More Realistic Simulation of Pedestrian based on Cellular Automata

Shao Pengyuan
Department of Information Science and Technology
Xiamen University
Contact − email : barretshao@gmail.com

Long Abstract: The Simulation of pedestrian has been studied for a long time from various points, however, most of them have not considered the psychological factors of pedestrians. In the beginning, we develop the fundamental model of pedestrian by Cellular Automata. We assume that there is a limited space for a certain number pedestrians to move. Assume that the space of simulation is $Width \times Width$,and we use the set$\{i, j | 0 \leq i, j \leq Width\}$ to represent the location of cells. t represents the time point. There are four situation types of cells and we use *situation* to represent them.

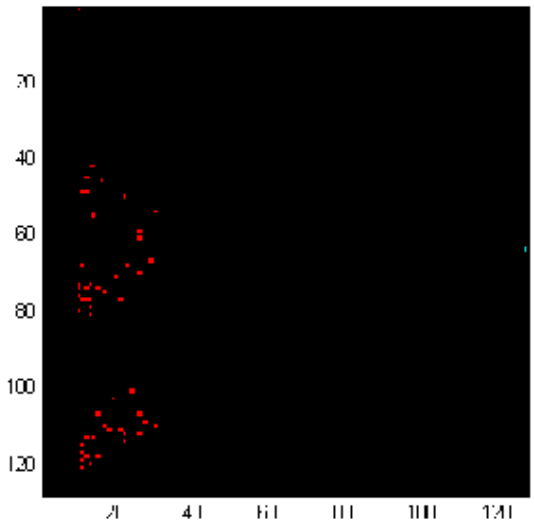
$$situation \in \{Object, Available, Decision, Held\}$$

Object refers to that this cell is held by the objects which could not be gone through, such as barrier and shop; *Available* refers to that this cell is available to get across; Decision refers to that this cell will be held by pedestrians next time; $Held$ refers to that this cell is held by one pedestrian. And we use the initial letter s to refer to "*situation*". Then we could find the cell representation is that $A\{i, j, s, t\}$.We can simulate the pedestrian walking by signs as follows:

$$S = \{k, x_k, y_k, x_k^*, y_k^*, next(k)\}$$

$$next(k) = \{up(k), down(k), left(k), right(k)\}$$

The result of this simulation would be like this graph, which the red points represent pedestrians and blue point represent destination of them:



From this cellular automata model and based on the Bresenham's Algorithm for Circles to find the next step for pedestrian.

However, it is obvious that this simulation of pedestrians is still idealistic and can not be applied to the reality. To solve this problem, this paper proposed two innovative changes on the former simulation. Frist every pedestrian in this model will have a personal space which varies from the distance of next pedestrians. This personal space will eusure more realistic of this simulation.

Moreover, when decide the next step of pedestrian cellular automata, we will embed Neural Network into every automata. The prior knowledge of neural network is based on the particular survey and research in reality. And then these pedestrians can decide the next step based on the neural network. This method can apply simulation into different topographies, such as mountain, marsh and so on. If we have enough learning knowledge ,which covers these topographies, for these pedestrians, we can achieve this more realistic simulation.Though the neural network, we let these agents to be more intelligent and human-being like. We embed these features into the Cellular Automata Agents and find the clustering effect.

This more realistic simulation can apply to assist the building of emergency exit, business strategy, and even the war simulation in the severe environment.

Key Words: Cellular Automata, Neural Network, Personal Space, Simulation