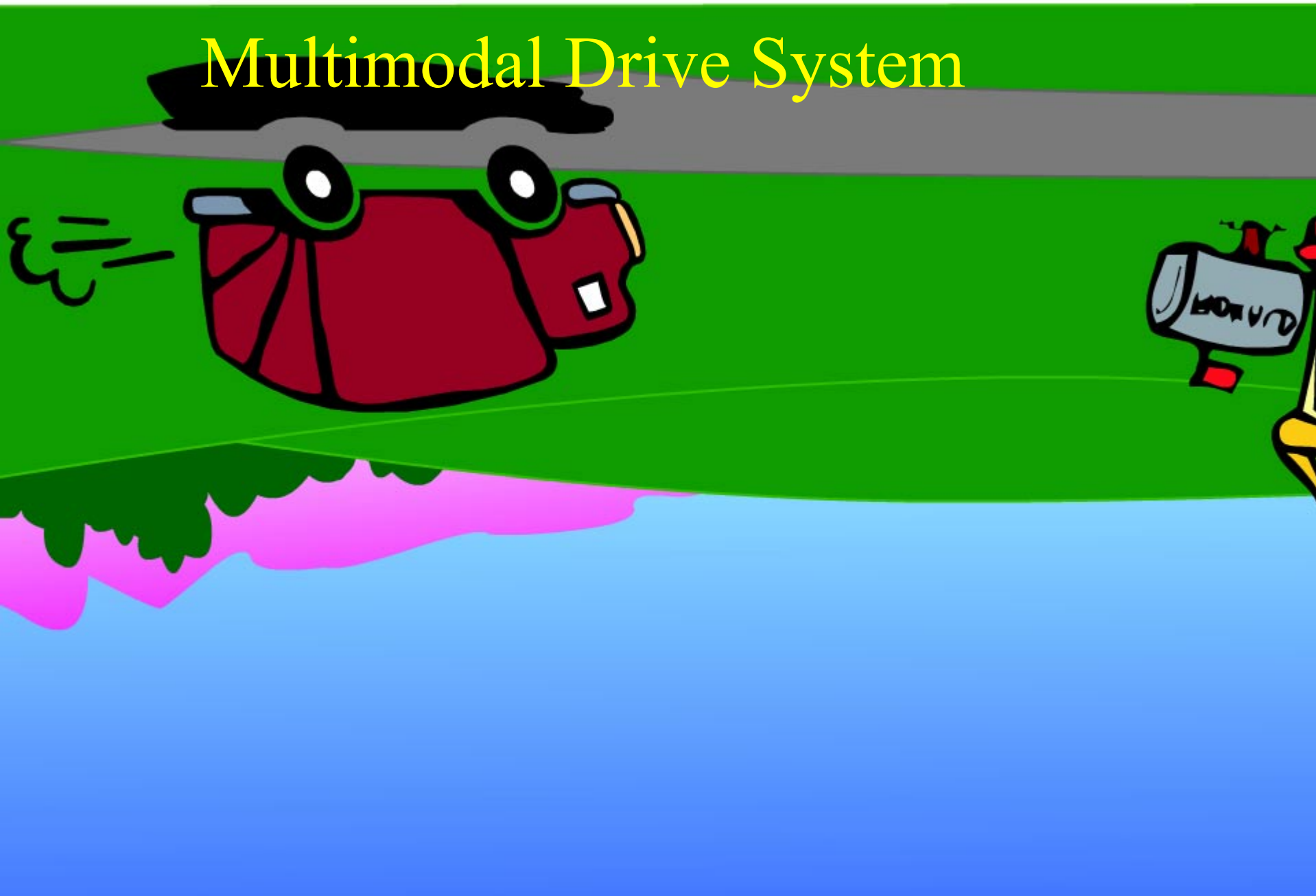
Multimodal Drive System



Multimodal McDrive System

Yun Pang

28 August, 2002

Supervisor: Drs.dr. L.J.M. Rothtkrantz

Department MediaMatics

Faculty of Information Technology and Systems

Graduation Committee

- Drs.dr. L.J.M. Rothtkrantz
- Prof.dr.ir. E.J.H. Kerckhoffs
- Ir. A. Wojdel
- Prof. dr. H. Koppelaar (chairman)

Introduction

- Multimodal extension of the McDrive system
- Multimodal system feedback such as graphics, animations, text and etc.
- A life-like wizard
- Manual prototype with an operator and customer interface

Overview

- Theory
- Research and Implementation

Multimodal McDrive System

Theory

Theory

- Case Study
- Multimodal System
- Smiley and Wizard
- Parsing
- Test of OZ

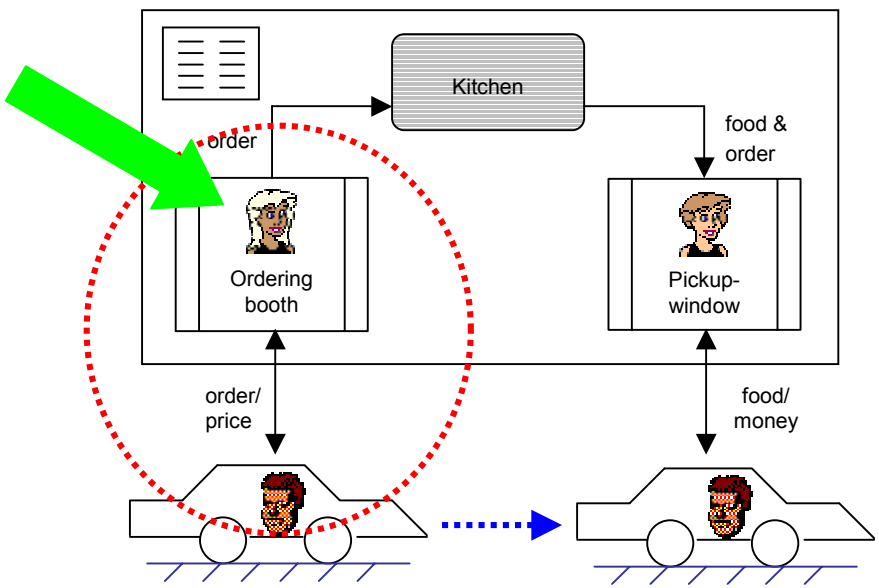
Case study

- Problem Definitions
- Dialogue Analysis
- Backus Naur Form
- BNF of System Prompts
- BNF of Customer Prompts
- What will be done?
- Requirements

Problem definition

- McDrive order process

The First Operator



Problem definition (2)

- The task of the first operator
  - Greet the customer and takes the order.
  - Gives the customer price and shows it on the display screen.
  - Tell the customer where he can collect his menu.
  - Send the order to the kitchen

Dialogue analysis

- Hundreds of dialogues recorded
- The minimal operator prompts set
- The minimal customer prompts set
- Supplementary prompts set
- Common dialogue model

A dialogue example

- Operator: Good morning. Can I have your order please?
- Customer: Hello. One Max Deluxe Menu with a big milkshake.
- Operator: Which flavour do you want?
- Customer: Vanilla and with fries sauce.
- Operator: 4 euro 75 and please drive to the second window.

Dialogue model

Operator-Customer

- Greet - Greet
- Ask for order – Give order
- Ask for additional information – Give additional information
- Ask for additional order – Give additional order
- Give price and send – End
- Give information – ask for information

Greet-Greet

- Operator: Good morning. This is Multimodal McDrive System. Please give the order after the tone.
- Customer: Hello

Ask for order – Give order

- Operator: Would you please give your order after the beep?
- Customer: I'd like to have two BigMac.

Ask for additional information – Give additional information

- Operator: What kind of dressing do you want?
- Customer: “Thousands islands, please.

Ask for additional order – Give additional order

- Operator: Would you like to have nuggets sauce with your nuggets?
- Customer: Yes.

Give price and end - End

- Operator: 4 euro 75 and please drive to the second window.

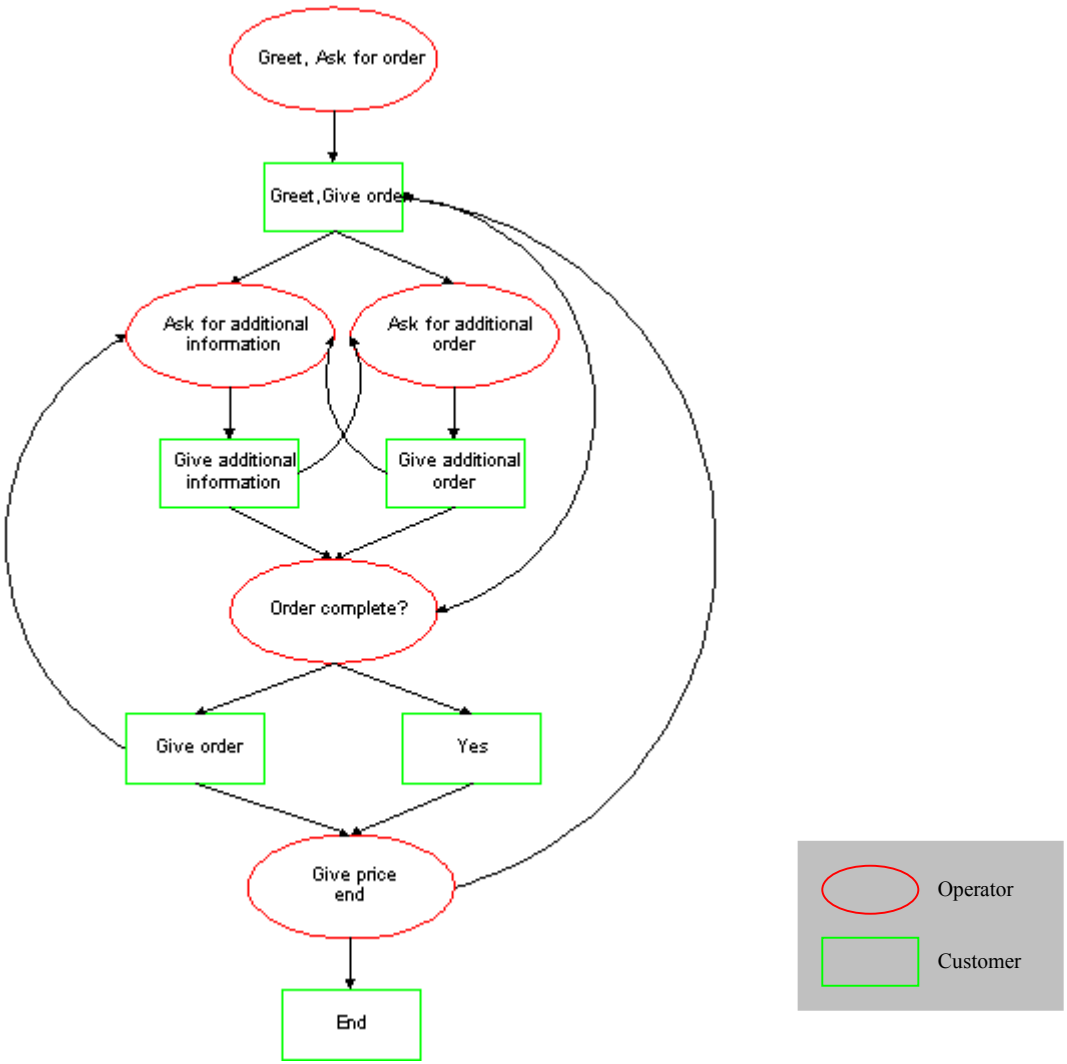
- Customer: Thanks.

