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Particle Swarm Optimization Based Object tracking for Quad copter

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Abstract: It is strongly believed that currently the security of general public in Pakistan is a priority for the Government and serious measures have been taken to enhance the security as well as to avoid incidents involving terrorist activities or natural disasters. Intelligence agencies have been really proactive ever since the heart breaking Peshawar Massacre took place. The work done in this research proposes a unique idea of a model quad copter unmanned aerial vehicle (UAV). As the name suggests, the aerial vehicle is provides a bird's eye view and allows the operator to take control action from remote place. The basic algorithm adopted for the completion of the research work is Particle Swarm Optimization (PSO); inspired by Swarm Intelligence which is one of the emerging technologies in the field of robotics.

Keywords: Particle Swarm Optimization (PSO), Unmanned Aerial Vehicle (UAV).

1. INTRODUCTION

The research work presented in this proposal provides an idea of not only avoiding critical situations but also if an unfortunate event has taken place then it serves for the rescue purpose. The term particle swarm refers to the fact that the swarm is composed of number of particles and each particle works in coordination with the other by extracting information from its neighborhood particles. This technique will be employed for the modeling and simulation of UAV for the control purpose. The efficiency of small copters is not usually high in terms of tracking. The object tracking is a dynamic optimization problem which may be influenced by time and state of object. **(Fig. 1)** below shows the model of a quad-copter having four motors and its thrust is produced through power transfer of engines into the propellers.It is 6 degrees of freedom: three straight-line motions, three rotational motions.

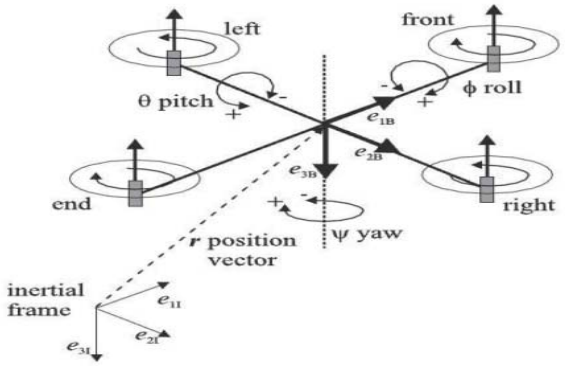

Fig. 1 Model Quadcopter

With this software based project we aim to study the up to date data available for the tracking of objects as well as for quad copter and UAV modeling. Develop a reconfigurable program on MATLAB and model the quad-copter using Simulink to allow particles to coordinate with neighborhood particles in the swarm.As a final outcome, the simulated model must be able to track an object and then perform actions accordingly.

2. STATE OF THE ART

Previously Swarm Intelligence has inspired researchers to develop an algorithm for Mobile Adhoc Networks (MANETs). For the design of distributed and reprogrammable algorithms, particularly routing algorithms, swarm systems have become a source of inspiration (Gianni *et al.,* 2005).

Paradoxically, algorithms based on Swarm Intelligence fail to show their competitive edge over other optimization techniques on static problems whose characteristics and conditions are time invariant. However, they are often more competitive to systems dealing with uncertainty which are time variant (Hazem, 2010). Efficient algorithms are required for real time object tracking in embedded applications. The comparison of the characteristics of the target object and video images in the search region serves the purpose to track the object (Chen and Guo, 2012).

The idea of social interaction to problem solving is applied by particle swarm optimization. Various agents (particles) that combine together to form a swarm moving around in the search region looking for the optimal solution.

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With the virtue of cooperation of each individual in a particle swarm, the most optimist solution can be worked out by the algorithm. Similarly, this algorithm can be used to work out the complex optimist problems (Qinghai, 2010).Although sufficient amount of work and research are required to be done for this new technique called particle swarm optimizer; yet it has been found swift in solving nonlinear and non-differentiable problems (Yuhui and Russell, 2001).

Nowadays, small copters are getting more popular due to their light weight as well as portability and easy handling. Owing to this reason several methods have been reconnoitered for achieving independent control of a small electric helicopter. Nonetheless, to achieve control of small helicopters compared to large ones has been extremely difficult, due to the sensor restriction. Generally, larger sensors have better accuracy and the small sensors usually mounted on small copters do not show enough accuracy for the required specification. Hence accuracy is a concern when dealing with small copters (Satoshi, *et al*., 2013).

