Bio and Health Drones

Drones as Air Guides Controlled by Genetic Algorithm – A HealthDrones Project

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Overview

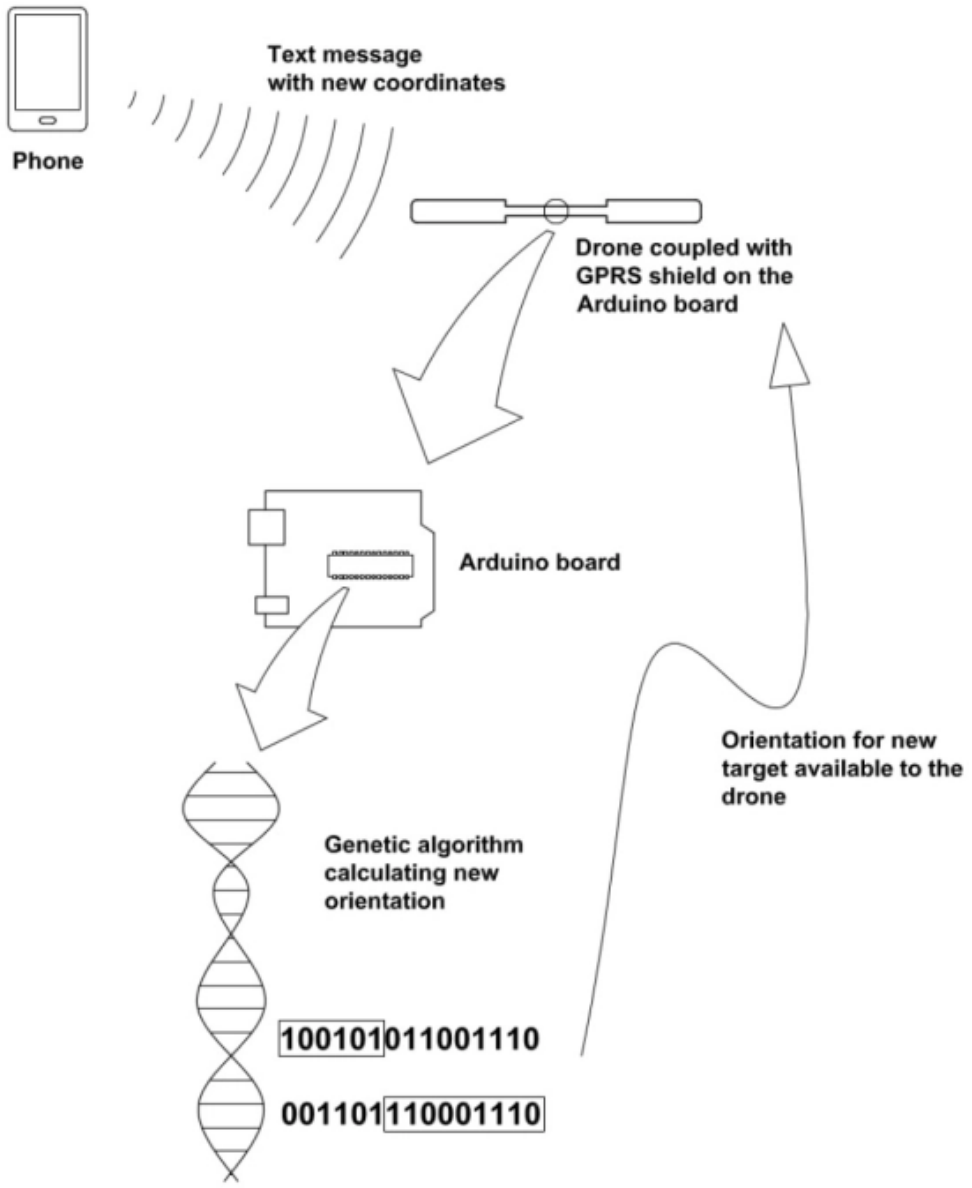
This post presents the use of drones, small unmanned aerial vehicles, with the functionality of tour guides in public places, with trajectory control based on genetic algorithm. From the time the tour starts, data and information are processed in order to evaluate the various circumstances which may affect the drone chosen path.

An initial trajectory control is done on-line in the drone itself through coordinates passed to it by a remote device. Such coordinated feed a genetic algorithm running on an Arduino UNO to generate the new orientation of the route.

The genetic algorithms have been widely used in solving different problems with numerous applications involving the planning and control of trajectories for unmanned aerial vehicles (UAV), presenting wide applicability for development with hardware accelerators and programmable devices.

