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Design of Four or Five Scene Transition in a Pupil Type Scenario Structure and Scenario Change by Some Triggers

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ABSTRACT
This paper presents first 4 scenes transition in a scenario by robot using terms of robotics and play in theater. The prologue, monologue, climax and epilogue which are 4 scenes in play were explained briefly. For shown the example of some scenarios combination, 4 scenarios and the construction of a mobile robot in a virtual town with 3*3 road were shown. Then, it was modified as pupil type double circulation structure. Software construction for realizing by a robot was shown staring from external and internal triggers to select and change of rules for robot action. The external triggers were classified to variable and fixed, irregular and regular elements. Finally, 2 kinds of color LED arrangements were shown with a smile face mark in illustration of virtual town. Scenario arm robot was introduced for comparison with mobile robots as another example.
Keywords-Arm Robot, Mobile Robot, Scenario, Scene, Trigger,

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I. INTRODUCTION

There are various methods of rule base, case base, petri-net base and scenario base, etc. for solving methodsof many problems by an agent. As for the scenario base [1-3], some important keywords (scene [4], single-agent, multi-agent, trigger, actor [4], emergence) had been talked, the introduction case is few though the prospect is high, and the definition is also fuzzy in these base methods.

This paper presents four or five scenario transition and pupil type scenario structure.

Proposal of some triggers contained internal triggers for changing the scenario and transition the scene, and classification of the triggers are tried aiming at structuring and systematization of the scenario by a scenario-robot.

II. STRUCTURE AND EXAMPLE OF SCENARIO ROBOT

The general definition of scenario is as follows.

Definition 1: general scenario

Scenario is a literature working being image a priori.

Necessary things are environment, actors or/and actresses, scenes and expression targets

Definition 2: this study's scenario

Scenario is reams of scenes to achieve expression target by interaction between behavior of environment and agents.

Definition 3: triggers

Triggers are things or events to become chance of the action in order to progress the scenario.

2.1 Four Scene Transition of Scenario by play terms and robot terms

Scenes are images visualized in scenario. There are some formatting three or four scene transition in various scenarios. For examples, three-stage composition of introduction, main subject and conclusion is simple in the report and paper. etc. However, there are many cases where there are four stages including discussion.

In plays performed in theaters there are cases where four scene configurations are used.

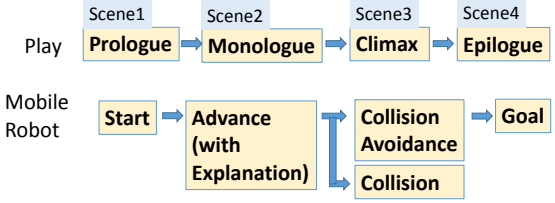


Fig.1 4 scene transition of a scenario by play terms and robot terms

Table 1 shows explanations of 4 scenes of a play in a theater.Here, a monologue that is not in the three-stage configuration scenario is an explanatory function and is important for the evolution and intelligence of the scenario robot.

Table 1 Explanations of 4 scenes of a play in theater

A **prologue** is an opening story that establishes the context and gives background details.	A **monologue** is a speech presented by a single character most often to express their mental thoughts.
A **climax** is the tide of the story, the exiting part. Often there are dialogue, communication, conversation.	A **epilogue** is the part of the ending drawn from the viewpoint of the story to complete the story in ordinary literary works, movies, dramas, etc.

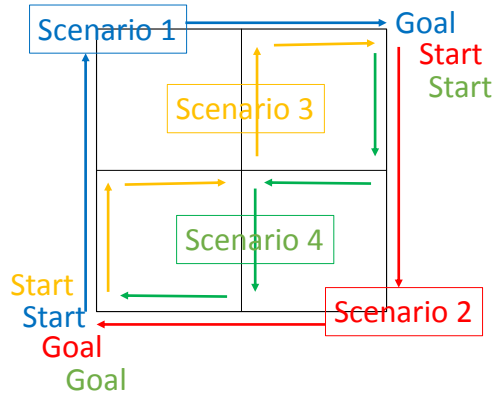
2.2 Structure of Scenarios

In a small virtual town of 3 * 3, there are various things such as a hierarchicaltype, a divergence type and a circulation type as a structure of a compound scenario in which a plurality of scenarios from a start to a goal of a mobile robot are combined.