The key for developing appropriate team behavior for a swarm of UAVs are extensive training sessions that first are executed in simulation software, then in controlled lab environment and finally in an outdoor setting(Stephan *et. al,* 2014).

The attitude and position control in six degrees of freedom (DoF) is usually the main problem in the navigation process of an aerial vehicle which provides stabilization and control of the system. Although, the attitude control can be handled well by today's systems yet without a position control these systems are vulnerable to drift over time. This issue could be resolved either with the use of off-board sensors or onboard sensors in global positioning system-denied environments. The use of off-board sensors focuses on control issues with ease (Davide and Michael, 2014).

Primarily a single movement is computed and the object corresponding to this movement is detected. The process to find other objects in the remaining region is repeated thoroughly. As soon as a single object has been identified, it is excluded from the region of analysis (Sakuntala *et al*., 2015).

3. PROPOSED WORK

The simple block diagram of the system is shown in **(Fig. 2)** first the PID controller will perform the control action the output of which is the input to the modeled quad copter. After this the output of quad copter is analyzed by the help of algorithm and the detection is taken place. Modeling of particles working in swarm to implement motion detection and obstacle avoidance is then accomplished.

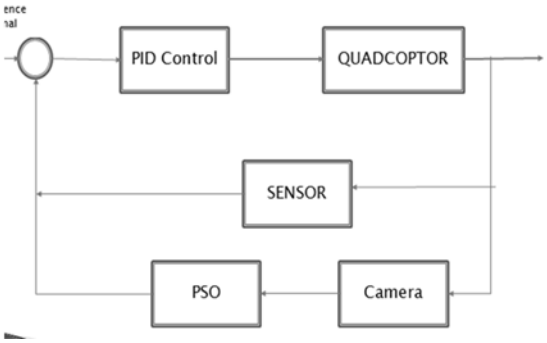

Fig. 2 System basic block diagram

The basic idea followed by the system is to detect the coordinates of the target object with the help of feature extraction (Andre, 2008). These coordinates will then be the input for the quadcopter so that it has to move to that point hence the object has been tracked. In the end the PSO will optimize the smallest possible path for the quad copter so that it takes minimum time to reach the target object (Dian *et al*., 2011).

4. Outcome of the proposed prototype

When the query image **(Fig. 3)** is given, features of objects are detected using Speed Up RobustFeature (SURF) at first as shown in **(Fig. 4)**

Fig. 3 Sample Image

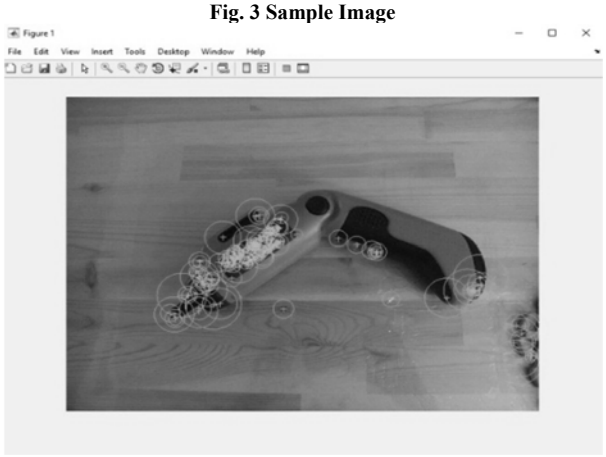

Fig. 4 Features detection of object

After that PSO is optimising the features of the object and selects the strongest feature according to the requirement of system for recognition of object in future as shows in figure 5. In this way training of different objects is done using one to multiple class SVM classifier.

Fig. 5 Feature Optimization

Fig. 6 Recognition of Object

In **(Fig. 6)** when query image is given, system is extracting the features of objects optimizing the features using the PSO algorithm, then comparing it with the database and it shows the recognized. In this way, the quad copter will be able to track the required objects after recognizing them.

5. CONCLUSION

In this research project, we are using a new technology called particle swarm optimization (PSO) inspired by Swarm Intelligence. With this we developed a model on software and simulated the results for tracking of objects by quad copter UAV. It is intended to implement this project on hardware in future and make a swarm of little quad copter UAVs.

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