Give information –Ask for information

- Customer: What kind of salad dressing do you have?

- Operator: Thousands islands, blue cheese.

Flowchart of dialogue model



Simulated dialogues

- Verification is necessary, a new pair is added.

Operator - Customer

Ask for confirmation - Give confirmation

- Give up after two times failure.

Backus Naur Form (BNF)

- Specify dialog syntax
  - Terminal symbols
  - Non-terminal symbols
  - Start symbol
  - Production rule

For example:

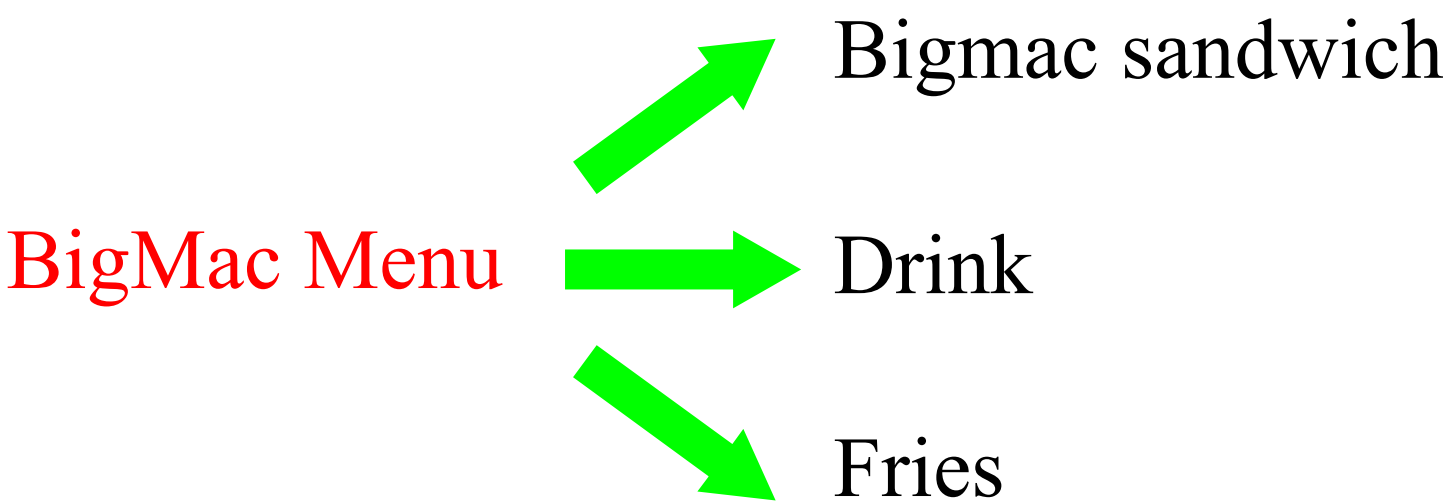
GREETING := Good morning | Good afternoon |
Hello | Good evening

BNF of McDrive menus

- Menu categories:
  - SuperMenu
  - Sandwiches
  - Salads
  - Fries
  - Drink
  - Happy Meal
  - McMorning
  - Desserts

Complex menu items

- Some menu items are combinations of several sub menu items
  - A menu item of category SuperMenu has three sub menu items.



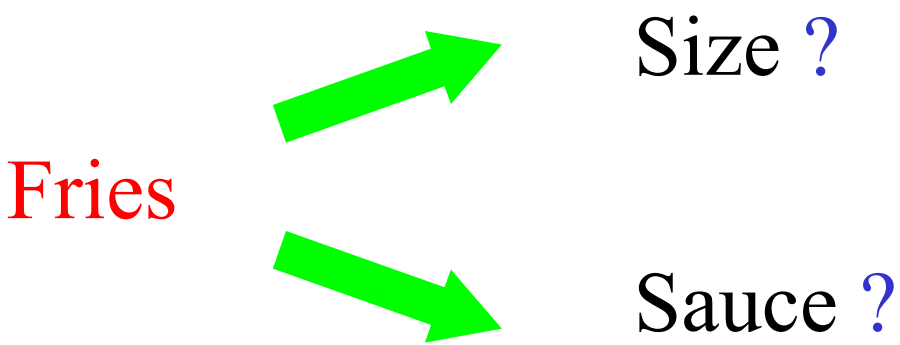
Complex menu items (2)

- Some menu items have attributes

For example:

If you order a fries, the operator needs to know

What kind of sauce you want.



Complex menu items (3)

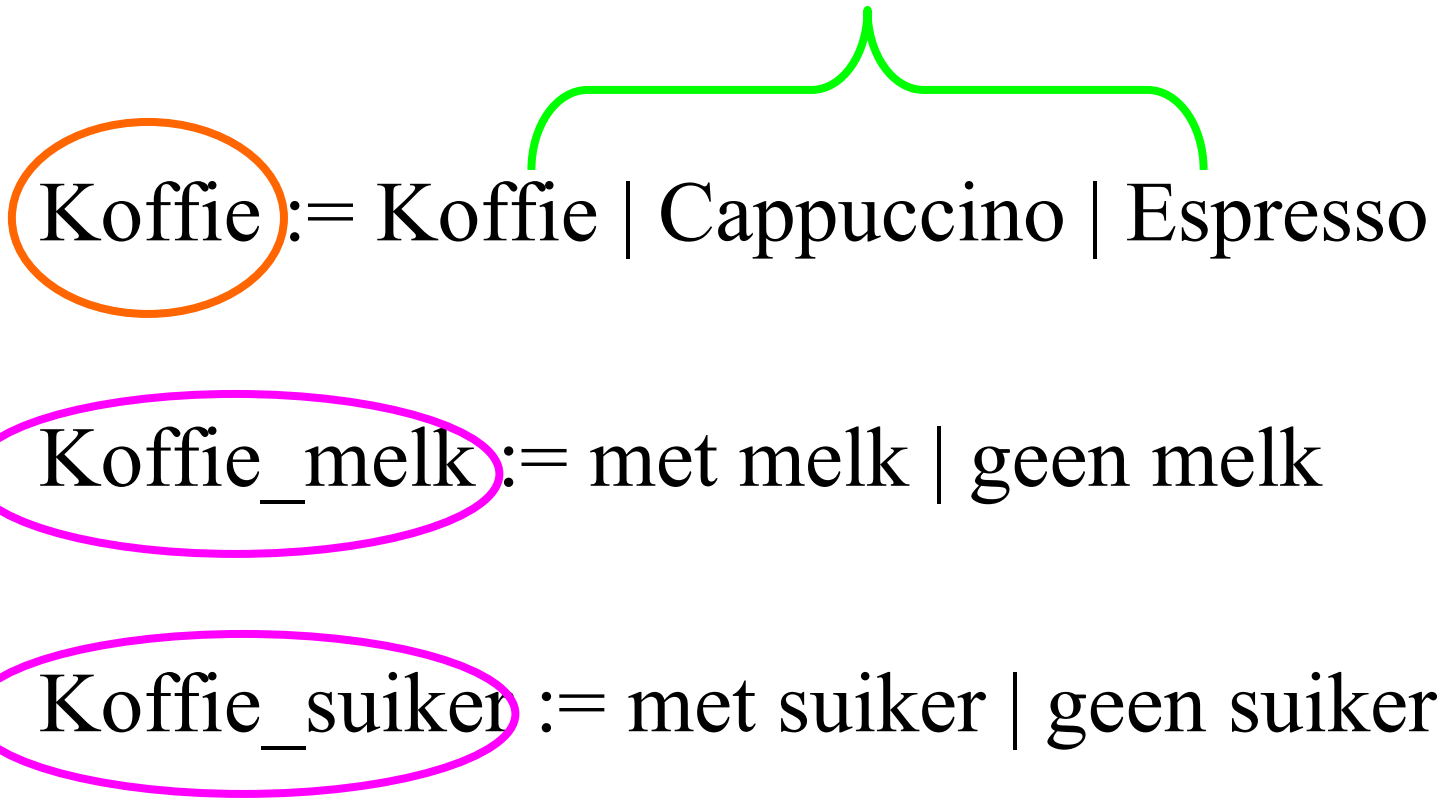
- The menu items in the same category may have different attributes. The number of attributes is also different.

- For example in category Drink:
  - Cola: Size
  - Coffee: Milk, Sugar
  - Tea:
  - Chocomel: Temperature
  - Milkshake: Flavour, Size

Complex menu items (4)

- We put menu items with different attributes into sub-category.
- Menu items in a sub-category have the same attributes.
- Category Drink is divided into 5 sub-categories.

Some example of BNF of menu items



BNF of system prompts

- Defines the syntax of the system prompts

For example

OPEN := GREETING OPENING

GREETING := Good morning | Good afternoon

OPENGING := This is Multimodal McDrive System.
Please give your order after the beep.

Minimal system prompts set

- Contains the most used and necessary system prompts
- BNF of system prompts is built on the basis of basic system prompts set

BNF of customer prompts

- Defines the syntax of customer prompts
- Minimal customer prompts set
  - Contains the most used and necessary customer prompts
- BNF of customer prompts is built on the basis of minimal customer prompts set

Rules of customer's order

- Only the menu items, number and attributes contains order information
- Some customer know what they want to order and give their order in one sentence.
- Some customers waits the operator to ask for additional information.
- Each sub-category has its own rule.
- The customer may order in different ways.

An example of different order ways.

- I would like to have a big vanilla Milkshake.
- A big Milkshake please.
- A milkshake, big, vanilla.
- A milkshake please.

Context: Give order

Order:

- Sub category: Milkshake
- Menu item: Milkshake
- Quantity: one
- Attributes: big, vanilla

Rule for the example

Shake_rule =[Numbers], [Stuk], [Size],
[Shake_smaak], Shake, [Met],
[Size], [Shake_smaak], [Size].

[ ] is optional.

Number is optional. Default number is one.

Attributes are optional.

Different ways to give an order.

Try to cover all the possible situations.

What will be done?

- Design an interface for the customer.
  - What kind of feedback the customer will get?
  - Interface screen will be divided into a number of sub-screens according to the feedbacks.

# sub-screens	:	# feedback
1	:	1

What will be done? (2)

- Analyse existed / simulated dialogues and find out which feedback can be given:
  - Text prompts
  - Pictures and movies of of the menu items
  - Smiley and facial expression of the wizard.

What will be done? (3)

- Choose a tool to make a wizard.
  - The wizard will have facial expressions.
  - The wizard will always be on the screen.
  - The wizard will show the right facial expression at the right moment.
- Build a nonverbal dictionary that is consisted of possible facial expressions.

What will be done? (4)

- Implement a manual prototype in which an operator- and a customer- interface will be built.
  - The operator can generate the system response by using a special keyboard.
  - The text answer and the belonging picture and smiley will be shown on the screen of the customer interface.
  - The wizard will show the right facial expression.

Requirements

- Under normal circumstances MMS is able to replace the human operator.
- Behave like a real person, that means that MMS has feelings.
- Response in real time.
- Keep track of dialogue.
- Flexible and dynamic system.
- User friendly.

Requirements (2)

- No huge costs.
- The decentralized character of the organization needs to be maintained.
- Other parts of McDrive keep the same.
- Guarantee the privacy of the customer.

Multimodal system

- A multimodal system supports interaction with the user through more than one modality, with respect to input and/or output, and with the capacity to interpret and/or generate with respect to the representation of content.
- A multimodal system strikes for meaning.
  - An electronic mail system that supports voice and video clips is not a multimodal system if it does not interpret the inputs.

