D i n n e r T a b l e

Work in Progress Report, November 2001

Scenario

You meet a friend at your favorite restaurant for dinner and are offered the best table in the house. While you check the menus for surprises the Maître de Service appears and explains the specialties of the day.
"Hello, how are you this evening? I am happy to have you here today as my guests. I do hope you will enjoy your dinner tonight. While I am sure we have an exquisite menu to satisfy all your wishes I would like to focus your attention, for a moment, on your dinner table. This is not an ordinary dinner table but, may I say, an uninvited guest. You see, besides being well designed and functional, this table knows of your presence. The strange figures you see on the glass tabletop are characters of a game you, the players, are invited to join. As in a game of chess the different pieces have different capabilities and meaning. There is The Angry Young Man, for example. This piece is Rich Girl. The screen you see by your right will later visually elaborate on the figures as they move about. Pick a piece that appeals to you. Place your choice on the game board. The pieces will then become characters in a story that the table spins; the narrative is dependent on and informed by your choices and the events of the evening. Are you wondering how the table knows of its surroundings? Well, there are microphones integrated into the table. There is also a camera that can see the sequence of events. No, there is no misuse of information here. This is a kind form of surveillance where all information is fed back into the table. Only with your consent will any information be collected and nothing will be stored. The table can analyze the sensor information to understand to a fair degree what is going on around it. By image and speech analysis it discriminates sounds, voices and the sequence of events, unobtrusively listening in on your conversation. As a matter of fact, the table is listening right now. Depending on the tabletop figures you chose and the events occurring throughout the evening the table spins different stories. The stories are "told" by moving the figures over the storyboard to different locations with the help of a mechanical manipulator elegantly hidden under the table. The game the table lets you play is like a game of *LIFE* but different. There are some obstacles, but there is nothing to win or loose. You may see your conversation being discretely commented upon while you enjoy your dinner. Go ahead: choose your figures. Then pretend I never told you about the dinner table. You may be in for a surprise."

Two guests at an early prototype of DT

Overview

DinnerTable is both an artwork and an investigation tool. It is a table and a machine that listens in on table talk, measures and records biometric data and generates narratives in the form of an interactive game according to the events surrounding it. The table is situated in a restaurant where people meet for a fine dinner. If the guests choose to engage with the table, they can do so by picking one of four game pieces and putting it on the table. Each piece represents a character with preexisting dispositions and a background of recorded stories that condition the game to be played.

Rich Girl

Independent Operator

Angry Young Man

Working Woman

In response to the conversational flow throughout dinner, the pieces move on the tabletop, designed as a game board of urban environment, and enact a unique story that unfolds itself between the users and the table in real time. The users are players and authors at once as the table creates narratives informed by the dynamics of speech and the presence of the guests at the table.