Path Control

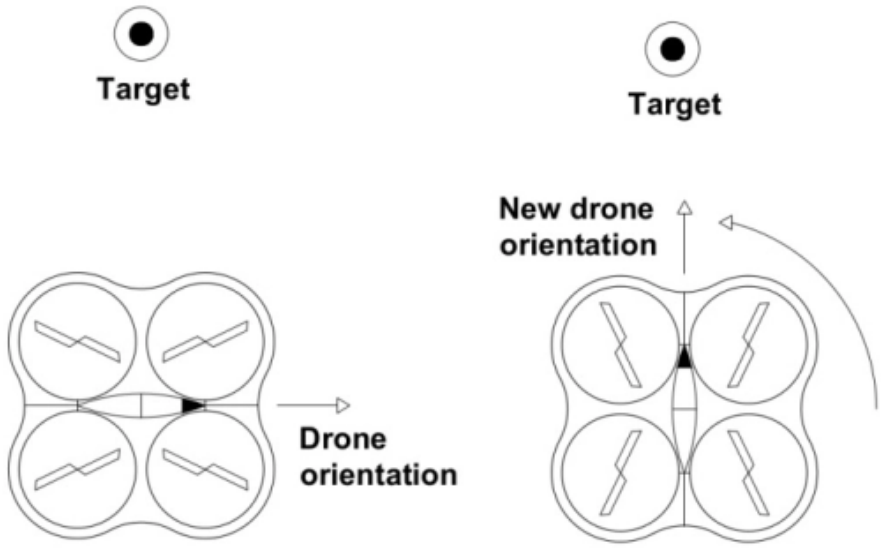
The path control here proposed consistis of the use of a mechanism embedded in the drone based on Arduino platform and capable of executing a genetic algorithm in real time. Such an algorithm receives coordinates of positioning and angular orientation of origin and destination, and presents a solution of reorientation for the drone. The following figure illustrates how the control is established.



All the computational apparatus for the algorithm's excution comes from a microcontroller unit based on the Arduino platform (Arduino UNO R3), with implementation and organization of the source code classes (GA library) as presented by *Nuno Alves (nuno@brown.edu)* – ENGINEERING DIVISION, BROWN UNIVERSIT, more information in the links section below.

Through any cellular device, a text message is sent to the drone with its current coordinates, its angular orientation (in principle considered only in the XY plane) and the coordinates of the target. By means of a GPRS module connected to the Arduino board, the message is captured, interpreted and submitted to the genetic algorithm, which then searches for a solution for the correction of the angular orientation of the drone, in order to align it with the target.

As described in the specifications of the library used, some considerations must be verified due to certain microcontroller unit processing restrictions, such as population size limited in 100 individuals, represented by means of 32-bit chromosomes and fitness evaluated between 0 and 100. In order to obtain the new orientation of the drone's displacement, the fitness calculation was adapted to the problem in question. The following figure sketch out the angular correction.



The table below shows the orientation correction angles found by the genetic algorithm for several positional initial states of the drone. It is assumed that the population is formed by 99 individuals with stopping criterion after 20 generations. The algorithm must receive the coordinates of the drone and the target, calculating what should be the new orientation that the drone needs to rotate to align with the target. It is assumed that the drone is oriented in the positive direction of the X axis and that the calculated angle is taken with respect to the horizontal in the counterclockwise direction.

Drone X-Y		Target X-Y		Angle (°)	Time (ms)
0	0	10	0	**1**	2760
0	0	10	10	**46**	2726
0	0	0	10	**93**	2750
10	0	-10	10	**150**	2766
10	0	-10	0	**181**	2754

In general, the orientation correction through genetic algorithm presented good performance and regularity. It is worth emphasizing the possibility of several other applications where the external control of coordinates for drones can be employed, such as surveillance and search for survivors.

Links

Implementing Genetic Algorithms on Arduino Micro-Controllers, Nuno Alves. (https://arxiv.org/abs/1002.2012) The source code for the GA arduino library has been released into the public domain under a GPL license and can be directly copied from the paper: **https://arxiv.org/pdf/1002.2012.pdf (https://arxiv.org/pdf/1002.2012.pdf)**.

The Arduino platform: **https://www.arduino.cc/ (https://www.arduino.cc/)**.

Source code to be loaded on the Arduino UNO board: **https://github.com/HealthDrones/Drone-GA (https://github.com/HealthDrones/Drone-GA)**.