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An Immersion into a Multi-Agent Store Simulation

Philippe MATHIEU, David PANZOLI and Sébastien PICAULT

1 Introduction: an Interaction-Based Simulation

FORMAT-STORE¹ is a Serious Game (SG) in 3d designed in collaboration with the game studio Idées-3Com² and the business school ENACO³, aimed at training undergraduate students to the management of a convenience store and customer relationship. In FORMAT-STORE, the learner is immersed in a virtual replica of a store populated by artificial customers, so as to practice daily activities of a salesperson. Immersive SG raise specific issues as explained in [3]. An Interaction-Oriented approach such as IODA [2] offers a particularly convenient way to address the multiple problems of such a SG simultaneously.

Basically, the IODA approach is based upon three key ideas [2]: 1) each relevant entity should be represented by an agent, 2) each behavior should be written as an abstract interaction, which is roughly a condition/action rule that can occur between a *source* agent (which performs the interaction) and a *target* agent (which undergoes it), and 3) the simulation model is described by the assignation of interactions to source and target agent families, which is achieved inside the *interaction matrix* (cf. fig. 1). This allows for a generic (i.e. domain-independent) engine to run the simulation.

As a consequence, **all the entities in the virtual store are in fact represented by agents**. Therefore, every entity in the store (items, information signs, the checkout, etc.) is likely to play an active role in the simulation, offering an original implementation of the affordances concept [1]. Each agent will consider every interaction in

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² <http://www.idees-3com.com>

³ <http://www.enaco.fr>

decreasing priority until one is deemed realisable (e.g. the preconditions are met and the limit distance is matched). While shopping in the store, every customer seems to follow a plan. Yet, every action is independent from the following and their sequence has merely been established by selecting priorities.

Source/Target	∅	Employee	Customer	Door	Sign	Checkout	Item	Queue	Stain	Crate
Employee	Converse(0) Move(0)		StartConversation(1,0) EndConversation(1,0)				Remove(1,0) Supply(1,0) Order(1,0)		Clean(1,0)	PutAway(1,0)
Customer	Wander(0) GoTowards(1) Converse(13)	Wait(2,3)		Exit(1,12)		Pay(2,10)	Get(2,5)	StepIn(5,7) MoveOn(1,8) WalkOut(1,11)		
Door	SpawnCustomer(1)		Acknowledge(10,0)							
Sign			Acknowledge(10,0)							
Checkout			Acknowledge(10,0) Checkout(2,0)							
Item	Expire(1) MakeStain(1) SpawnCrate(1)		Acknowledge(10,0) Upset(1,0) Ack_OutOfStock(1,0)							
Queue										
Stain			Upset(1,0)							
Crate			Upset(1,0)							

Fig. 1 The interaction matrix lists the interactions between each agent family. For instance: (Upset, 1, 0) at line “Stain” and column “Customer” means that a Stain agent can perform the “Upset” interaction on a Customer agent, with priority level 1 and at distance 0 (i.e. when the customer is very close to the stain).

2 Demonstration

Game overview

FORMAT-STORE is a single-player game where the player controls a salesperson in a virtual convenience store populated with intelligent customers shopping for goods (fig. 2.a) or conversing with the player (fig. 2.b).

During a session (20 min.), the game manager, which controls the simulation, invokes new customers in the store. Each customer is assigned a profile, a shopping list (see section 2) and possibly a question. Once invoked, a customer is an entirely autonomous agent, shopping for the items on its shopping list, conversing with the player and decreasing its own satisfaction level when encountering inconveniences (out of stock items, stains in the floor, crates obstructing the aisle). Finally, when exiting from the store, the customer is destroyed by the game manager. On this occasion, its satisfaction level is collected, so that the player is evaluated with flexibility by the virtual customers themselves.

