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Flocking with Distance Perception Obstacles Avoidance

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Abstract: **- Innature, organisms depict bound behavior whereas traveling at each microscopic scales(bacteria) also as large scales(fish) referred to as flocking. to know the flocking behavior higher simulation is that the 1st and best step. Animals organize themselves in to larger teams (birds-flocks, fishes-shoals, ants-swarms) with easy coordinated behavior and that they work as a unit. the primary flocking behavior was simulated by Craig Reynolds in 1986 and he known as the generic simulated flocking creatures as boids. His model was supported three-dimensional (3D) process pure mathematics that was ordinarily utilized in pc power-assisted style or pc animation. Separation, cohesion and alignment area unit the 3-basic steering behaviors that describe concerning a personal boid manoeuvres supported the positions and velocities of its close flockmates. within the current work it's tried to simulate the flock with target seeking and distance perception obstacle turning away behavior in conjunction with the preceding basic behaviors wherever the required direction is calculated by every boid with reference to the obstacle.**

Key words— flocking, distance perception, obstacle avoidance

I. INTRODUCTION

Several independent agents emerged as a flockthat has a common trait in nature. The flock always tries to maintain an ordered and coordinated behavior in the event of movement. While forming a flock, the group of agents well coordinate their spatial positions and move together in the group.[1]

To simulate a flock a bird's behavior in a group is imitated. To augment this behavioural"control structure" it is needed to simulate small portions of the bird's natural behaviour mechanisms and concepts of the physics of a simplified flight. In case of the above simulated bird model imitates flock-member behavior, then to create a simulated flock, some instances of the simulated bird model can be created and allowedto interact. Flock is a term which can be expounded as an aggregation of independent analogous agents irrespective of their size and density.[3]

The inspiration for this activity is implementation of flocking models for various applications invarious fields like Nano robotics, medicine, and ecosystem.

Flocking is usually grouped with AI algorithms because of itsevolution. Composite behaviouris a result of the interaction of simple local group conducts. Flocking has been found its use in gaming world extensively. Some of the examples of its application can be seen in games like Enemy Nations (Windward Studios), Half-Life (Sierra), and Unreal (Epic).

II. LITERATURE SURVEY

Normally a scalable flocking model permitsa greater number ofquadrotors to be includedinto the existing runtime quadrotors, surrounded at any given moment creating no effect to the flock. Then a simulator has been created, that permits in fully self-sufficient quadrotors to comply with a different list of behaviors. After that the behavior, separation and alignment, cohesion and knowledgeable avoidance direct a group of quadrotors. This simulator model is used to add independent quadrotors to a flock.[9]

For some particular matters to an extinct, in this nature as how some animals will arrange themselves into larger groups so easily with less efforts. By looking into the more approximated results this behaviourmight be capable enough of following this information to find new answers to our problems. One of the importantsteps is to get to know that how is flocking behaviour is possible with a purpose to execute it. The very first flockingbehavior simulation was done on a computer regards to Craig Reynolds in 1986 and he called it as “Boids” simulation program. In these days it’s nevertheless to most used version for simulating flocking behaviour. This thesis tries to evaluate two exclusive definitions of the neighbourhood of the boids. The definition of the neighbourhood has amazing impact of the way the boids act.[3]

It deals with how these flocking behaviours helps in server-based control system. Speed, position, target are the properties applied for each boid. Other two properties are included.

1. Targeting - moving towards a common target
2. Obstacle avoidance – not colliding with any obstacles

Flocking can appear in natural (school of fish) and synthetic ways (robotics). A flocking set of rules has been implemented on base processing server which controls of every boid. There are some parameters that are related to international and environmental like radius, coefficient of static and kinetic, friction and acceleration. We can identify each boid by giving unique id to it.

