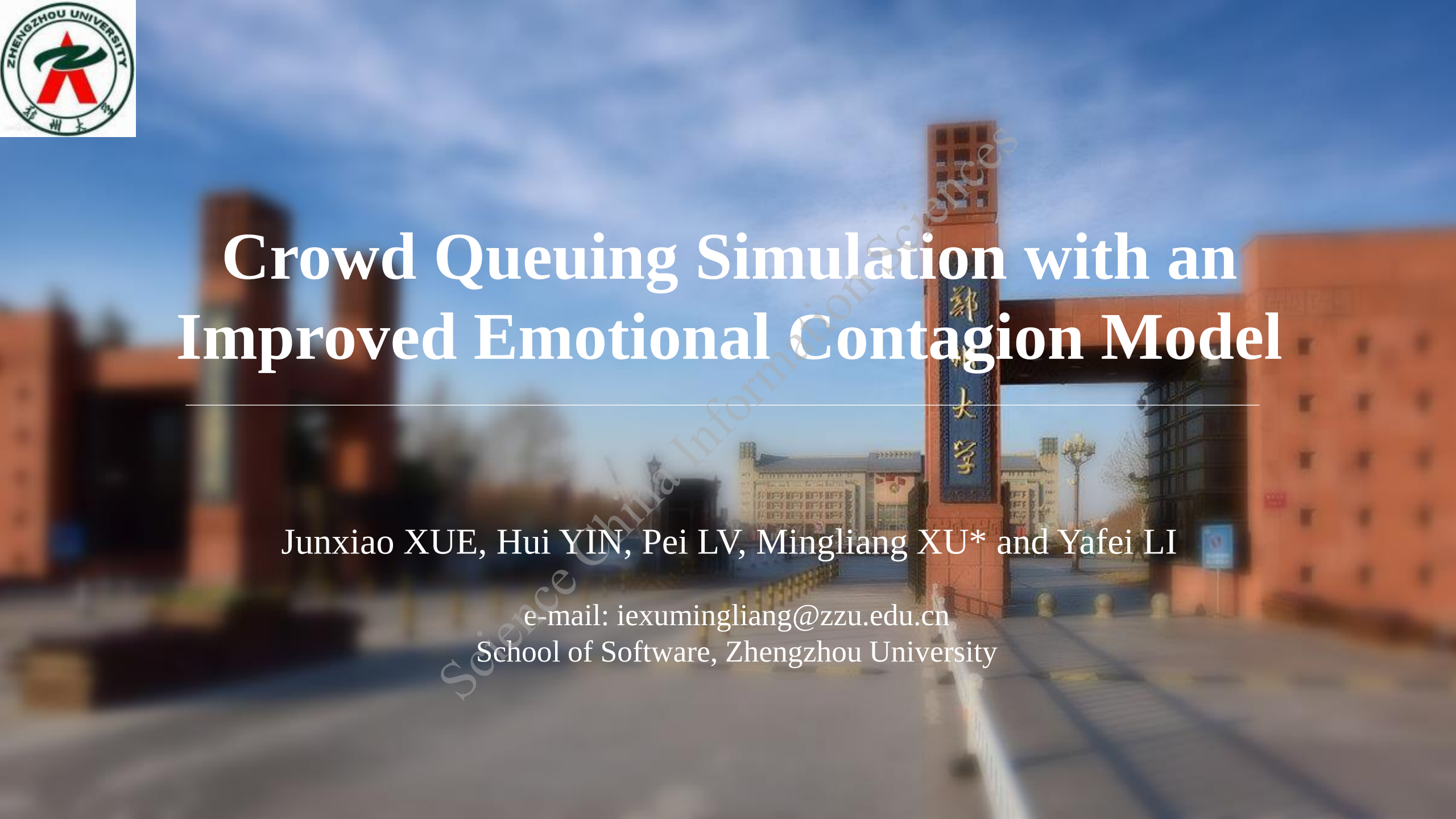


Crowd Queuing Simulation with an Improved Emotional Contagion Model

Junxiao XUE, Hui YIN, Pei LV, Mingliang XU* and Yafei LI

e-mail: iexumingliang@zzu.edu.cn
School of Software, Zhengzhou University

CONTENTS

Intro-
duction

Status
Analysis

Research
process

Summary
and
prospects

INTRO-DUCTION

Part One

Background

Extensive

Queuing is everywhere. And everyone's state is different.

