fly can

Keywords
MCU-Microcontroller unit

Multirotor- The vehicles with more one dedicative rotor for flight. In this case three rotors are used for transportation

Tricopter- The name is framed from the three rotors being used for aviation.

ESC-Electronic speed controller

1. INTRODUCTION
Assisting humans in their problems is the important research topic over the past few years. While there are many innovations made for assisting humans but this method of aerial assistance is the promising technology of the future of robots that has many new and wide applications. Aerial robots? Actually it is a multirotor equipped with MCU and on board sensors for its navigation and maneuverability. Multirotor-a helicopter with more than two rotors. In this study a three rotor based helicopter with onboard MCU environmental sensors is used for effective maneuverability. it just needs to be programmed once for the specific purpose and then it is completely on its own. These robots can also work as swarms as like birds flying in a group and accomplish task given to them faster as a team.

2. RELATED WORK
The multirotor commonly called as a tricopter has three brushless motor for lifting it and there is an additional servo motor for tilting the third motor for the rudder movement. The tricopter has a flight controller has the gyro that makes the tricopter stable during its flight. Generally it controls the speed of each motor so that the tricopter is kept stable in the air. The flight controller has to be interfaced with a MCU to with onboard environmental sensors, GPS modules etc. Can be interfaced and used for the effective flight. Cameras can be fixed as additional accessory and it can be developed by using image processing to perform certain tasks.

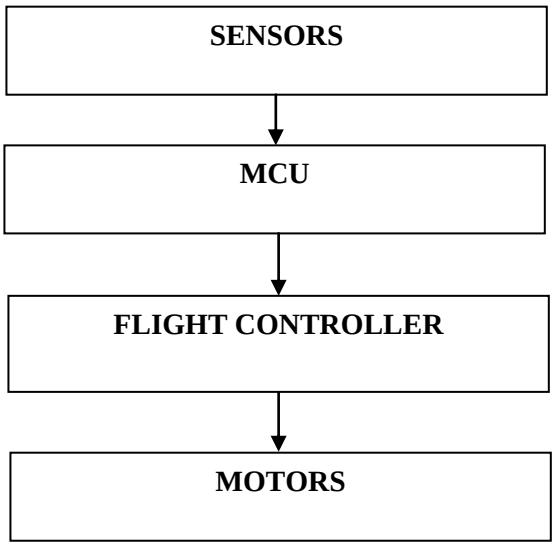

Fig.1[Block Diagram On The Working Of Tricopter]

2.1 Motors
The motors being used in the tricopter are BLDC (brushless DC) motors, as these motors are light and deliver a huge thrust and they need a PWM input to make them operate at the desired speed. This PWM input for the motor is provided by the ESC(electronic speed controllers).

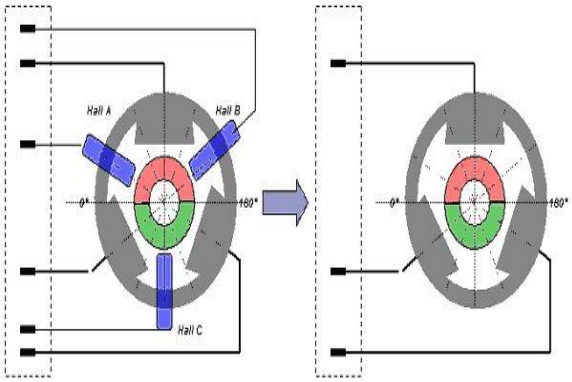

Fig.2

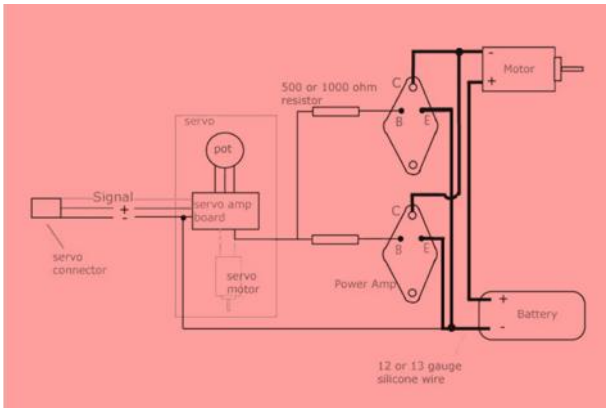

Fig.3

2.1 Microcontroller Unit

The MCU is the main component that controls the ESC and the sensor data are fed into the MCU, this MCU through the sensors observes the environment and reacts in such a way that it is completely autonomous. It is interface with the sensors that are essential like the barometric pressure sensor for the altitude measurement and the gyroscope and accelerometer for the stability of the copter. This is programmed once for an application and after the verifying process the MCU controls the vehicle based on the programmed instructions.