Mulitmodal Interface

- Natural: easy to use and seamless as possible.
- Speech and graphical interface compensate with each other.
- Needs to be carefully designed.
  - Select the right input and output modalities.
  - How to combine different input and output channels?
  - The interface if adaptable if the user can choose the modalities.

Unimodal / Multimodal input in MMS

- Customer speech (in manual prototype it will be replaced with text).
- Identify a customer by using
  - License plate of the car,
  - Or the voice characteristic of the customer.
- A pressure-sensitive sensor to detect new visitors.

Multimodal output in MMS

- Text feedback
- Graphical feedback:
  - Pictures
  - Movies
  - Smileys
- Wizard action

Multimodal data presentation

- Example:

  What should be shown to the customer when MMS asks the customer which size of cola he prefers?

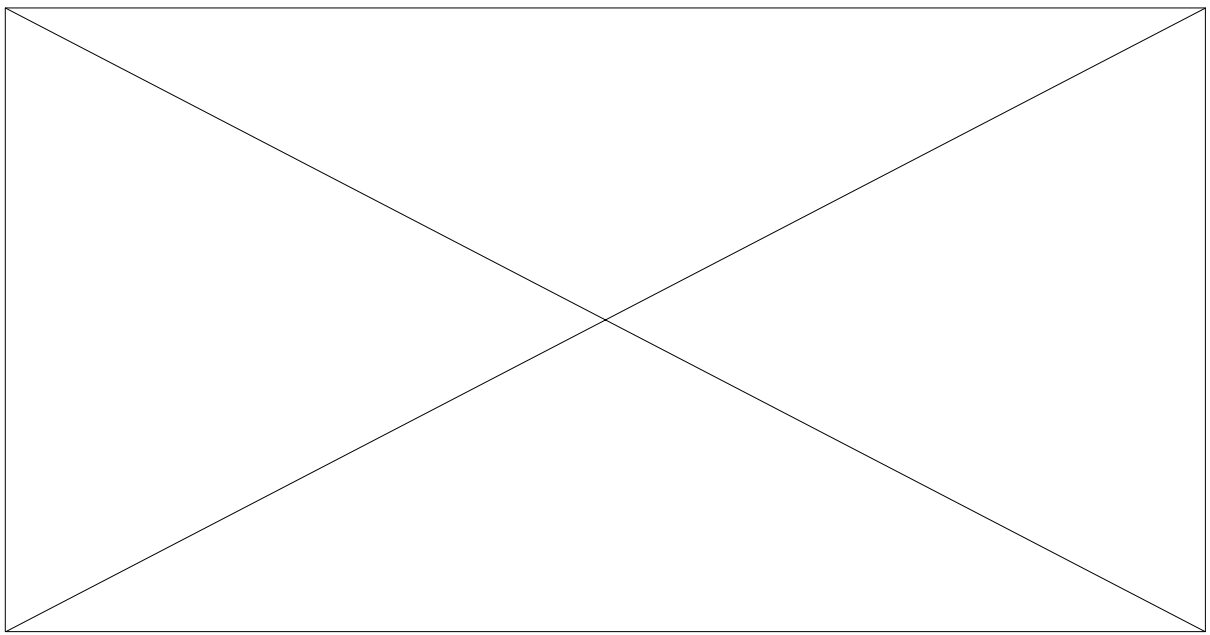
Multimodal data presentation2

- A picture of cola?

  The emphasis of the question lays on the size, not on cola self.

Multimodal data presentation (3)

- A flash movie that shows in turn cola in three format?
  - Gives a more direct impression.
  - More attractive.



Smiley and wizard

- Smiley
- Functions of smileys
- Wizard design
- Microsoft Agent
- Build the wizard

Emoticon or Smiley

- Combinations of standard ASCII characters.
- Graphical representation of words, thoughts, emotions
- Sideway
  - :-) a happy face on its side
- Used everywhere
  - Email, discussion form, SMS, advertisements,…
- Clarify a conversation that is not face-to-face.

Why pictures of smileys are used?

- Hundreds of smileys
- No standard definition
- Some basic smileys are universal used and recognized
- The user has to interpret the meaning of smiley by himself
- Pictures of smileys : emotion – n : 1

angry

Why pictures of smileys are used? (2)

- The customer needs to listen to the operator and look at the text, the picture and the wizard.
- At same time tip the head to the left to see what the smiley mean?
- Conclusion:

  Too much asked from the customer.

- Advice:

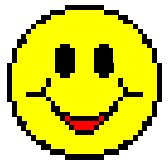
  Use pictures of smileys.

Functions of smiley

- Emblem
- Illustrators
  - Batons, underlines, ideographs, kinethographs, rhythmic, spatial, deictic
- Affects utterance
- Regulators
- adaptors

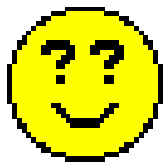
dialogue example with smiley

- MMS: Good morning. This is Multimodal McDrive System. Please give the order after the tone.

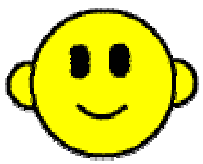


•Customer: Hello. One BigMac, please.

•MMS: You want a BigMac, is it right?



•Customer: Yes.



Wizard design

- A face to face conversation involves more than just talking.
- An interactive character shows facial expressions and gestures.
- Improve understanding.

Choices

- Ready-made characters provided by Microsoft.
  - Peedy, Genie, Melin.
  - Can be used directly.
  - Cartoon style.
  - Few or no facial expression.



Choices (2)

- Ronald or other characters of McDonald's.
  - Funny and popular.
  - Cartoon style.
  - It is a clown. A laughing figure.
  - Not enough facial expressions.

Choice (3)

- A life-like character
  - Male or female?
  - Whole body or upper part of the body including hands?

Decision

- Female.
  - McDrive has more women employees.
  - More friendly.
- Upper part of the body and hands
  - The location of wizard on the screen is fixed, the wizard doesn't need to walk around.
  - Facial expressions and hand movements are important.
  - The format of the wizard will be bigger.

Lisa

- A blond girl in a white T-shirt.
- Stays on the right upper part of the screen.
- Standard setting is 320*320 pixel.
- Default language: Dutch.
- Task: show the right facial expression at the right moment.

Microsoft Agent

- Example: Office assistant
- Supports the presentation of interactive animated characters.
- Conversational interface.
- Character has its own window and is always on the top of screen.
- Character can guide, introduce and entertain the users as interactive assistant.

Build the wizard

- Development tool:
  - Microsoft Agent Character Editor
- 3D tool:
  - Poser

Microsoft Agent Character Editor

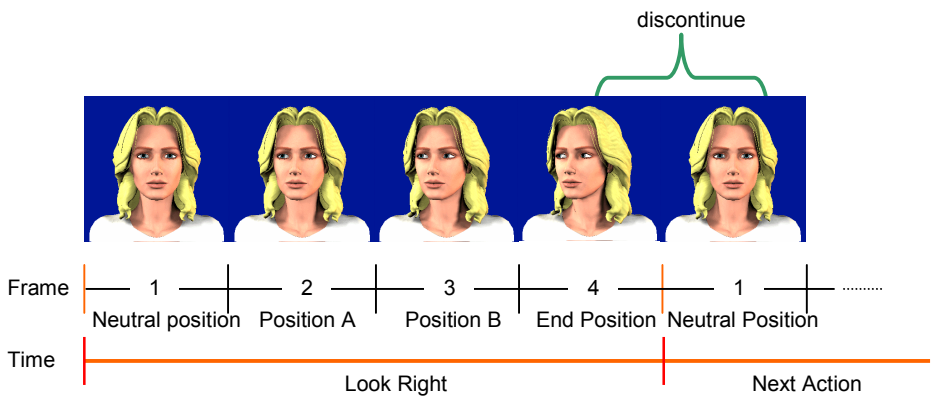
- Assemble , sequence and time the images.
- Supply character information.
- Compile into a character file.

Create a new animation

- An action is an animation that is composed of a timed sequence of frames.
- Most actions contains 4-6 frames.

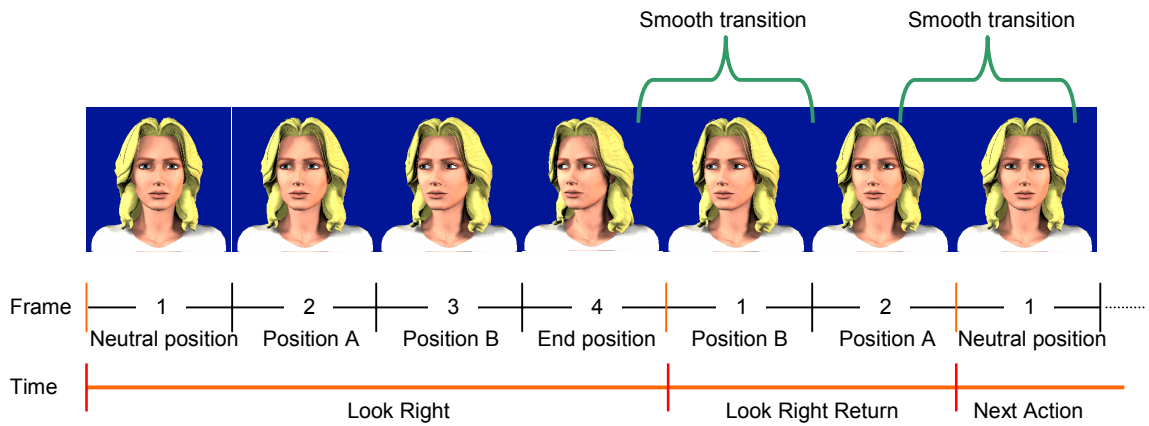
Transition between the animations

- A neutral position: from which the animation starts and returns.
- The wizard turns right and then turns left.
- Problem:
  - There is an interruption between these two actions.



Solution

- Return animation.
  - A separate, complementary animation.
- Branching
  - A few frames added within the animation.



Poser

- 3D-character animation and design tool.
- Facial movements can be generated by adjusting the parameters of brows, eyes, mouth, jaw and etc using the sliding buttons.
- Mimic




Parsing

- Prolog parser
- XML parser
- VB parser

Prolog parser

- Prolog: rule-based programming language.
- Definite clause grammars (DCG).

BNF rule:

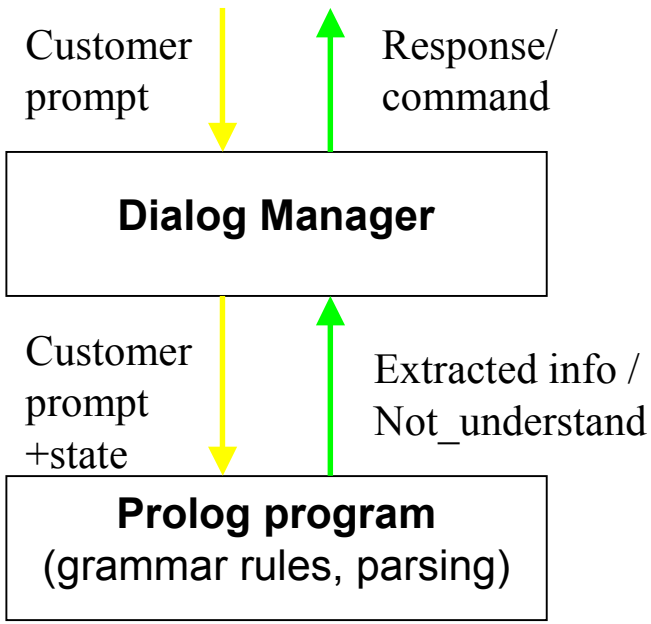
GIVE_ORDER ::= SUBJ ORDER | ORDER PLEASE

DCG rule:

give_order ([X|Y]) → subj(X), order(Y).
give_order ([X|Y]) → order(X), please(Y).