It's been simulated by using MATLAB software to build GUI and setting global and local parameters to each boid. The flocking algorithm on server based will helps to find properties of boids. They're running on contrast with present strategies with Fuzzy logic Genetic Algorithms which is used in optimization problems with given inputs, Neural Networks that tries to recognize the relationship in a set of data.[8]

III. BOIDS MODEL DESCRIPTION

In 1986, Reynolds has performed the research on group behavior in the beginning and simulated the flock. It is observed that the virtual flock of birds in the computer can simulate the bird organizations flying in the real world with threebasic rules of Alignment, Separationand Cohesion respectively. For some extent, it is needed to arrange the individual's perceptual capability within the flocking groupto simulate some sensing mechanisms of the flock.In the Boids model, geometric database can be directly accessed by the individual agent, which specifies the exact direction, location and the speed of all the objects in the environmental perception.

A concept of "neighbourhood" is used to implement three rules Separation, Alignment and Cohesion which are dependent on angle and distance [4]. The neighbourhood of the flock is categorised into three regions.

First location is the closest place to the central person which is called a different zone in which there may be a rejection effect by way of all people to the central person. Second area referred to as the similar zone close to the excluding zone in which the centre person decides the direction of motion of the subsequent move in line with the route of motion of all people in the zone. The last place known as the enchantment area, which guarantees that the people do no longer leave the organization inflicting outliers.[5]

IV. EASE OF USE

A. Low memory consumption

Widely accepted algorithms ranging from 'bug algorithms' to more sophisticated 'optical flow' use memory space whereas the proposed code uses comparatively less memory space.

B. Involves lesser calculations

The proposed code just calculates the desired direction with respect to its current velocity by knowing the obstacle coordinates in a 2D plane.

V. APPLICATIONS

The applications of Flocking of boids can be used in

1. Controlling the behaviour of Unmanned Aerial Vehicles (UAVs).
2. Visualizing facts and for optimization tasks.
3. It has been carried out to routinely program net multi-channel radio stations.
4. Microbots
5. Animations, Screensavers and films.
6. Flocking has been utilized in many films to generate crowds which moves greater realistically

VI. IMPLEMENTATION

Flocking behavior includes three simple steering behaviors that tells each individual boid perceives depending on the position and speed of other flockmates. The behaviors of the flocksare separation, cohesion and alignment.

A. Separation

The rule of separation confirms that each boid maintains some distance without colliding to its flock members. Crowding can be prevented by using the separation rule. A velocity parameter can be created by using the equation 1:

$$V_{si}(k+1)_{x,y,z} = \left[S * \sum_{n\in N}\left(\frac{1}{Dx_{i,n}(k)}, \frac{1}{Dy_{i,n}(k)}, \frac{1}{Dz_{i,n}(k)}\right)\right] \quad \text{---------- (1)}$$

Where:

$V_{si}(k+1) \rightarrow$ The velocity of the present boid.

$N \rightarrow$ Total no. of boids within flock.

$Dx_{i,n}(k) = P_{ix}(k) - P_{nx}(k)$ The range of boid in x-axis.

$Dy_{i,n}(k) = P_{iy}(k) - P_{ny}(k)$ The range of boid in y-axis.

$Dz_{i,n}(k) = P_{iz}(k) - P_{nz}(k)$ The rangeof boid in z direction.

$P_i(k) \neq Pn(k)\ \forall n \in N$

$P_i(k) \rightarrow$ Current boids position

$P_n(k) \rightarrow$ The neighbour's position from the set-N.