2.2 Electronic Speed Controllers

The ESC is a circuit that provides the required bidirectional wave to operate the motor, these ESC are also used to control the speed of the motor and the speed of the motor depends on the duty cycle. These speed controllers controls the rotational speed of the motor based on the signals from the MCU by varying the signals to the motor. These ESC act as a bridge between the 12v and 3.3v volt signals between the MCU and the motor.

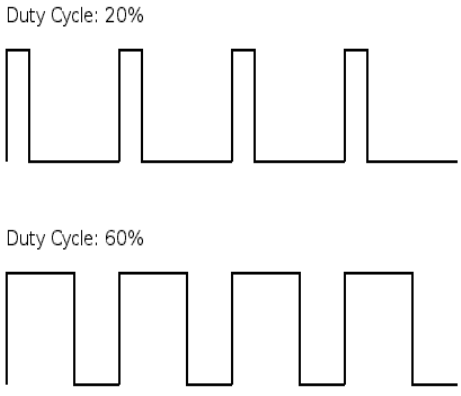

Fig.4

In the above figure there are two distinct duty cycles mentioned and for a 20% duty cycle the motors spins at a certain speed (say 1400rpm) and when there is a 60% duty cycle the motor attains more speed (say 2500 rpm).

2.3 3d Mapping And Navigation

The technique of 3d mapping and navigation is implemented with this proposal which helps the multirotor to move in new vicinity and automatically map the area and provides a effective navigation path to be executed. This makes the multirotor fully autonomous and to explore a new location and effective manipulate the area and build a path in which it can be operated without being interfered by any obstacle.

2.4 Path Planning

The 3-D mapping and navigation method is used to analyze the environment of the multirotor and plan a path in which there is not interference of any objects. There are different algorithms used for such applications and each algorithm differ by the processing time but still the produce the same results. This feature is the main advantage of this proposal, where the technique of 3D mapping an path planning can be implemented to navigate the multirotor to a required location automatically and also avoid obstacles and change course automatically if there is any difficulty in the current route.

3. APPLICATIONS

As discussed earlier the tricopter has wide range of applications a few are explained below. it can be used as a surveillance robot but this is not an extraordinary applications, it can be used to rescue lost people from forests, seas etc., It can be used to assist blind people, it can also be used to explore new and unexplored areas where there is no suitable terrains for the conventional wheeled robots. If the idea of autonomous navigation system is developed then it has a wide field of applications almost in all the fields

3.1 Rescue Robot

This tricopter equipped with specialized thermal cameras and GPS modules can ultimately serve the rescue teams to rescue lost peoples faster as it is a robot it never gets tired and it can be made to scan for lost people inch by inch so that no part is missed. This tricopter actually relays the images taken by the thermal cameras to a server that analyses the picture for human signature if it matches the signature the GPS data from the tricopter helps the rescue team to the place that is marked by the tricopter's GPS data, thus this technology helps the rescue team to find and help the people lost in deserts, seas, and dense forests. According to a study it takes about 2 days for a rescue team to locate and provide medical attention to the lost people if this technology is implemented it is calculated that approximately it would take 10-36 hours to track down a person depending on the area and the number of robots used As these robots can work in groups it makes the rescue operation even faster, hence this technology is promisingly a fiction that came true type for rescue operation.