Serious

When people are out of control, there is a serious crowd accident.

Little

At present, there are few studies on queuing events in simulated crowd.

INTRODUCTION

Research meaning

02

Our research can combine computer vision techniques and an efficient method of crowd aggregation computation in public areas to prevent crowd confusion.

01

We hope that our emotional contagion model can provide important help for crowd emotion simulation.

Status Analysis

Part Two

Traditional crowd simulation models

At present, many different kinds of models have been proposed: cellular automatons, social forces.

	Motion	Obstacle avoidance	Individual variable
Cellular automatons	Direction	Rule	0 or 1
Social forces	Speed	Force	Freely

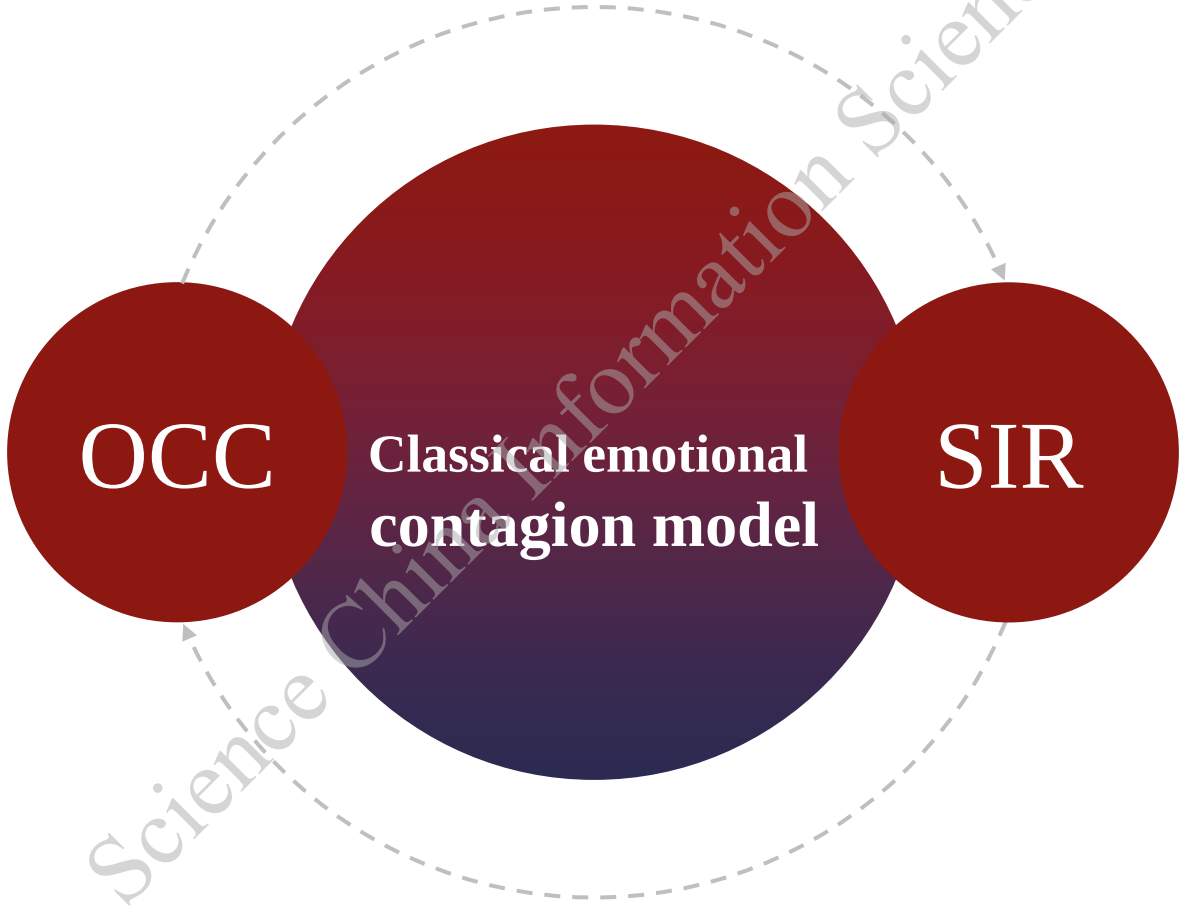
Status Analysis

Principle mechanism

Individuals recognize and evaluate the outside world.