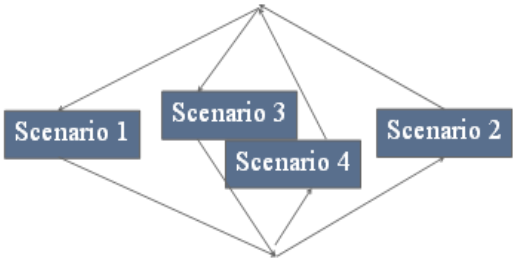
An example of double circulation 4 compound scenario was shown in Fig.3(a) with flow arcs.

Moreover, rewriting the compound scenario, the pupil type scenario structure figure was obtained as shown in Fig.3 (b).

Other structure's figures were omitted.



(a) An example of double circulation scenario



(b) A pupil type scenario structure

Fig.2 An example of double circulation scenario and the pupil type scenario structure

The structuring of such a complex scenario is thought to be useful for supplementing the lacking scenario and deploying it to a new structure.

III. SOME TRIGGERS

3.1 External and Internal Triggers

Triggers for scenario change and rule select and change have external and internal as shown in Fig.3.

External triggers come from environment of the agent, for example, corner or T-way, internal triggers come from internal of the agent, for example, emotional or emotional storage [5-6] etc..

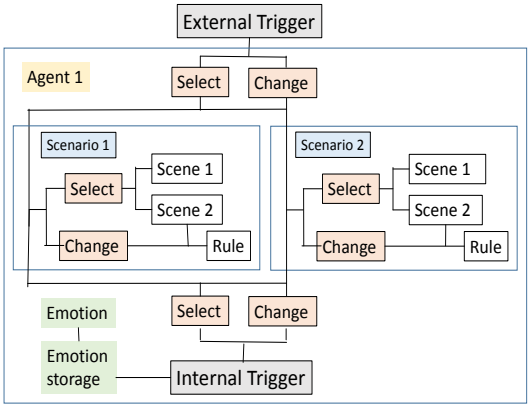


Fig. 3 Design of select and change scenario and scenes by external and internal triggersin a scenario agent

Table 1 shows types of some external triggers for changing scenes in a scenario or selecting the following scenario. The terms in column are irregular or regular encountered by the agents and the terms in rows are variable or constant values.

An explanation is described inside the intersecting matrix

Table 1 Types of Some External Triggers

	Variable trigger value	Constant trigger value
Irregular Encounter	**Emergent trigger** **Influence : Emergence of scenario** **Examples : Signal • Rail road crossing • Opposing vehicle**	**Land-mark trigger** **Influence : Useful for self-location recognition** **Examples : Building • Intersection • Dead end • Shop • Entrance of subway**
Regular Encounter	**Regular variable trigger** **Influence : Diversification of Scenario** **Examples : Starting command • Arrival command**	**Time-mark trigger** **Influence : Useful for current time recognition** **Examples : An alarm • Start and end signal**

From this table, it can be seen that not only the trigger's purpose and movement change depending on the type of trigger, but also the scenario is greatly affected.

Fig. 4 shows two examples of some triggers by color LEDs in T-way or corners and a smile face mark as an agent in illustrations.

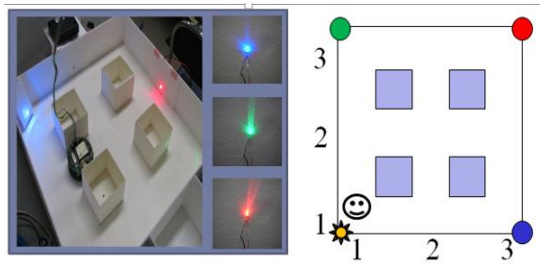


Fig. 4 Examples of some triggers by color LEDs in corners or T- road and a smile face mark

The smile face mark means that the mobile robot has not routine behaviors but unpredictable behaviors like a human by interaction between various triggers in the world corners and the position of the robot.