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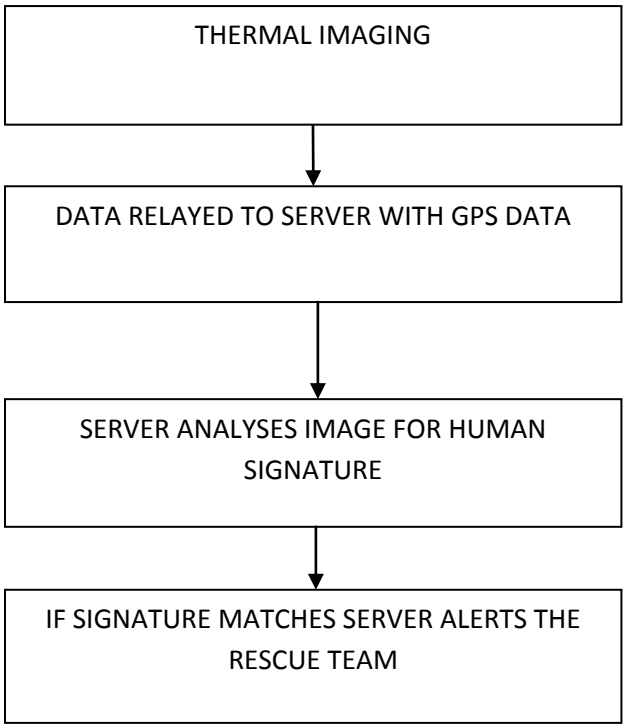

Fig.5[Block Diagram On Thermal Imaging]

Fig.6 [A Image Obtained Afterthermal Scanning]

3.2 Assisting Blind People

People with visual abilities can be assisted with this technology to help them to navigate their path without the help of others. Actually a tricopter equipped with necessary sensors for ranging and obstacle sensors, in the field, a tricopter is made to follow the person with disability over their heads and it relays necessary information like the distance of incoming obstacle and live commands to safely navigate the person through a microphone fixed to an ear of the person and it helps them walk through even a busy and crowed path. As the robot is airborne it does not come in contact with the person or any other person so it's surely safe. Practically this makes the visually challenged people to develop their lifestyle. It can also be used to monitor these visually challenged persons by their family and also actually aid them by seeing them in a computer screen. By implementing this technology all the visually challenged people can explore their way.

3.3 Exploration

This technology can also be used for exploring remote area to know about their environment and nature of the particular area and can be used to discover new natural phenomena that has not been registered,

3.4 Surveillence

Surveillance robots are the most welcomed robots as no risks are made during the surveillance act. These robots can be made to fly above areas where heavy surveillance is required for an example take a prison and there is a tricopter under the surveillance device, think of a prisoner escapes the prison, if the tricopter is equipped with proper camera and image processing commands it could track down the criminal and sends the main server the GPS data of the criminal's hideout. By implementing this technology the surveillance power of a organization is developed in a way that it not only monitors the area but it also has the tendency of tracking down a suspicious person

3.5 Military Applications

This technology can also be used in military applications like following the sergeant from the air and by this technology the sergeant has an extra dimension of attack and it enhances the vision of the combat soldier. By using this technique the amount of causalities will decrease drastically. This drones can also save injured soldiers by sending distress signals to the headquarters along with the GPS location of the injured soldier.

3.6 Swarm Of Robots

These drones can be also combined into swarms and allowed to perform certain tasks that are essential when there is more than one number of drone. If a net is fixed with four drones then can be used to catch objects and even transport them to places. If there is a search and rescue operation a swarm of drones helps to reduce the rescue time unlike a single drone that engages itself in the rescue operation.

3.7 Package Delivery

These drones can be developed as package delivery vehicles which can be of great advantage in delivering required materials to the required place or person in any instant where the land transportation is severe. It can also be used as medical supply vehicles during war or any other natural disaster scenarios. The important packages can be delivered to the required places in less time as compared to the conventional methods. Since all the multirotor are controlled by a single central hub, these vehicles can change the destination during the journey also if there is any emergency. So this application if developed may lead to a major revolution in the field of delivering the materials.

4. CONCLUSION

The paper presented by our efforts to implement a new mode of assistance to humans, Aerial assistance by robots is the study that includes environmental sensors onboard in the tricopter to capture all the essential data for the effective functioning of the flight. In additional to these sensors special modules like GPS,GPRS modules can be added to it for relaying data to a centralized server to analyze the data from the tricopter to the human team that monitors the function of tricopter. Therefore, this is a technology that has wide range of applications as discussed earlier. These robots can be developed more and more based on its applications. It can be made as a team of similar robots that interact within themselves and performs the tasks given to them faster and accurately. These robots can be developed in a advanced manner by adding new technologies to it. It serves as a platform for the developer to add any new and innovative ideas to it. The study provides strong information about the changes that occurs to our lives after the implementation of this technology.