Three components

Event, subject and object



Principle mechanism

It is used in the spread of disease.

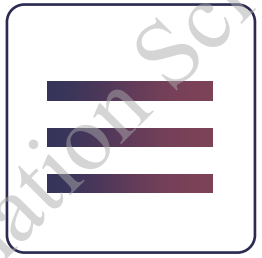
Three states

susceptible, infected and recovered.

Crowd simulation with emotional contagion

Behavior

Focus on the simulation of behavior, lack of emotional impact on behavior.



Emotion

Emotional parameters are not enough.

Process

Emotions and behaviors should be continuously interacted.

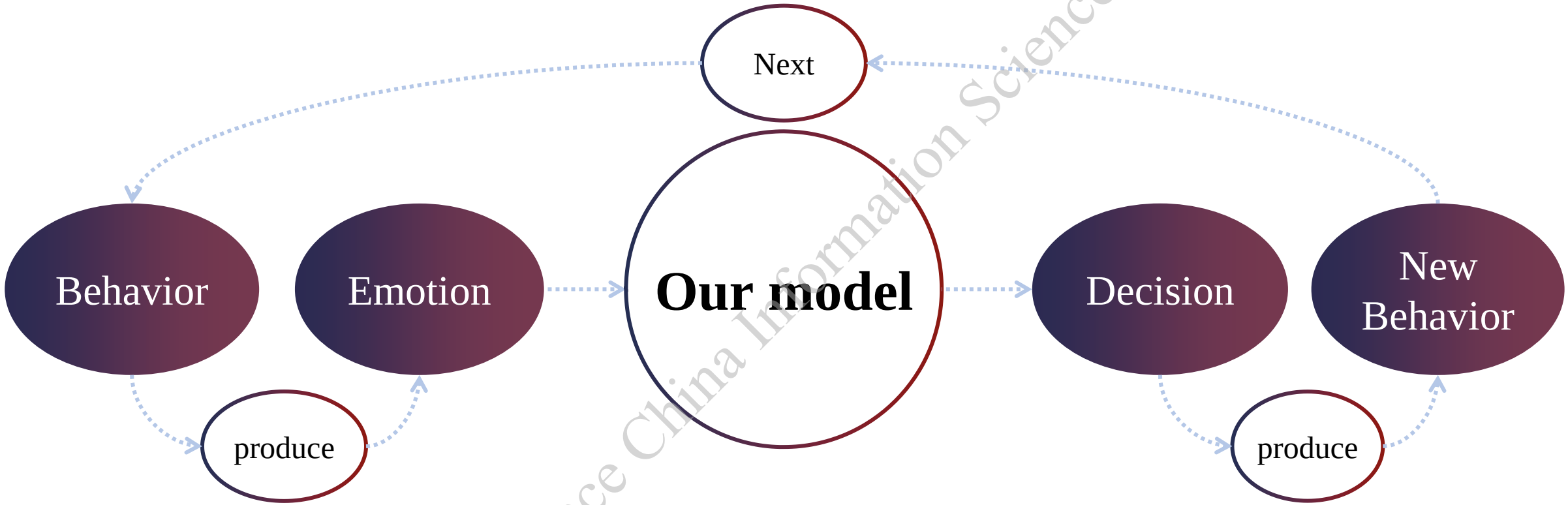
Personality

Personality is an important factor affecting individual behavior.

RESEARCH PROCESS

Part Three

Research Process



The relationship between behavior, decision making and emotion.