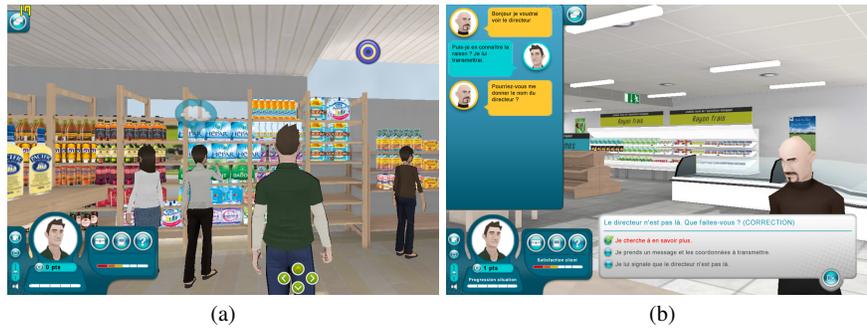


Fig. 2 (a) In FORMAT-STORE, the player controls an avatar in the virtual store using the keyboard arrows and interacts with the items and the customers using the mouse. (b) Dialogues in the game describe problematised situations and are rendered by means of a specific interface.

Mise en scène and dialogues

From a game perspective, IODA also facilitates the *mise en scène* of the simulation. In essence, several interactions can be forethought as a sequence by adjusting the preconditions. For example, when an item is taken by a customer, it can be damaged. The item is therefore likely to make a stain on the floor, that the employee must clean before other customers are upset by the stain. At the checkout, the behaviour of a customer is staged by four interactions, three of which (*StepIn*, *MoveOn* and *WalkOut*) are triggered by the checkout itself – e.g. the customer plays a passive role, being guided, moved and positioned by the checkout.

Another type of *mise en scène* involves designing more complex interactions like the dialogues in FORMAT-STORE, taking advantage of IODA's modularity. Dialogues extracted from problem situations defined by business experts from ENACO are contextualised in the game. Within the *Converse* interaction, they are interactively played in a specific interface when the player meets a virtual customer.

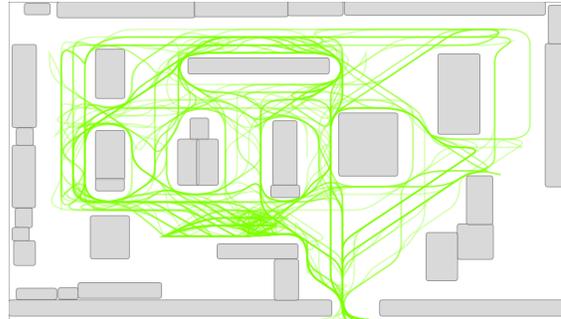
Realistic customers

In addition to the intrinsic variety offered by according visual models (fig. 2.a), customers profiles based on expert knowledge also define behavioural characteristics such as the size of the shopping list or the mood of the customer. IODA offers a mean to take them into account without impeding on the generic nature of the interactions, namely owing to a local interpretation of the primitives inside each agent. As a consequence, i) the impact will be different following the nature of the upsetting agent and; ii) the impact will be different following the mood of the *Customer* defined in the profile.

Variety is also obtained owing to the adaptive nature of the behaviours resulting from IODA's action selection mechanism. For instance, the allocation of pseudo-randomly generated shopping lists to each customer entering the virtual store guar-

antees that each customer takes a different path from each other. This is illustrated in figure 3. Besides the varied items, a path is made unique by the way customers read the information signs throughout the store to orient themselves. Although the navigation is guided by the signs, their encounterance reciprocally depends on the path taken, which turns the navigation into a highly complex and dynamic mechanism. Ultimately, the importance of the information signs can be highlighted by their removal from the environment, which causes the customers to wander aimlessly in the store, stumbling occasionally across an item in their shopping list.

Fig. 3 Recording and drawing the position of each customer during the simulation illustrates how varied routes are obtained owing to the mere attribution of different shopping lists, however relying on IODA's adaptive planning of each customer's behaviour.



Finally, the behavioural differentiation is also expressed by the adaptivity of the virtual customers towards the unpredictable behaviour of the player controlling the employee. The player is integrated in the game by means of controlling one of the agents in the simulation, following a “letterbox” principle: actions from the player are captured, sent and expressed by the agent triggering the corresponding interaction. Conversely, interactions undergone by the agent are notified to the player. As a result, actions from the player are seamlessly conveyed in the simulation, preserving the autonomy of the agents and the independence of the action selection mechanism. On the other hand, the controlled agent introduces perturbations which, combined to the behavioural adaptivity of the customers, fosters a great variety on the situations presented to the player.

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