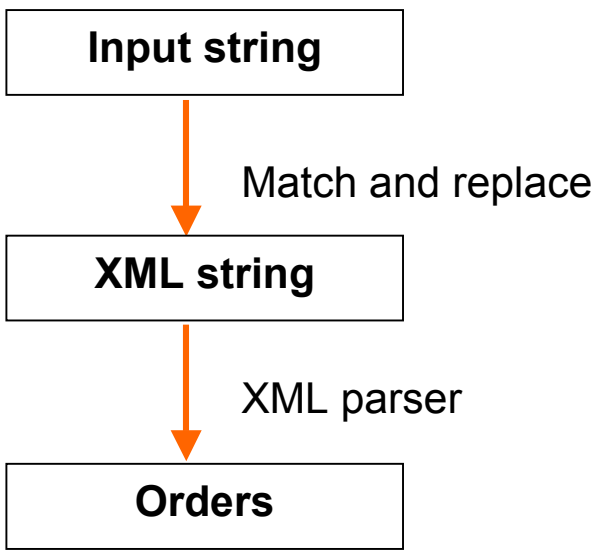
Amzi! Prolog

- Compatible with Visual Basic
- VB – Graphical User Interface
- Amzi! Prolog - parsing



XML parser

- XML – Extensible Markup Language
- Document Type Definition (DTD)
- Preformatted inputs.



An example

- I would like to have three small milkshake vanilla.

```
<orders>
        <shake>
                <menu>milkshake</menu>
                <number>three</number>
                <size>small</size>
                <m_flavor>vanilla</m_flavor>
        </shake>
</orders>
```

Sub-category

Attributes

VB Parser

- Syntax

```
sandwiches_rule = [number], [stuk], sandwiches
                  (field)      1                  3
```

- Code

```
sandwiches_rule = numbers & "?\s?" & stuk &
                  sandwiches
 ‘ add to XML string
res = res + objRegExpr.Replace(objmatch,
        "<sandwiches><name>$3</name> &_
      <number>$1</number></sandwiches>") & vbCrLf
```

Test of Oz

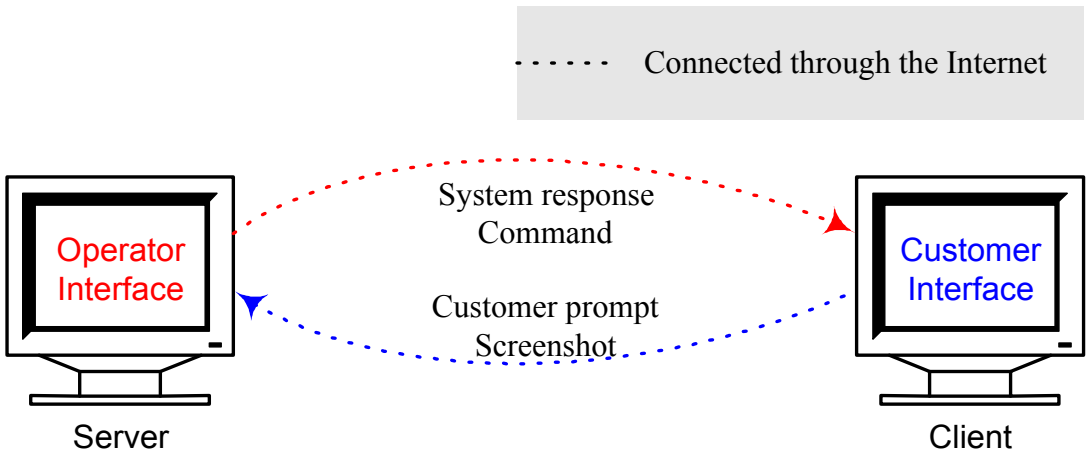
- Test whether the design is feasible.
- Simulate a dialogue
- Timeline of a dialogue

Multimodal McDrive System

Design and implementation

Structure of model

- The two interfaces of the manual prototype is connected through the Internet.
- The Client needs to know the IP address of the Server.



Operator interface

- The interface is divided into a few parts and each part is an individual.
  - Keyboards
  - Order window
  - Dialogue window
  - Monitor window
  - Transport module
  - Control module

Customer Interface

- The customer interface is divided into 4 parts according to the system response.
  - Graphical
  - Text
  - Wizard
  - Smiley

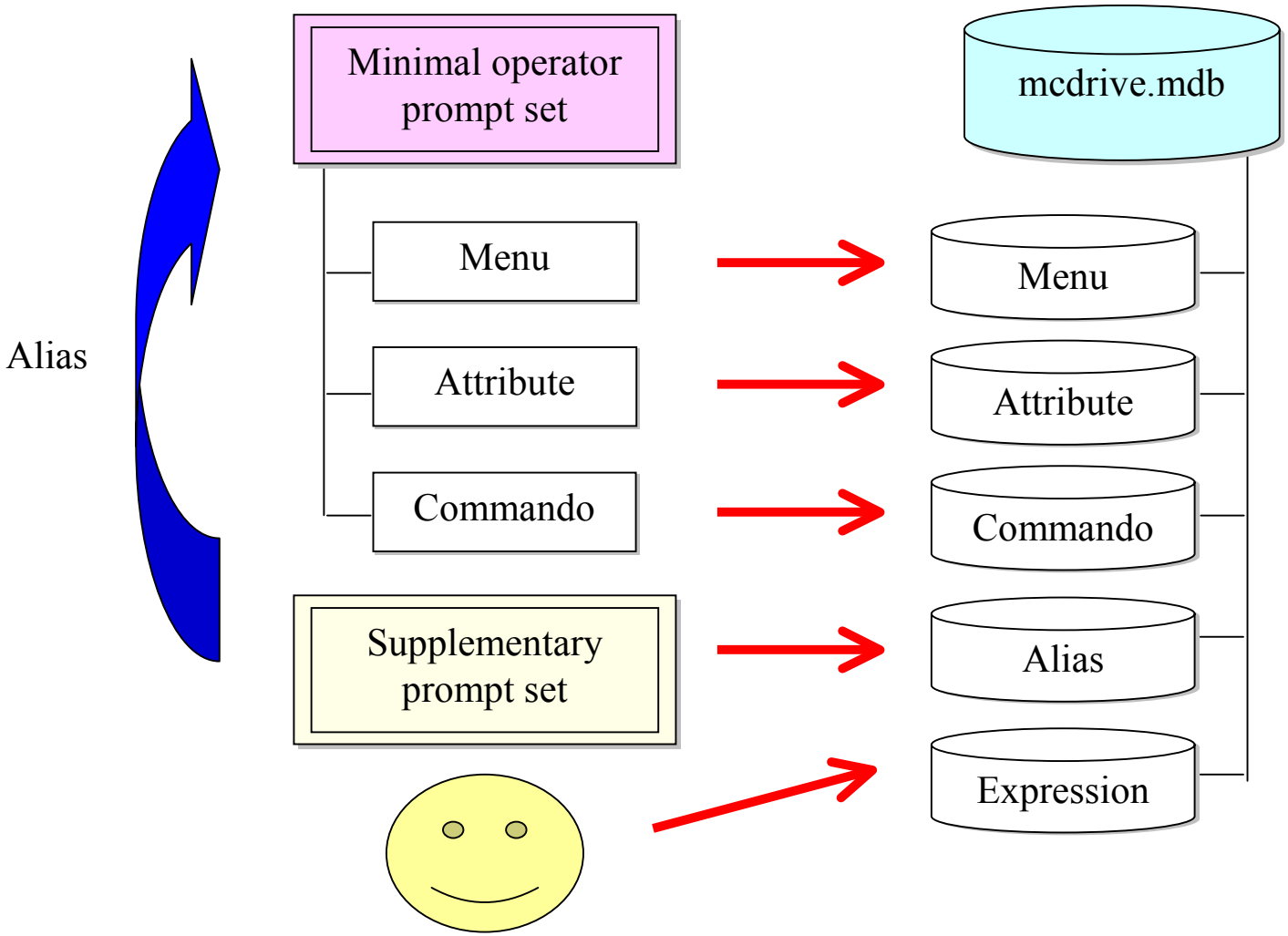
Data Management

- Two databases used:
  - Local database
    - The information of customers.
    - Non-regular data.
    - Updated frequently.
  - Central database
    - Menu items, smileys and other data.
    - Regular data.
- Microsoft Access

Regular data

- Minimal operator prompts set:
  - Menu
  - Attributes
  - Commando
- Supplementary set of the minimal set
- Smileys
- Wizard actions
- Pictures of menu items

Data locations



Database Management

- Database Manager
  - Global
  - Table, field actions
- Table Managers
  - Local
  - Every table has its own manager
  - Record actions

Database and its managers

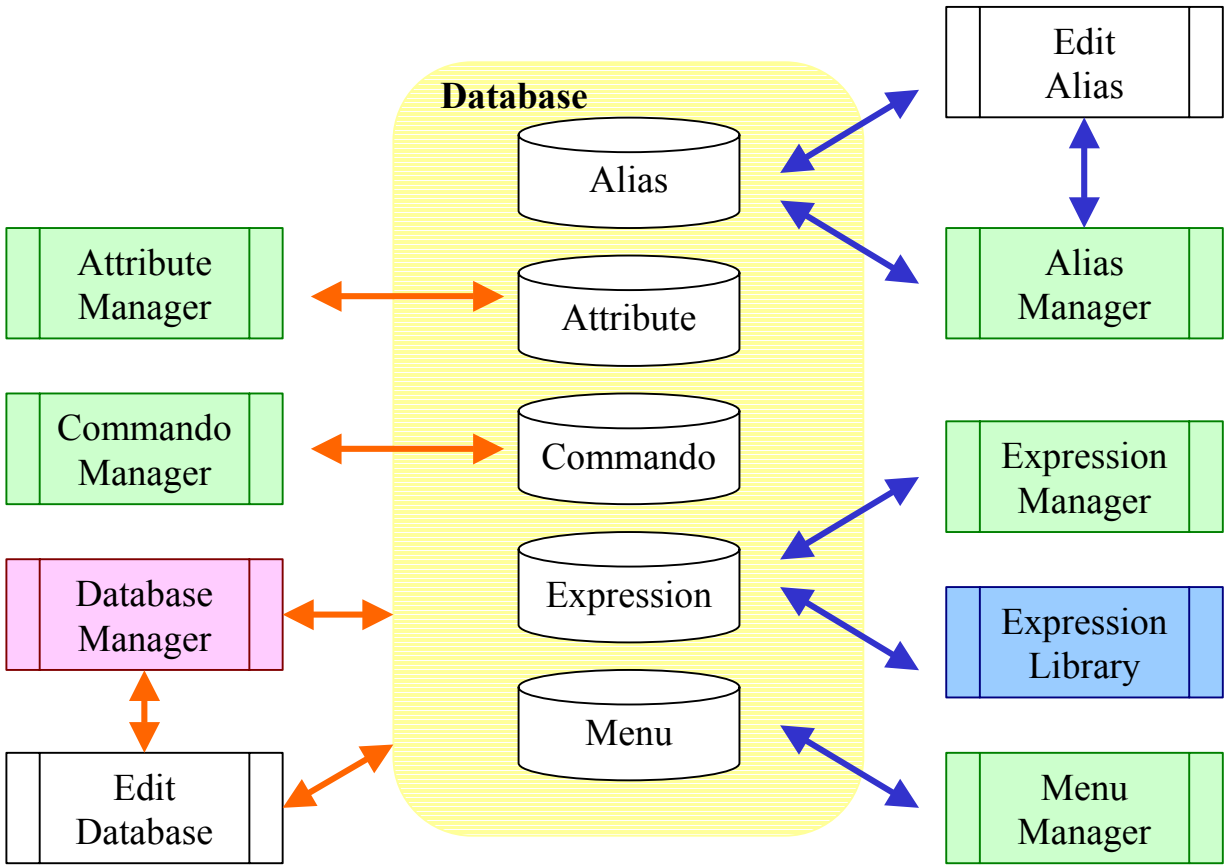


Table Menu

- Fields of table Menu
  - Code
  - Name
  - Category
  - Icon
  - Picture
  - Attr_type

Field Attr_type

- Classify menu items with attributes.
- Same as sub-category?
  - Same
    - When menu items do have attributes;
  - Different
    - When menu items don't have any attributes.
    - For example:

      Tea belongs to sub-category Tea; but de field Attr_type of Tea is none.