$S \rightarrow$ Strength of separation

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B. *Cohesion*

By this rule every boid guides to maintain average position to its neighbours and maintains as group without breaking away.Cohesion can be calculated by (2).

$$V_{ci}(k+1) = \left[c * \left(\frac{\sum_{n\in N} P_n(k)}{N}\right) - P_i(k)\right] \quad \text{------ (2)}$$

Where:
$V_{ci}(k+1)$ →Current boid's cohesion velocity
$P_i(k) \rightarrow [P_{ix}(k), P_{iy}(k), P_{iz}(k)]$Current boid's position
$P_n(k) \rightarrow [P_{nx}(k), P_{ny}(k), P_{nz}(k)]$ Neighbour's positionfrom set-N
$c \rightarrow$ Strength of cohesion

C. *Alignment*

Alignmentmake sure that every boid contest with velocity of itsneighbours. Flock can move thoroughly in a same direction by using Alignment. An alignment velocity can be calculatedby using equation (3)

$$V_{ai}(k+1) = \left[a * \left(\frac{\sum_{n\in N} V_n(k)}{N}\right)\right] \quad \text{---------- (3)}$$

Where:

$V_{ai}(k+1) \rightarrow$ Velocity of the present boid.
$V_n(k) \rightarrow$ Velocity of its neighbour boid from the Set-N.
$a \rightarrow$ Strength of alignment.

D. *Target seeking*

The rule permits every boid directs to move regardingparticular target within area.Flock can move thoroughly towards common goal. Target velocity can be calculated by using equation (4)

$$V_{ti}(k+1) = [t * (P_T - P_i(k))] \quad \text{------ (4)}$$

Where:
$V_{ti}(k+1)$ →Targeting velocity of the present boid.
$P_i(k) \rightarrow [P_{ix}(k), P_{iy}(k), P_{iz}(k)]$ Present boid position.
$P_T \rightarrow [P_{Tx}, P_{Ty}, P_{Tz}]$ Targets Position
$t \rightarrow$ Strength of the target

E. *Obstacle avoidance*

This behavior of the flock enables boids to effectively avoid the obstacle. The proposed minor change in the traditional algorithm is that here with the known obstacle position, its radius of existence and the boids velocity we can calculate the desired direction i.e., velocity to avoid the obstacle. Like the traditional behavior this does not use any matrices to store the coordinates of the boids vision. Here proposed change is to just deflect the boids from the obstacle to a certain degree with respect to the obstacle existence radius.

The description of the proposed change is as follows:

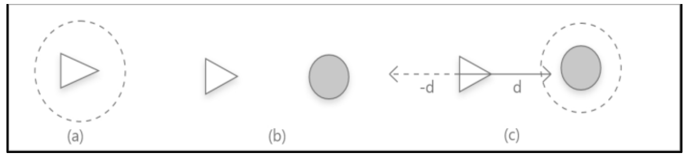
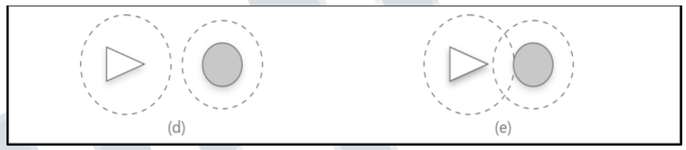


Fig (a) shows the boids perception region
Fig(b) represents the obstacle and the boid
Fig (c) depicts boids velocity(d) and buffer zone within which the obstacle exists



Fig(d) boids move towards the obstacle
Fig (e) obstacle detection

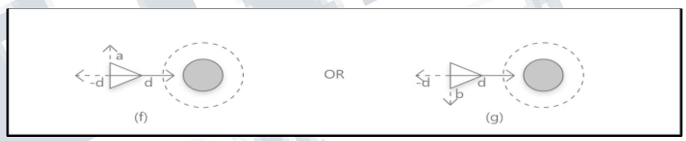


Fig (f) and (g) represent the calculation of the random perpendicular vectors to the boids velocity

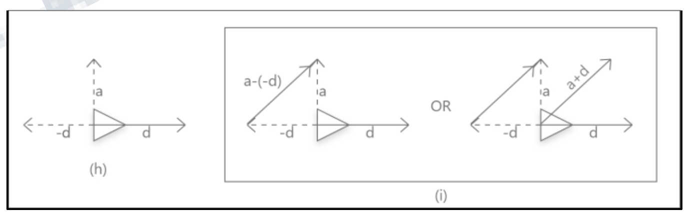


Fig (h) and (i) depict the calculation of the desired velocity to avoid the obstacle