3.2 Designof pupil type scenario structure without color sensor on the agent

Here, let referring the specification of old small Khepera as shown in Table 2.

Table 2 The hardware main profile of Khepera

Processor	Motorola68311（16[MHz]，32bit）
RAM	256[Kbytes]
ROM	512[Kbytes]
Motion	2 DC motors with incremental encoder （about 10 pulses per mm advancement）
Maximal speed	60[cm/s]
Sensors	8 Infra-red proximity sensors （measurable distance：0-1023 level） （measurable brightness：0-511 level）
Size	Diameter：55[mm]，Height：30[mm]
Weight	About 70[g]

There are especially 8 intra-red proximity and ambient light sensors with measureable brightness 0-511 level around 5.5 cm diameter round robot.

If you make it dark like Fig.4, the agent in one corner can recognize the light of the opposite corner.

The instinctive emotional behavior assumption is that the brighter one is comfortable and the agent heads for a comfortable direction [5].

The agent does not have to be able to distinguish colors and only needs to identify ON/OFF of brightness. Table 3 shows examples of LED control like SFC description.

Table 3 Examples of LED Control under instinct emotional behavior assumption

Process	Scnr1	Scnr2	Scnr3	Scnr4
Start	(1,1) Green On Others Off	(3,3) Blue On Others Off	(1,1) Green On Others Off	(3,3) Blue On Others Off
Turn1	(1,3) Red On Others Off	(3,1) Yellow On Others Off	(1,2) Green Off Red and Blue On	(3,2) Blue Off Green and Yellow On
Turn2	--	--	(2,2) Blue Off Green and Red On	(2,2) Green Off Blue and Yellow On
Turn3	--	--	(2,3) Green Off	(2,1) Blue Off
Goal	(3,3) All off	(1,1) All off	(3,3) All off	(1,1) All off

If you arrange the four LEDs to T-way placement instead of the corner placement, you can make them easier and more reliable.

3.3 Design of pupil type scenario structure with color sensor on the agent

Recently, sensors capable of identifying a fairly large number of colors by CRGB (clear, red, green, blue) decomposition are commercially available (TAOS:TCS34725). The performance of the color sensor was confirmed by installed in a Raspberry Pi Mouse for detecting the goal with the color wall.

If you arrange the four LEDs to T-way placement instead of the corner placement in this case,it is not necessary to control the ON/OFF of the LED, it is only necessary for the agent to learn the order of colors of LEDs to be headed and the direction of turn after his arrival to the LEDs for each scenario.

Even if an old robot can not attach a color sensor, it will be possible to attach a mark that expresses colors by way of communication.

When LEDs can be distinguished, LED control becomes unnecessary, and it is only necessary to store the color sequence for each scenario and act.

Table 4 shows examples of color number sequence for scenarios and scenes. The agent had better to explain through, turn or avoid the color LED in monologue. Climax is avoid the wall with the color LED.

Table 4 Examples of color number sequence for scenarios and scenes

Scene	Scnr1	Scnr2	Scnr3	Scnr4
Opening	Start from 11	Start from 33	Start from 11	Start from 33
Mono1	Through 12	Through 32	Turn 12 to the right	Turn 32 to the right
Mono2 Climax1	Avoid13 to the right	Avoid31 to the right	Turn 22 to the left	Turn 22 to the left
Mono3 Climax2	Through 23	Through 21	Avoid 23 to the right	Avoid 21 to the right
Ending	Goal to 33	Goal to 11	Goal to 33	Goal to 11

Scnr : Scenario,
Mono: Monologue, explanation of robot behavior
"start", "advance", "turn to the right", "goal", etc.
ij: i is column number and j is row number of 3*3 road of virtual town

IV. DESIGN FOR 5MEMBER OF AGENTS

Let us consider the case that there are 5 member (5M) of agents as shown in Fig.5. For avoidance of dynamical obstacles each other, some rules are needed for safety.

However, for simplicity, we have not given a purpose or mission to each agent yet.