5. REFERNECES

[1] S. Shen, N. Michael, and V. Kumar, "Autonomous multi-floor indoor navigation with a computationally constrained mav," in Robotics and Automation (ICRA), IEEE International Conference on, May 2011, pp. 20-25.

[2] F. Wang, J. Q. Cui, S. K. Phang, B. M. Chen, and T. H. Lee, "A monocamera and scanning laser range finder based UAV indoor navigation system," in International Conference on Unmanned Aircraft Systems (ICUAS), May 2013, pp. 694-701.

[3] Paull, S. Saeedi, M. Seto, and H. Li, "AUV Navigation and Localization: A Review," IEEE Journal of Oceanic Engineering, vol. 39, no. 1, pp. 131-149, Janunary 2014.

[4] A. Georgiev and P. Allen, "Localization methods for a mobile robot in urban environments," IEEE Transactions on Robotics, vol. 20, no. 5, pp. 851-864, October 2004.

[5] J. Guivant, E. Nebot, and S. Baiker, "Localization and map building using laser range sensors in outdoor applications," Journal of Robotic Systems, vol. 17, no. 10, pp. 565-583, 2000.

[6] J. Guivant, F. Masson, and E. Nebot, "Simultaneous localization and map building using natural features and absolute information," Robotics and Autonomous Systems, vol. 40, no. 2-3, pp. 79-90, 2002.

[7] Lucas D, Crane C, "Development of a multi-resolution parallel genetic algorithm for autonomous robotic path planning," Control, Automation and Systems (ICCAS), 2012 12th International Conference on. IEEE, 2012, pp.1002-1006.

[8] Chen, Xiong, et al. "A fast two-stage ACO algorithm for robotic path planning," Neural Computing and Applications, 2013, 22.2, pp. 313-319.

[9] Zhang L J, Xie X F, Cao J, et al, "Flight Path Planning Based on PSO and Minimum Threat Surface," Advanced Materials Research, 2012, No.461, pp.482-486.

[10] L. Kavraki, P. Svestka, J. Latombe, M. Overmars, "Probabilistic roadmaps for path planning in high-dimensional configuration spaces," IEEE Transactions on Robotics and Automation, 1996, Vol. 12, No.4, pp. 566-580.

[11] S. M. Lavella and J. Kuffner Jr. "Rapidly-exploring random trees: Progress and prospects," 2000 Workshop on the Algorithmic Foundations of Robotics, 2000.

[12] Kim J, Kim M, Kim D, "Variants of the Quantized Visibility Graph for Efficient Path Planning," Advanced Robotics, 2011, No.25(18), pp.2341-2360.

[13] Luca De Filippis, Giorgio Guglieri, Fulvia Quagliotti, "Path Planning Strategies for UAVS in 3D Environments", J. Intell. Robot. Syst. 2012, No.65, pp.247-264

[14] RJ Fossati, "The Construct of Drape Surface with Constrained First Derivatives", ORiON, 2003, Vol. 17, No. 1/2, pp. 65-80

[15] Wang Tao, Lei Rong, "The Improved Algorithm for the Extraction of Contour Lines from Grid DEM," Geometrics World, 2006.02, No.1, pp.39-44

[16] Jones. N., Kennard. M. "Fast algorithm for generating sorted contour strings," Computers and Geometrics, 2000, Vol. 26, No. 7, pp. 831-837

[17] Tang Lihua, Xu Ai-jun, etc., "The algorithm of creating contour lines based on DEM," Geo-informatics 2008 and Joint Conference on GIS and Built Environment Proceedings of the SPIE, 2009, Vol. 7146, pp. 71462T-71462T-10.

[18] David Douglas & Thomas Peucker, "Algorithms for the reduction of the number of points required to represent a digitized line or its caricature," The Canadian Cartographer, 1973, No.10, pp.112-122