Proposed change:

1. Detect the obstacle before collision
2. Calculate the inverted velocity of the boid i.e., (-d)
3. Calculate the random perpendicular vectors to the boids velocity
4. Add the boids inverted velocity with the resultant velocity from step 4
5. Resultant velocity from step 4 is the desired velocity to avoid the obstacle
6. Velocity from step 6 is passed as the current

velocity of the boid

7. Boid avoids the obstacle

VII.EXPERIMENTAL RESULTS

Results obtained by simulating the above flocking rules.

Fig (1)Boid approaching towards target

Fig (2)At the time of colliding with obstacle

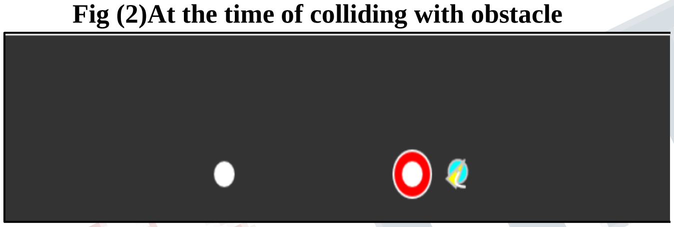


Fig (3) Moving away from obstacle before colliding

Fig (4) Turned and Changed its direction

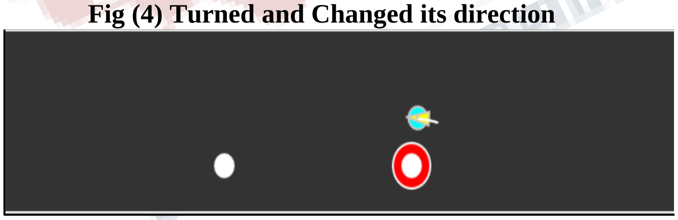


Fig (5) In motion towards the goal

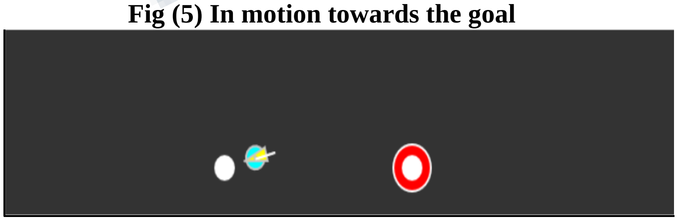


Fig (6) Ultimately reached its target

As we can see in Experimental Results:

1. In these figures we get to know a boids travel its path to reach its target.
2. The figures explain how the boids travelling towards the target.
3. Whenever any obstacles happen to appear between path the boids tend to take turn in a direction when minimal space is provided to reach the target.

CONCLUSION

The paper defines the “autonomous character” in phrases of autonomous agents and spontaneitymovement. Also, it gives the decomposition of the challenge of developing the motion behaviors for self-reliant characters into 3-stage order of movement selection, steering, locomotion.Further implementation method of the locomotion level is represented in phrases of a “Aquarium Simulation”then moving on to the steering behaviors which also includes the arrival of the object and it’s obstacle avoidance, path following, flow field following,non-aligned collision avoidance, separation, alignment, cohesion, andfollowingthe leader.Thereby, the flock simulation is achieved by the distance perception of an obstacle with the help of the preceding basic behavior, with respect to the behavior which tries to turn away from the path it follows. This project can be further enhanced in multiple ways and the overview of it is mentioned.

FUTURE SCOPE

1. Genetic algorithms can be embedded with the obstacle avoidance behavior to train the model and can be compared with the traditional behavior of the flock.
2. Quadtree optimization can be used to enhance the functions of the flock environment.
3. Training the ML model such that it selects the algorithm that best suits the flocking environment with obstacle avoidance.
4. Greater the distance between the boid and target, greater should be the velocity after a slight deflection from the original path when boid encounters the obstacle.

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