For example,

1) The agent should not turn in the direction of a dynamic obstacle approaching the T-way.
2) It is better for every agent to proceed by turning in the direction of a dynamic obstacle moving away from the T-way.
3) Install a signal on the T-way, stop the agent approaching there on the temporary stop line, and perform collision avoidance control by encounter.

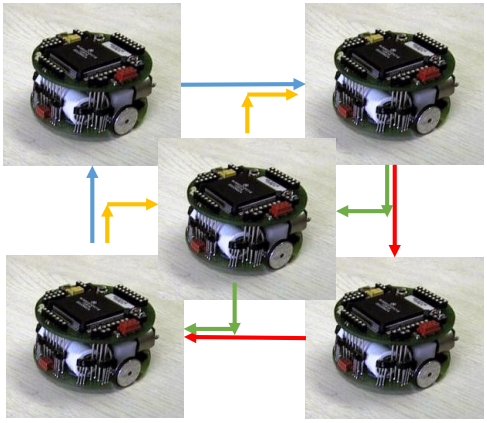


Fig. 5 In the case of 5 member (5M) of agents

Table 5 shows an example of signal control for avoiding dynamic obstacles like a cellular automaton at T or L-way. It is omitted for other T-way.

Table 5 Examples of signal control for dynamic avoidance of collision at T or L- way

TorL-way invasion	Advance Permission Condition	Right Turn Permission Condition	Left Turn Permission Condition
(1,1) ->(1,2)	There is no one in {(1,2)(1,3) } Signal 12 ON	There is no one in {(1,2)(2,2)} Signal 12 Slow Blink	×
(2,2) ->(1,2)	×	There is no one in {(1,2)(1,3) Signal 12 Fast Blink	×
(1,3) ->(1,2)	×	×	There is no one in {(1,2)(2,2) } Signal 12 Slow Blink
(1,2) ->(1,3)	×	There is no one in {(1,3)(2,3)} Signal 13 ON	×

Table 6 shows an example of signal control foravoiding dynamic obstacles like a cellular automaton at center cross-way in scenario 3 and 4.

Table 6 Examples of signal control for dynamic avoidance of collision at center cross-way

Center cross way invasion	Advance Permission Condition	Right Turn Permission Condition	Left Turn Permission Condition
(3,2) ->(2,2)	There is no one in {(2,2)(1,2)} Signal 22R ON	There is no one in {(2,2)(2,3)} Signal 22RFast Blink	There is no one in {(2,2)(2,1)} Signal 22R Slow Blink
(1,2) ->(2,2)	There is no one in {(2,2)(3,2)} Signal 22L ON×	There is no one in {(2,2)(2,1) Signal 22L Fast Blink	There is no one in {(2,2)(2,3)} Signal 22R Slow Blink

Dead lock: when facing each other at the cross-way
Avoidance: left turn each other like scenario 3,4 under both permission signals with a time difference

V. IN THE CASE OF ARM ROBOT

To explain the operation of this arm robot using the terms of the scenario robot, the first scenario is to move from the starting point and the shape there (Fig. 6 [7]) to the target point and the shape there. The external trigger for the transition to the climax scene in the meantime is the approach to the pile. By this trigger, the rule of the forward scene is changed to the rule of collision avoidance. With the goal reach trigger, the first scenario will transition to the next scenario in order to return from the goal to the starting point.

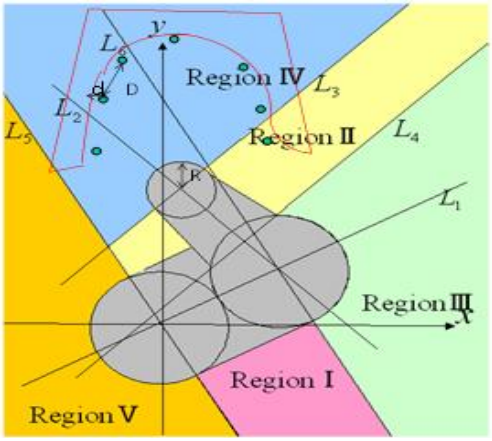


Fig. 6 Start point and figure of an arm robot and an obstacle

Then, a trigger for scenario change is necessary. Scenario robotics is useful for the action program design of the robot like this.