Field Attr_type (2)

- Contains only the name.
- Details about the sub menu items are in configuration file “attribute.ini”.
- Details about the number and names of attributes are stored in file “attribute.ini”.
- There are some predefined questions for the attributes. The names of these questions are also put into file “attribute.ini”.

An example

- Fries has two attributes.
- The value of field Attr_type of fries is Fries.

In attribute.ini

[Fries]

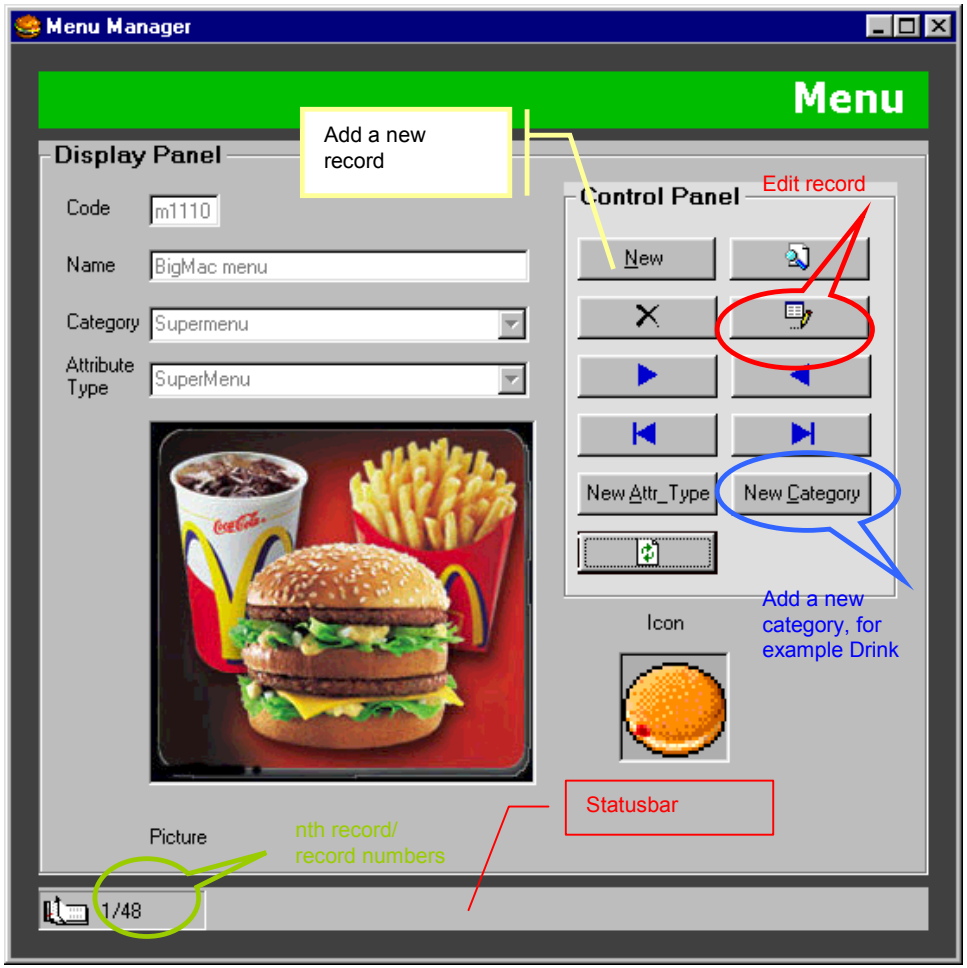
attribute1=Size

attribute2=Fries_Sauce

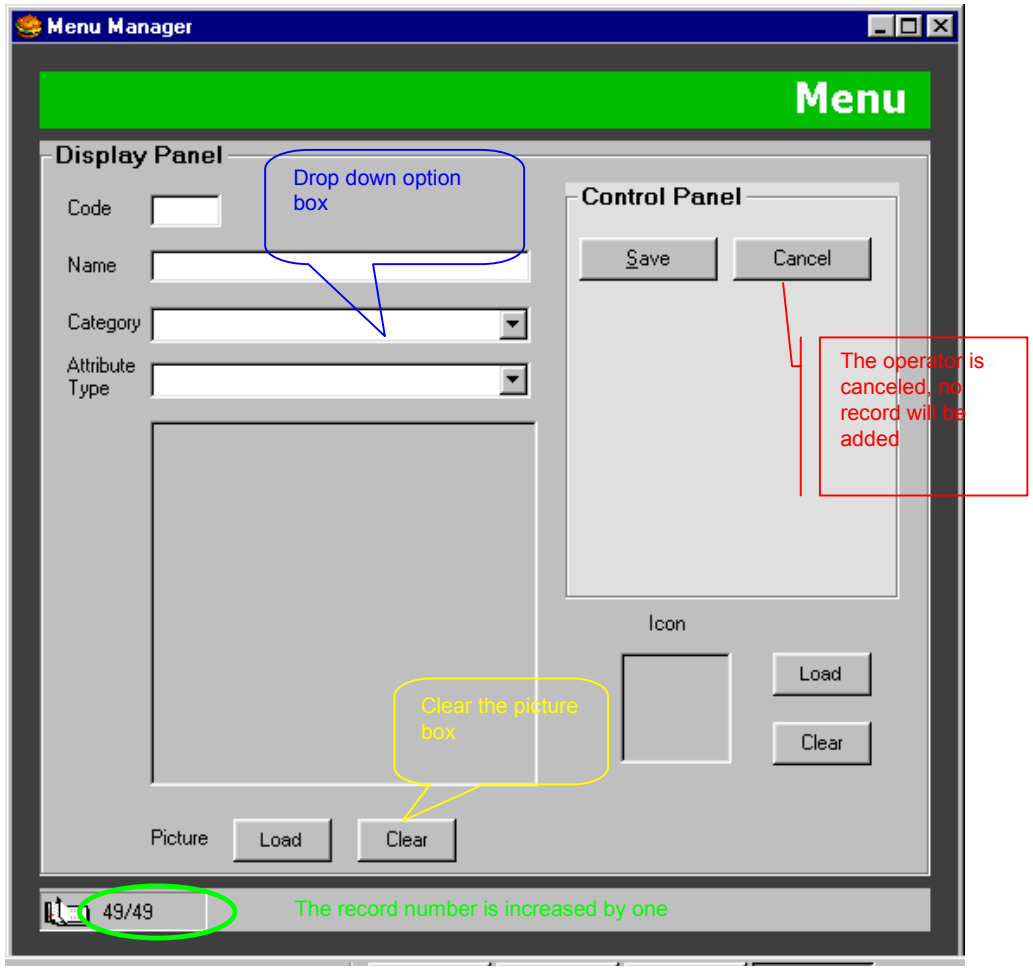
question1=Ask_Fries_Size

question2=Ask_Fries_Sauce

Menu manager



Add a new record



Add a new record

- To make sure the new record is validate.
  - Check the code
    - Empty?
    - Length
    - Existed?
  - Check name
  - Check category

Actions

- Add a new record.
- Edit an existed record.
- View the existed records by moving around.
- Delete an existed record.
- Search a record through the name or code.
- Add a new category.
- Refresh.

Attributes

- Menu items from different menu category may have same attributes.
- A attribute has a few possible values. Each value will have an entry.
- One attribute value only need to be stored one time.
- Functions as supplementary of table Menu.
- Related with table through “attribute.ini”.

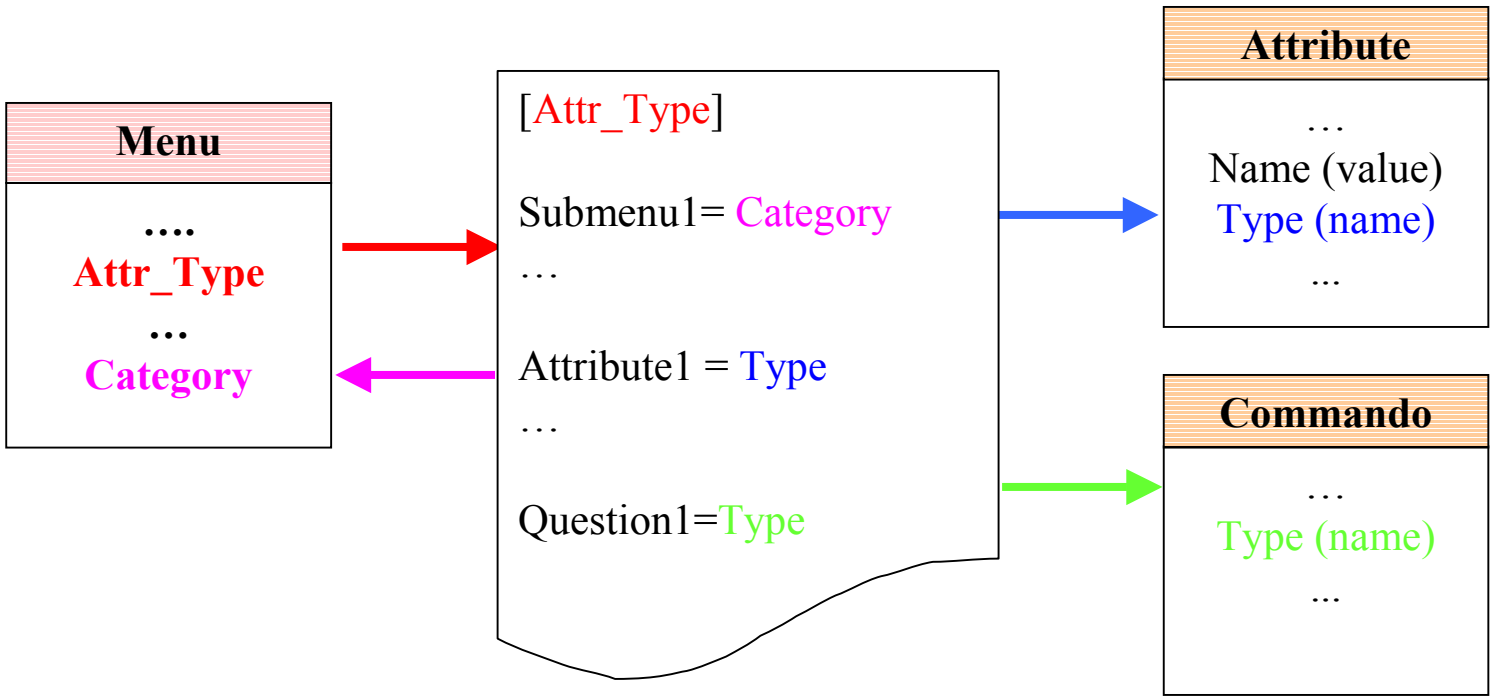
Table Commando

- Table Commando contains three kinds information:
  - Predefined questions.
  - Prompts which don't belong to table Menu and Attributes.
  - Functions.
    - Undo
    - Redo
    - Text
    - send