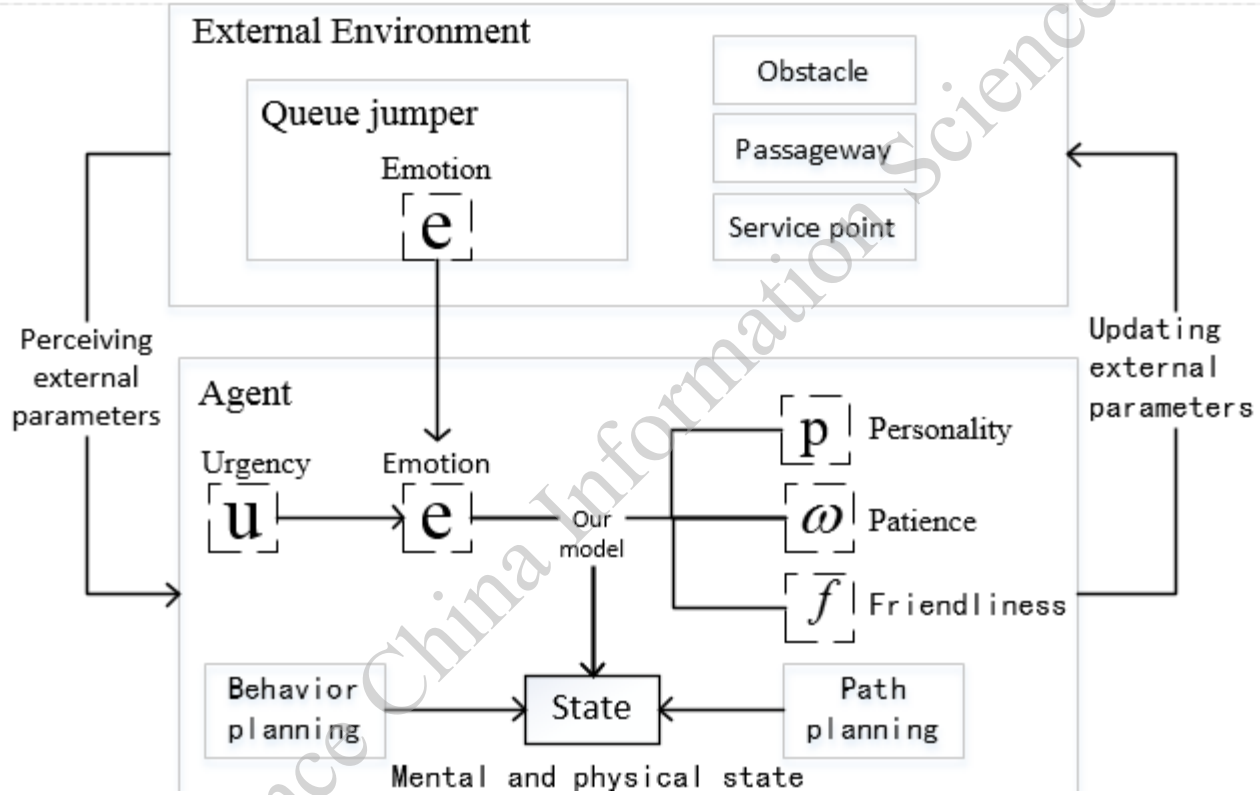
Research Process

Personality

patience, urgency, and friendliness.

Hooke's law

It is used to calculate the weakening process of individual negative emotion.



Our model

SIR

We improved the SIR model.

Five scenes

ATM, subway stations, bus stations, indoor service windows, and outdoor service windows.

Research Process

Urgency (u_i):

$$e_u(i,t) = e_u(i,t-1) + u_i t^{\partial}$$

i : Agent
e_u: The negative emotional value that increased by u_i .
t : Time.
∂ : The time index.

Research Process

SIR:

$$D_{ji} = [1 - \frac{1}{(1+\exp(-L))}] \times E_i \times A_{ji} \times B_{ij}$$

D_{ji}: The effect of the queue jumper j on the individual i.
L : The distance between individual i and individual j .
E_i : The intensity of the emotional contagion of i.
A_{ji}: The emotional intensity of the queue jumper j on the queuer i.
B_{ij}: The emotional intensity of the queuer i on the queue jumper j.

Negative emotional value( ): e_{neg}

$$e_{neg}(i,t) = e_u(i,t) + \sum_{j=1}^{K} D_{ji}$$

K: The number of jumpers within the range of perception.