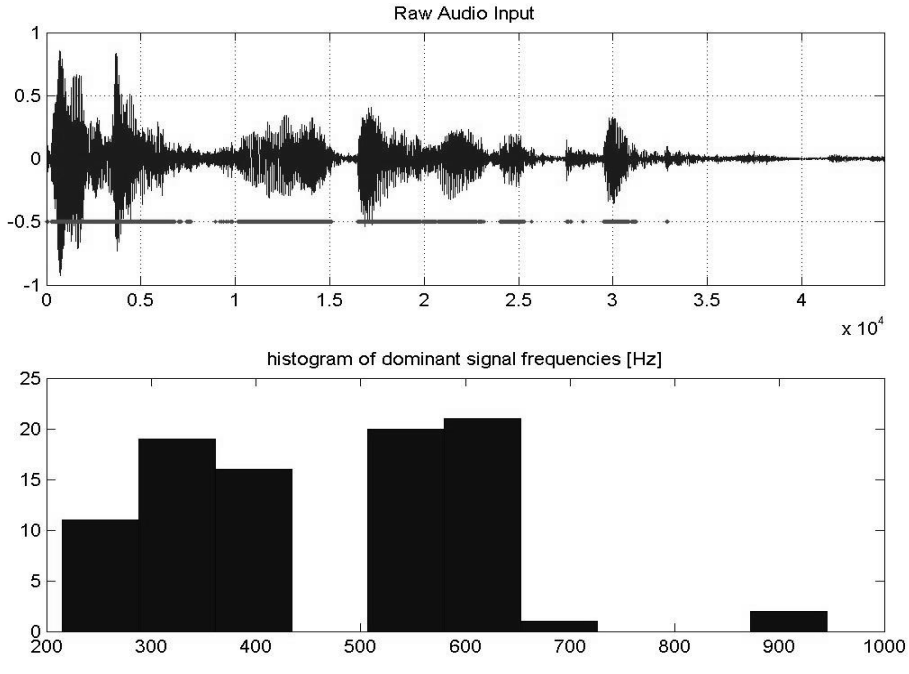
DinnerTable as a Research Platform

Image Analysis

Streaming image data allows us to unfold the narrations parallel and sensitive to the dining event itself. The presence of the guests as well as that of visitors and restaurant staff can be known. The level of activities around the table can be evaluated by standard image analysis techniques of arithmetic operations, filtering and segmentation. We can make use of dining-context specific events around the table to reason on ambiguous results. Furthermore, automated vision allows us to robustly track the motions of the game board pieces at all times.

Audio Analysis

We are in the process of designing a set of parameters to analyze conversation dynamics based on speech signal properties. Our parameters are largely trans-cultural, independent of user and to some degree even language. We can extract virtually in real time the presence of laughter, change of tone, coughing, silence, and excitement via frequency and amplitude based analysis of the speech signals over time. The frequency domain delivers spectral and perceptual information in the form of change of tone and vocal tract resonant frequencies (formants 1 and 2). Normalized power densities deliver intensity and excitement. A diachronic mapping of this information, performed simultaneously for multiple users, opens a window into discussion dynamics. The signal processing parameters thus extracted can then be fed into a (neural net based) classification algorithm to find the high level situational descriptions we seek.



Real-World Data Analysis

DinnerTable makes use of real world dirty data acquired in a non-laboratory setting. This is a real challenge. We are working in acoustically noisy and dimly light environments. This makes the task a very different one from designing for a contrived laboratory setting. We acknowledge that this can have very adverse effects on the reliability of our data analysis but accept the challenge. We believe that it only makes sense to work within the real context of the environment for which we choose to place our work. This is an engineering side consequence of situated artwork. We will rather accept a limited result that works in a real world setting than a brittle solution to a contrived problem of no interest. This can also be seen as a bona fide contribution within the research community. Much work is lost to invented ideal situations that fail to perform in the real world. For us as artists, the real world is the one we desire to operate in.

Non- intrusive Data Management

DinnerTable is an exploration into non-intrusive methods in recording and evaluating biometric data. Both the choice of our biometric parameters as well as the processed results write this into the project's agenda. The input parameters are image and sound based. Acquired data is fed into the machine in a closed loop manner and becomes nutrition for the narration engine. Data misuse is prevented, on the design level, by the fact that no data is stored beyond its use for the narration generation.

A Situated Machine

DinnerTable lives in the intimate setting and intimate exchanges that can occur in dining situations. We would like to add to the dining dynamics a device that humbly feeds off it and narratively contributes to the private exchange. We are conscious of the responsibility we take on when implanting a technical artifact in a social body. We believe it is important to address and include social and cultural parameters into the conception of machinery designed to interface with human beings.