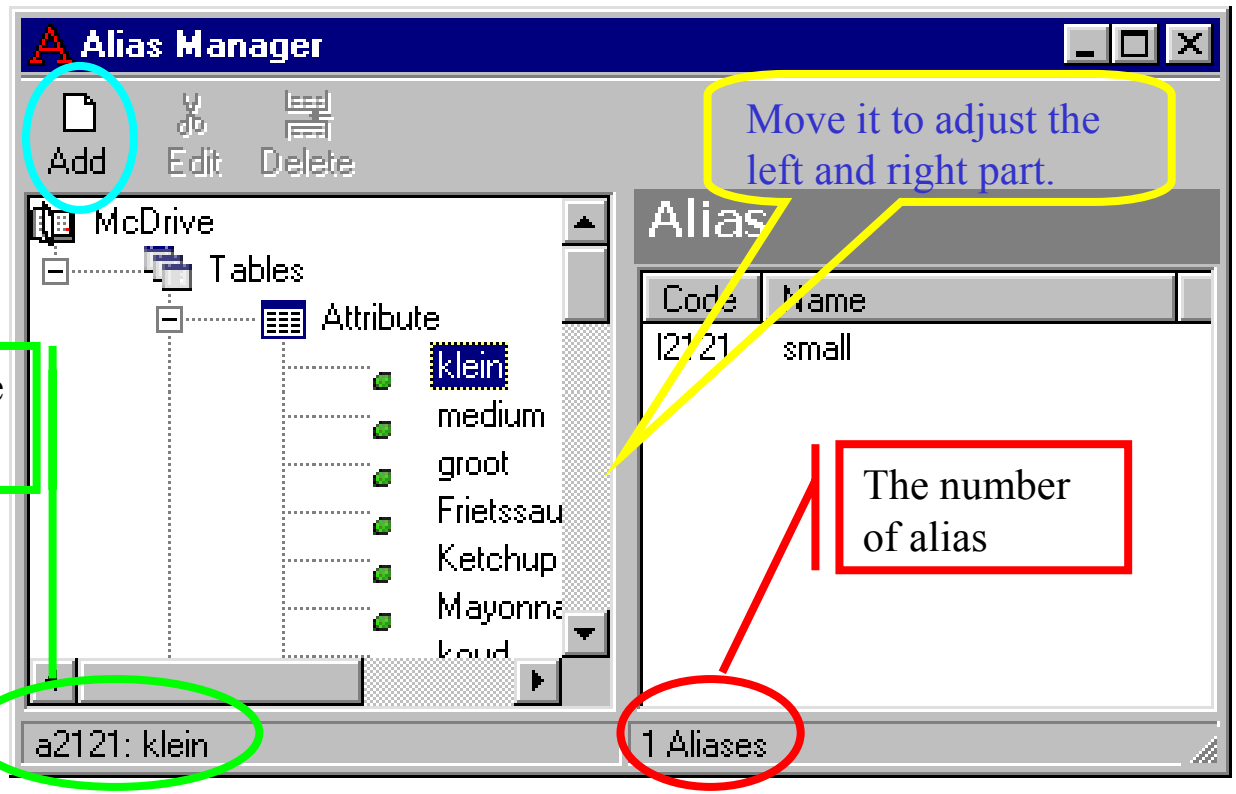
Attribute.ini

- Stores the names of attributes.
- Stores the questions related with attributes.
- Stores the submenus
- Maximum attributes / questions / submenus : 5
- Functions as a bridge between the menu board and the tables Menu, Attributes and Commando.

Attribute.ini

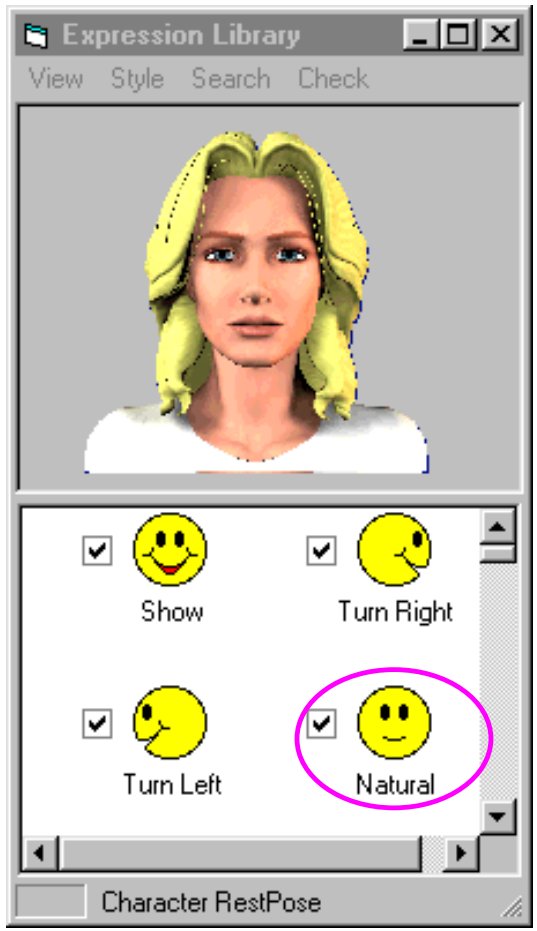


Alias manager

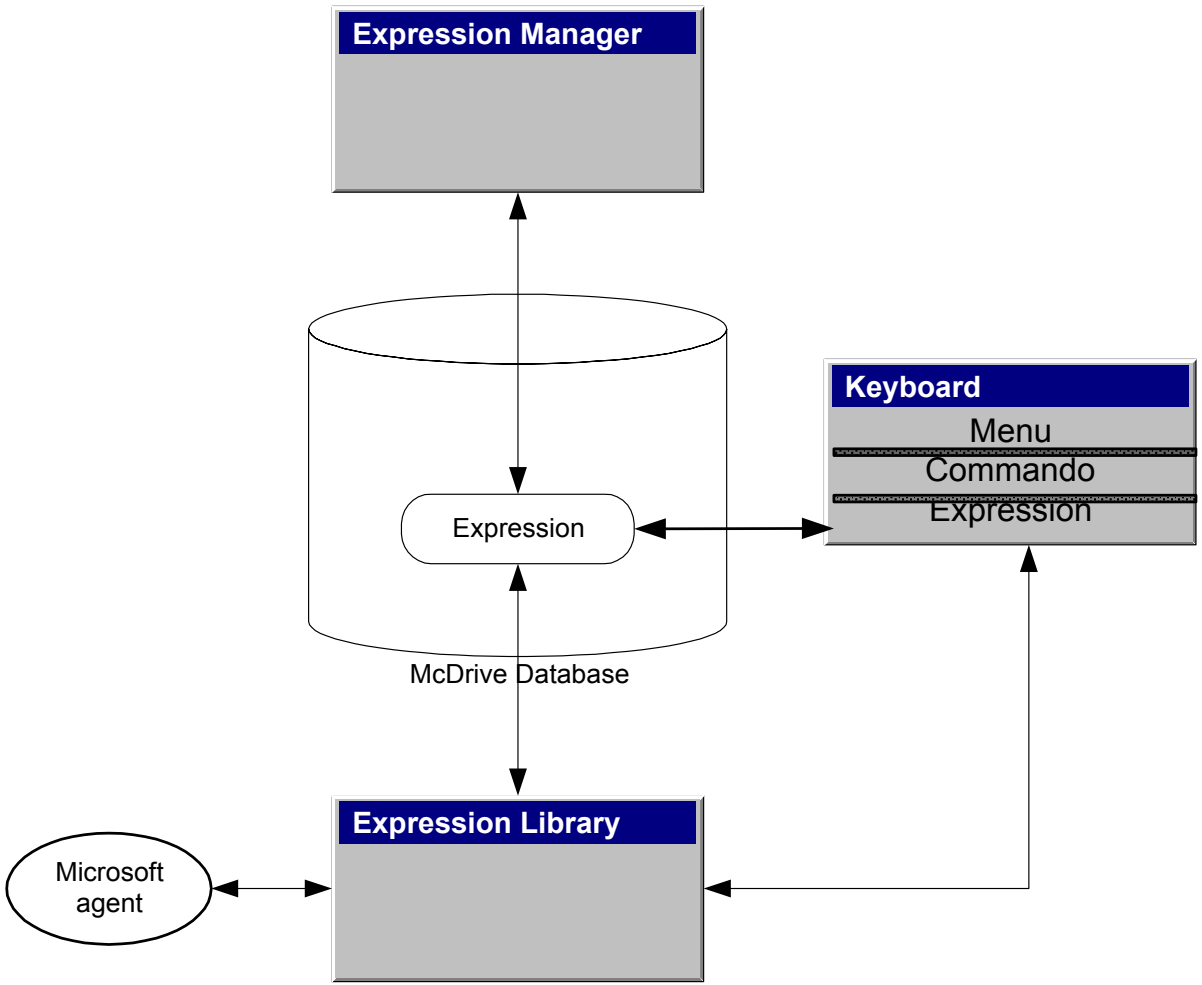


Expression library

- View the smileys and the corresponding wizard actions.
- Set the property “Show” of smileys by checking or un-checking them.
- View smileys in list or in pictograms.



Information flow of expressions



Database Customer

- Some customers always order the same menu.
- Customers usually visit the same McDrive restaurants.
- Check database periodic and delete out-of-date records.