Research Process

The negative emotional burst probability(p):

$$p=\begin{cases}1-e^{-\tau u_i \Delta t}, & \Delta t <= \omega_i \\ 1, & \Delta t > \omega_i\end{cases}$$

Δt: The waiting time.

ω_i: Patience.

Research Process

The weak of negative emotional values:

$$e_{neg}(i,t) = -kl$$

k : The coefficient of negative emotional value changed.
l : The individual walking distance.

Research Process

ATM	One-to-one service queuing scenes.
Subway	Many-to-many service queuing scenes.
Bus station	One of the most common queuing scenes.
Indoor service window with fences	The fences affects crowd movement.
Outdoor service window without fences	There are no fences that affects crowd movement.



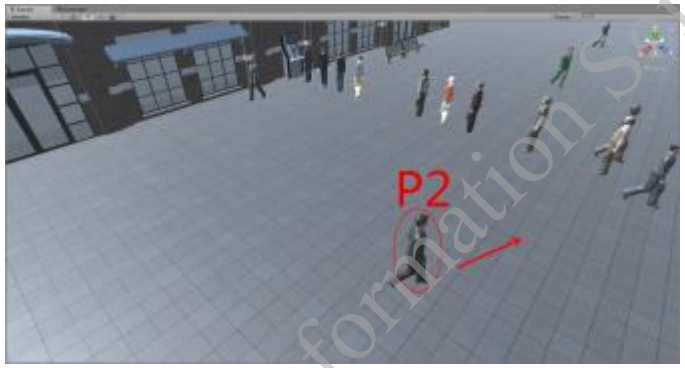


Research Process

ATM:

The initial movement state

The individual P1 is about to jump the queue. The initial movement direction of the individual P2 is shown by the red arrow.



Under the traditional emotional contagion model

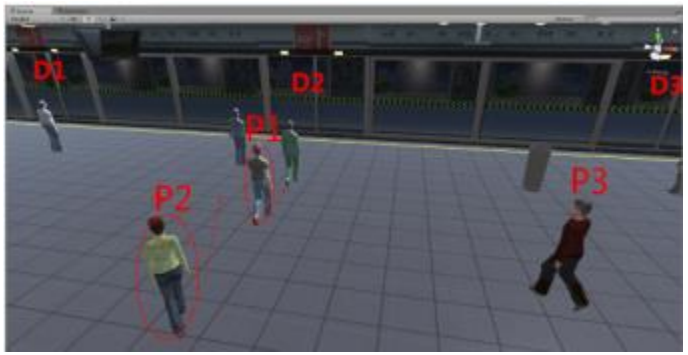
The agent P2 does not change the direction of the walk after the queue jumper P1 completes the movement of jumping the queue.

Under the new emotional contagion model

The agent P2 changes the walking direction and moves in front of the queue.

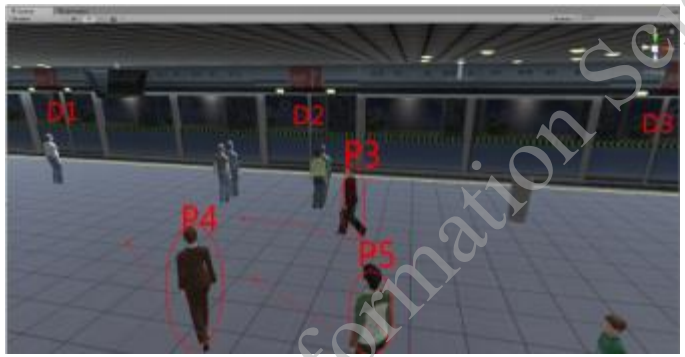
Research Process

Subway:



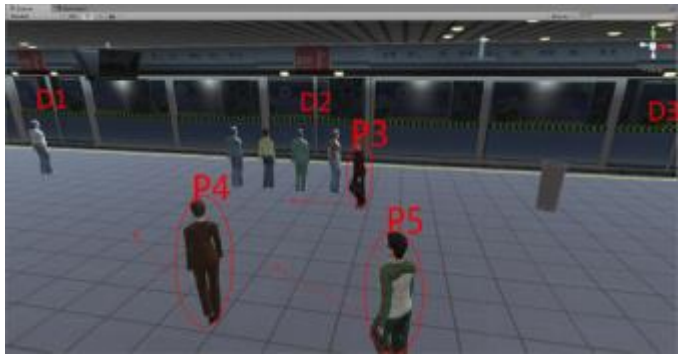
The initial movement state

There are 3 subway doors: D1, D2 and D3. The individuals P1, P2 and P3 search for the least number of crowd in the three waiting areas to move.