A scenario can be regarded as consisting of four scene transitions using a theatrical vocabulary. The start of robot action is prologue, the action to avoid collision by approaching virtual obstacle with virtual stake is climax, it is epilogue to adjust the target posture by reaching the target. The transition from the forward action to the reverse action at a breakpoint between them is equivalent to a monologue that needs to explain the situation.

Here, there is a repeated circulation scenes in a pupil type scenario structure in the arm robot as shown in Fig.7, too.

If you can not avoid a stake successfully with a left-handed climax, you may be able to bypass the clockwise climax or try again to make it a pupil type double circulation construction after tuning the combination of joint angles even if it is on the way of automation and if it breaks the automation.

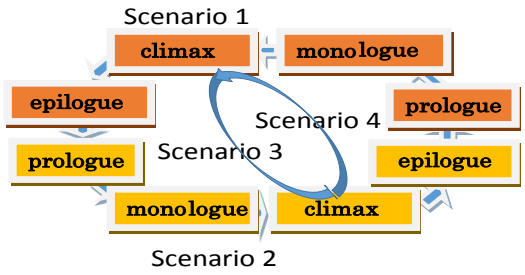


Fig. 7 A repeated circulation scenes in a pupil type scenario structure

Scenario1: Move from left to right
Scenario 2: Move from right to left
Scenario 3: Go back to left from the obstacle slightly
Scenario 4: Go back to right from the obstacle slightly

Inner rule triggers for scenario change 1) Alarm too close to obstruction (1->3, 2->4)2) Repeat times of backtracking due to obstacle avoidance failure and retrying in another course (1->3->4->3->4->3->2)
Automatic 2 scenario structure after tuning Scenario 1-> Scenario 2 -> Scenario 1-> ….

VI. DISCUSSION AND CONSIDERATIONS

If triggers can change the choices of many scenarios, the movement of the agent as a whole scenario becomes complicated and the agent looks smart from the viewer. Conversely, if the agent succeeds in avoiding difficult obstacles and the scenario options become smaller, the whole scenario becomes simpler and the agent becomes an automated robot without looking smarter.

According to research on emotional expression of mobile robot, like the opera, music expresses joy at the time of successful collision avoidance in the climax scene, expressing anger and sadness at the time of a collision, so that distinguished between these situations [8].

When emotional memory [5] is an internal trigger, its memory is often a driving behavior. In order to monitor the ejection of action memory contents by accumulation of other external stimulus and guide it to action, it is necessary to provide a virtual manager of memory inside the agent.

If the 4M problem mission that was initially placed in the home position of the four corners is to go through the three home positions of other agents and return to their home position, they will not collide with each other in the scenario 1 and scenario 2, they can accomplish their mission.

Whether or not the similar mission of 5M problem can be reachable to goal by signal control in text is a future task.

VII. CONCLUSION

In this paper, it was considered that one scenario was caused with four or five scene transitions for one agent by some triggers, and furthermore, by selecting and changing several scenarios by triggers, then, a composite scenario could be created. As two examples, the behavior of a mobile robot and an arm robot with pupil type double circulation structure consisting of 4 scenarios of mobile robot and circulation structure was analyzed and compared by robot term and theatrical terminology.

Next, the mobile robot were shown by a smile face mark of illustration in the virtual town. The smile face mark means that the mobile robot has not routine (always same) behaviors but unpredictable behaviors like a human.

Finally, examples of basic rule design, LED ON / OFF control without color sensors and color LED sequence control detected by color sensor in the case of about 5 agents were shown.

In this paper, the scenario is composed of 4 scenes with theatrical terms consciously adding monologue, which was unconsciously decomposed into 3 to 4 blocks, and the scene is transited by various triggers.One scenario consists of four or five scenes that consciously added the monologue of the theater terminology, and these scenes transition by various triggers. In addition, by using triggers to select and change several different scenarios, you can make various robot actions look smart.

Future tasks are examination of evaluation method of scenario, application to other agents, planning stage design of factory automation. In addition, the introduction of artificial trigger intelligence will lead to the development of smarter scenario robots.

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