Operator keyboard

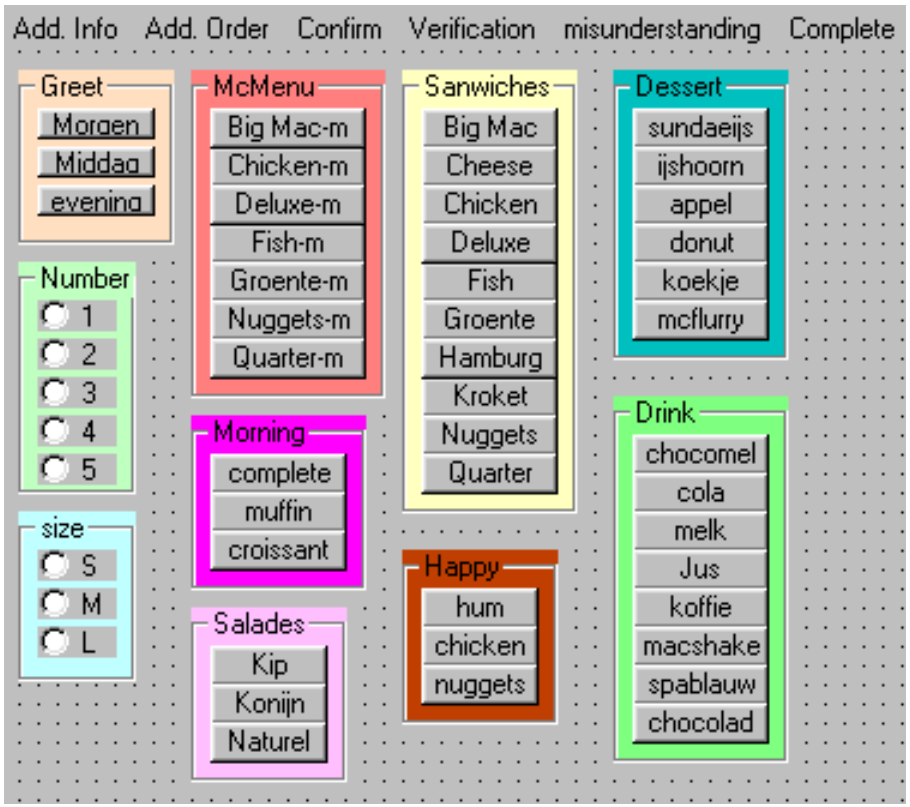
- Built on the basis of the minimal operator prompts set and database McDrive.
- Used to generate system response.
- First design – a text keyboard
- Second design – a graphical keyboard
- Last design – a layered keyboard with 3 sub-keyboards.

Text keyboard

- Built on the basis of the minimal operator prompts set.
- Generates only the text response.
- The dialogue patterns are also added.
- Two options for the menu items..

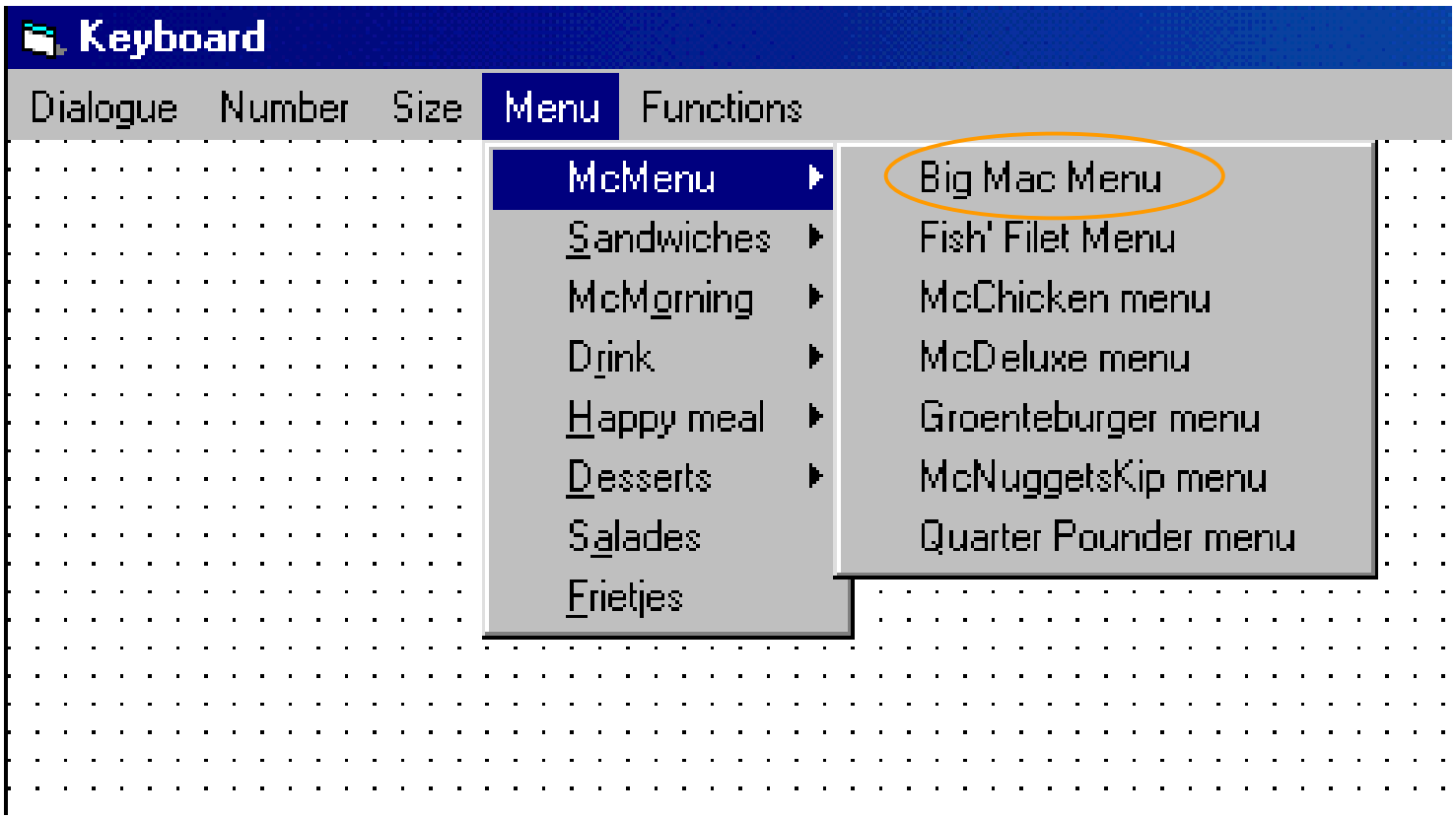
Option 1

- List everything on the keyboard.



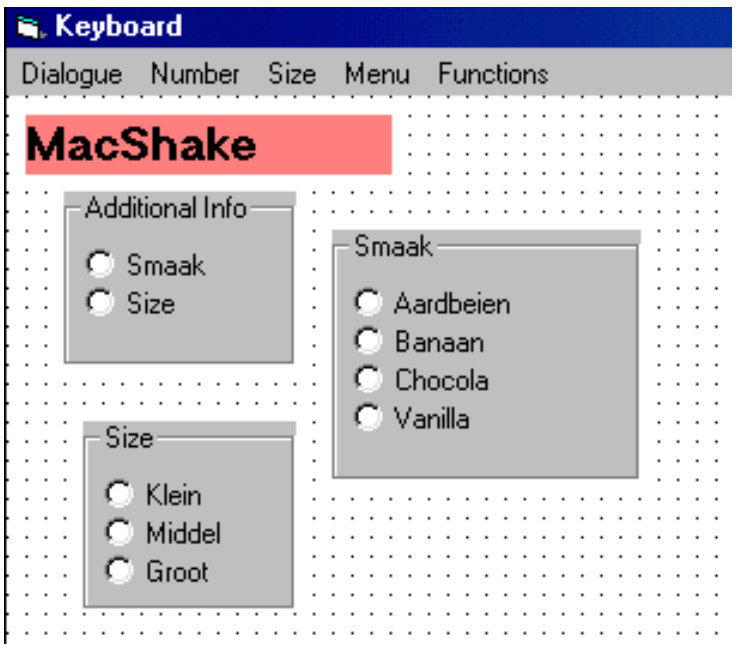
Option 2

- A layered approach



Option 2 (2)

- Attributes are shown on a separate window.

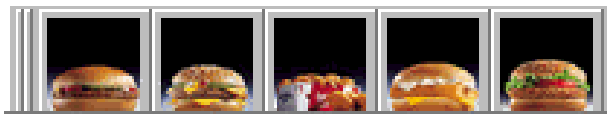


Graphical menu keyboard

- Generate the text and graphical response.
- There are two keyboards designed, one is for the customer and the other is for the operator.

Graphical button

- Use photo of menu items



  - All the sandwiches looks similar with each other; it is difficult to find out what is what at the first glance.

Graphical buttons (2)

- Use a symbol
  - Use an icon of cheese for the cheeseburger.
  - Use a fish icon for the fish filet.

- Conclusion
  - The user can find out what is what at the first glance.
  - **Need to find appropriate symbol for every menu items.**

Identical button

- In this design a customer keyboard is also built.

  Prompts which are contained in both prompt sets use same symbols.

Compact keyboards.

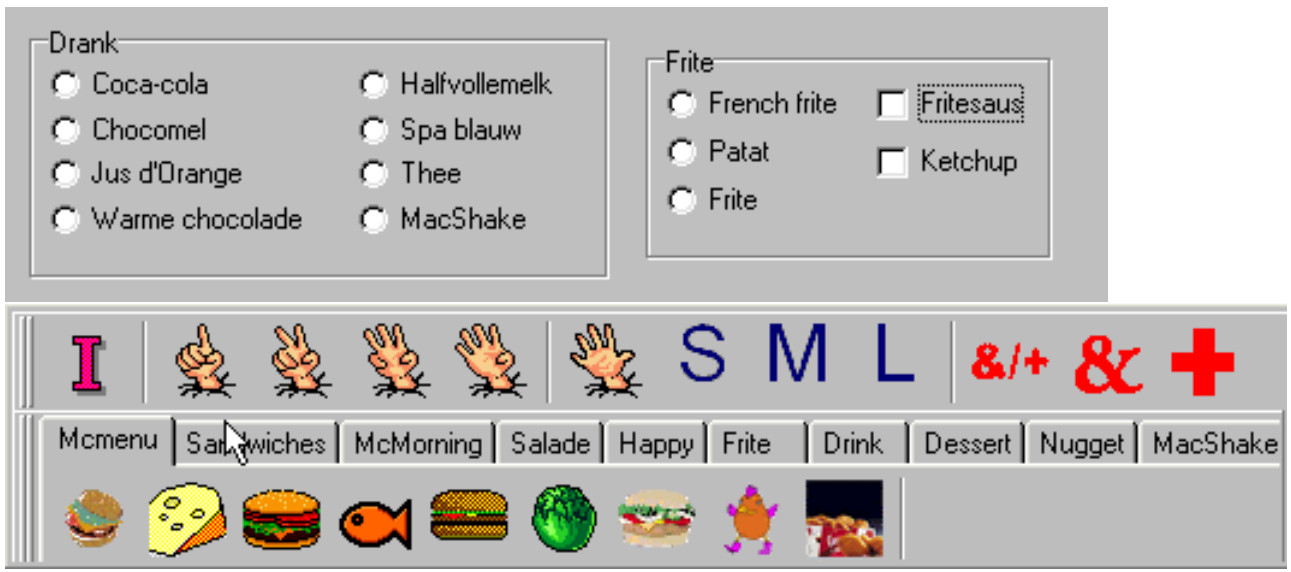
- The menu items are put into tab sheet according the categories.

Dynamic keyboards

- Only the necessary buttons will be generated.
- Predefined buttons and dynamic buttons.

Meta layer

- Some menu items have attributes.
- A meta layer with attributes will be generated when a complex menu item is clicked.



A manual keyboard with sub-boards

- Commando board.
- Expression board.
- Menu board.
- Dynamic generated.
- Is used to generate multimodal system feedback.