Under the traditional emotional contagion model

They form the left and right queues normally in D2. When the number of crowd in D2 increases, other people move to area D1.



Under the new emotional contagion model

The four queues are formed at D2. Other people approaches D1, because of the small number of D1.

Indoor service window with fences:

1s

10s

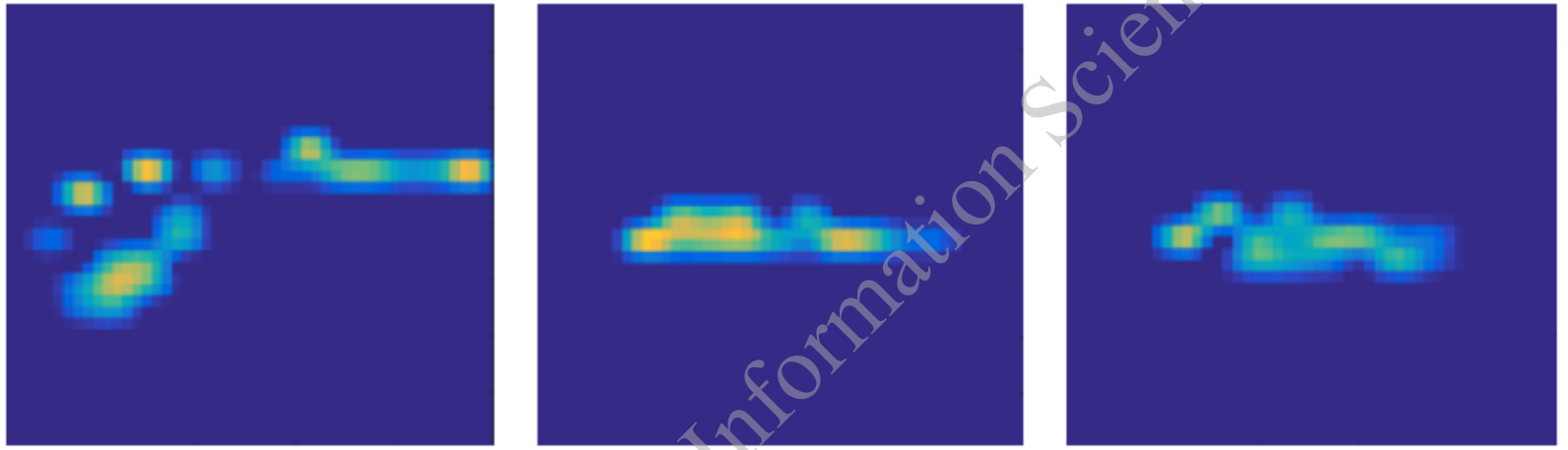
20s

1s

10s

20s

Research Process



a. 1s b. 10s c. 20s

The heat-map of emotional value. the positive and negative emotions are scattered in the initial state. At the 10th second, positive emotions turn into negative emotions at the end of the queue. At the 20th second, due to the role of the administrator, the crowd behind the queue form a new queue. Finally, the positive and negative emotions reach a relatively stable state.

Outdoor service window without fences:

1s

10s

20s

1s

10s

20s

Research Process

a. 1s　　b. 10s　　c. 20s

After 10 seconds, the negative emotions at the end of the queue increase, and the emotional values of the crowd who don't reach the tail of the queue have no change much. At the 20th second, due to the absence of administrators and the fence in the scene, individuals with outburst emotions jump in front of the queue, he emotional values of individuals in front of the queue generally increase, and individuals with negative emotions increased.

SUMMARY and PROSPECTS

Part Four

Summary of prospects

We plan to increase the role of the administrator. Simulate the movement trend of the crowd by controlling the distribution and number of the administrators.

THANK YOU