The Narrative Engine

With DT we are investigating the aesthetics of assisted "making" of interactive poetic narration. We propose a machine that can fabricate from a fragmented database of images and from real-time audio and video based external stimuli a poetic narrative. Our machine questions the role of human authorship and ponders the potential of internal computational procedures for the capacity of narrative significance. We have "delegated" top-level authorship to a selection of 6 seminal narration strands from literature and film and have created a database of over 2000 images to represent them. From this database DT creates and recombines particular narration instantiations as desired by its internal constraints and external stimuli. The AI system that is responsible for this, from here on called the narrative engine, must satisfy the following:

1. Be clearly responsive to the social situation in order for the participants to perceive DT as functioning as a commentator.
2. The participants should be able to discern the goal that the pieces have and the rules within which the pieces attempt to achieve this goal in order for DT to feel like a game.
3. The sequence of events produced by the table should form a narrative, meaning that the current event must be constrained by the history of past events and move towards a climactic future event in such a way as to convey conflict and theme.

This engine must provide the ability to map from sensory inputs to triggered sequences of piece movements and images, provide support for these sequences to interact (help and hinder) each other, such that the sequences can be perceived as moves in game, and organize these mappings into script-like global structure which constrain the mappings such that interactions with DT form narratives. The solution adopted by DT is to use reactive planning, specifically the reactive planning language ABL, which is based on the reactive-planning language hap [Loyall and Bates 1991; Bates, Loyall and Reilly 1992; Loyall 1997]. Reactive planning languages have the ability to immediately respond to changing stimuli while organizing this reactivity into sequential and hierarchical structures which provide the ability to maintain and achieve long term goals.

An ABL program is organized as a collection of independent behaviors, each of which consists of some number of primitive steps, which move pieces and display images on the table, computational steps which perform arithmetic and logical computations, and subgoal steps, which attempt to accomplish a more complex goal by appropriately selecting other behaviors to work on the goal. Additionally, an ABL program has a working memory where it stores working memory elements (WMEs). These working memory elements can contain whatever information the program needs to keep track of. Behaviors and goals can test working memory to determine which behaviors are selected, and

whether goals and behaviors succeed and fail. Behaviors can add and delete elements from working memory.

WMEs can be tied to sensory input. In this way, an ABL program can use WMEs as a window onto what is happening in the world. For example, a WME could keep track of how much laughter (on some numerical scale) has occurred at the table in the last 30 seconds. The WME is maintained by some process external to the ABL program, which senses laughter at the table. This WME can now be used to influence behaviors.

ABL fulfills the narrative engine requirements described above:

1. The hierarchical structure of behaviors provides the capability to control the global structure of events, through top-level sequential and parallel behaviors, so as to make a narrative happen.
2. The dependence of behavior execution on tests of sensed WMEs provides the ability to allow details of the narrative to depend on the sensed situation at multiple levels of abstraction so as to provide a non-human commentary on the social situation.
3. The ability to maintain long term persistent goals which are pursued reactively and opportunistically supports structuring reactivity in terms of helping or hindering character goals so as to create a game-like situation.

A dull night shift. The city shows its underbelly to those who care to look.

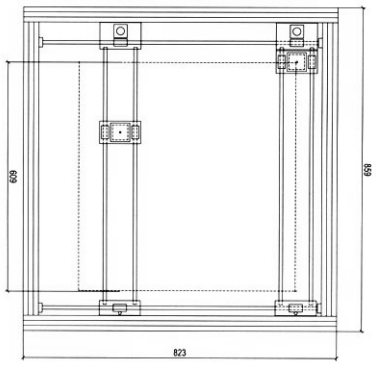
" How can I pay next month's rent ?"

" Where can I find the girl ?"

Physical Design

Planar Manipulator

The manipulator must be able to move two game pieces simultaneously through the urban landscape. We can achieve this with two planar tracks that are in turn mounted in a larger track. Each of the smaller tracks has a left or right field of operation that overlaps with that of the other track. By this design, a game piece traveling from one edge of the board to the other is handed off from one track to the other, invisible to the table guests. The action of the manipulator is transferred to the game board pieces via magnetic force. A rigid aluminum frame provides the required stability.



2D robotic manipulator

Table

The dining table should do justice to both functional as well as pleasure principles. It will house the manipulator, the motors and motor control necessary for motion as well as a computer, a projector, two noise reducing microphones, a color video camera as well as mirrors to redirect projected images.