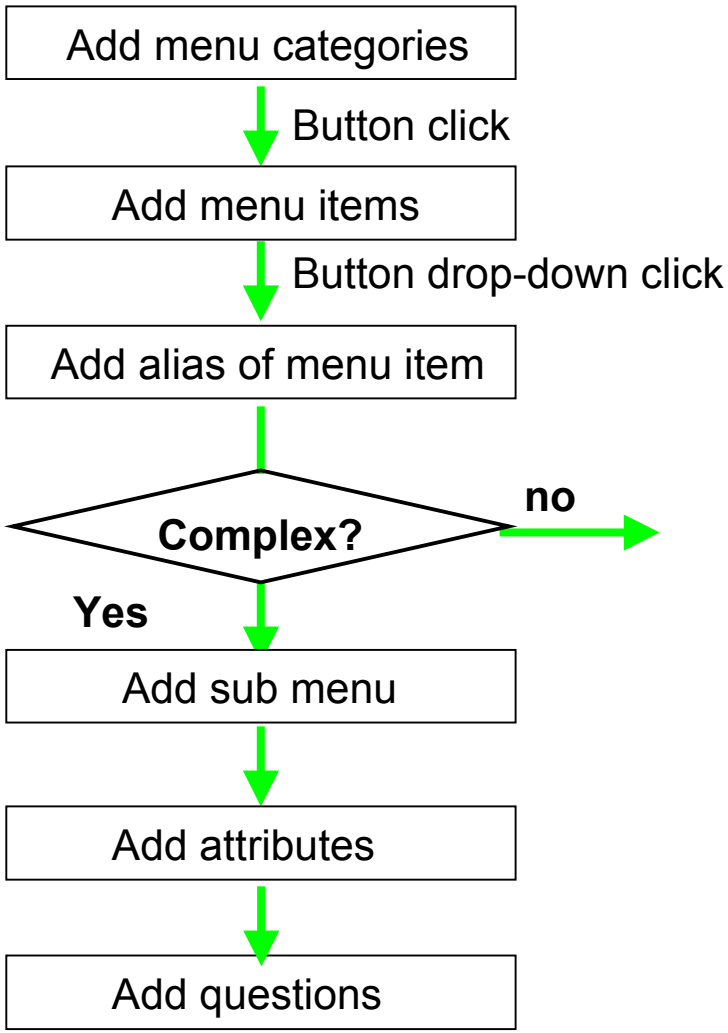
Menu board

- Can be shown or hide.
- Can be docked or undocked.
- A scroll bar will be automatically added if there is not enough space for the menu board.
- The size of menu board can be changed by dragging the right side or the bottom.
- Generated dynamically.

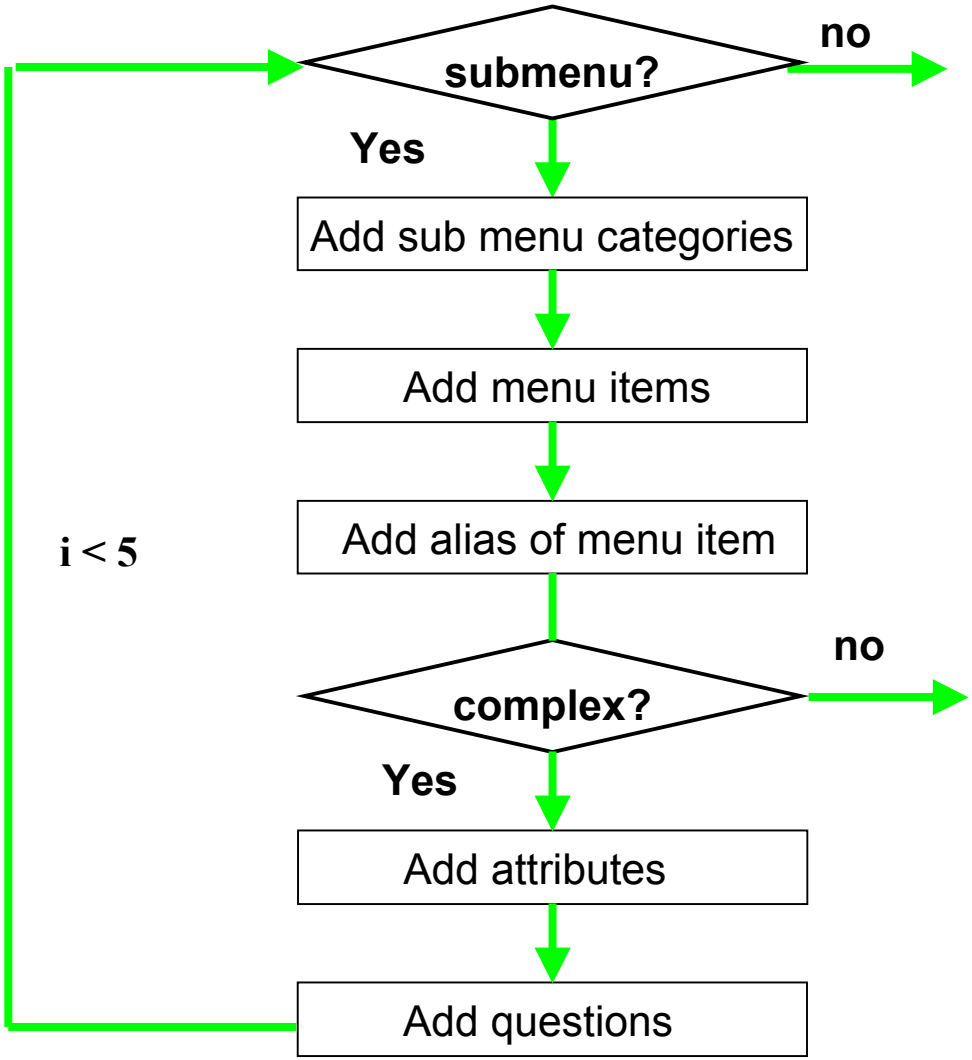
Menu board (2)

- Layered structure.
- Only the menu categories are shown on the menu board with their names and icons.
- Aliases, attributes, questions, sub menu items and the aliases, attributes, questions of the sub menu items are shown in the layers.

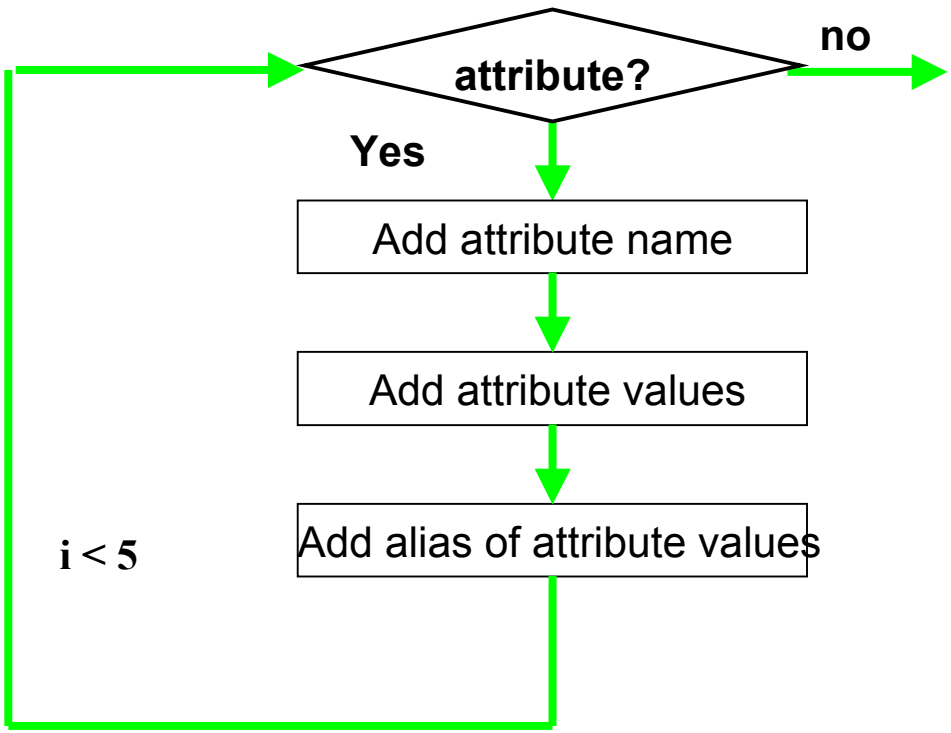
Generate the menu board



Add sub menus

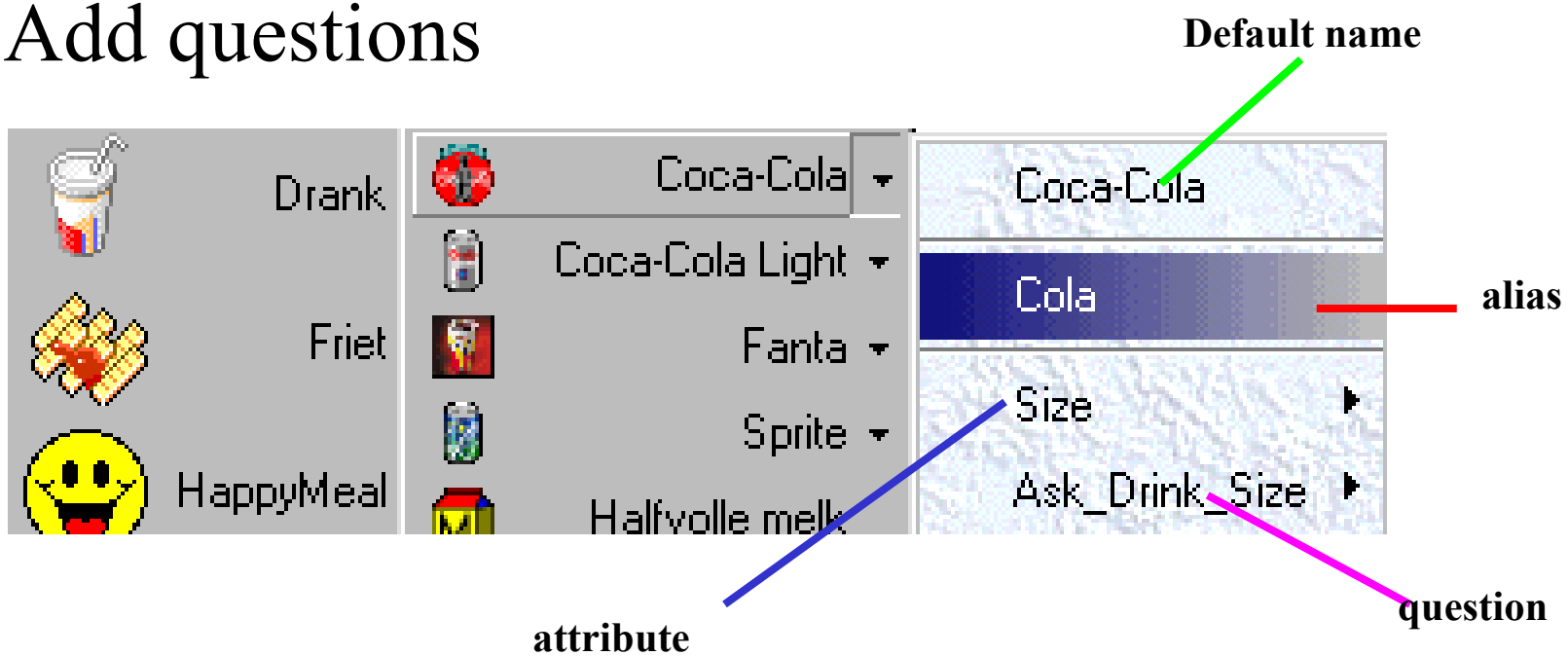


Add attributes



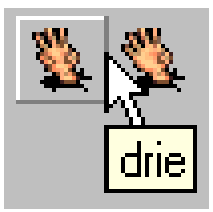
For example: cola

- Add alias – first the default name is added
- Add attributes
- Add questions



Show alias

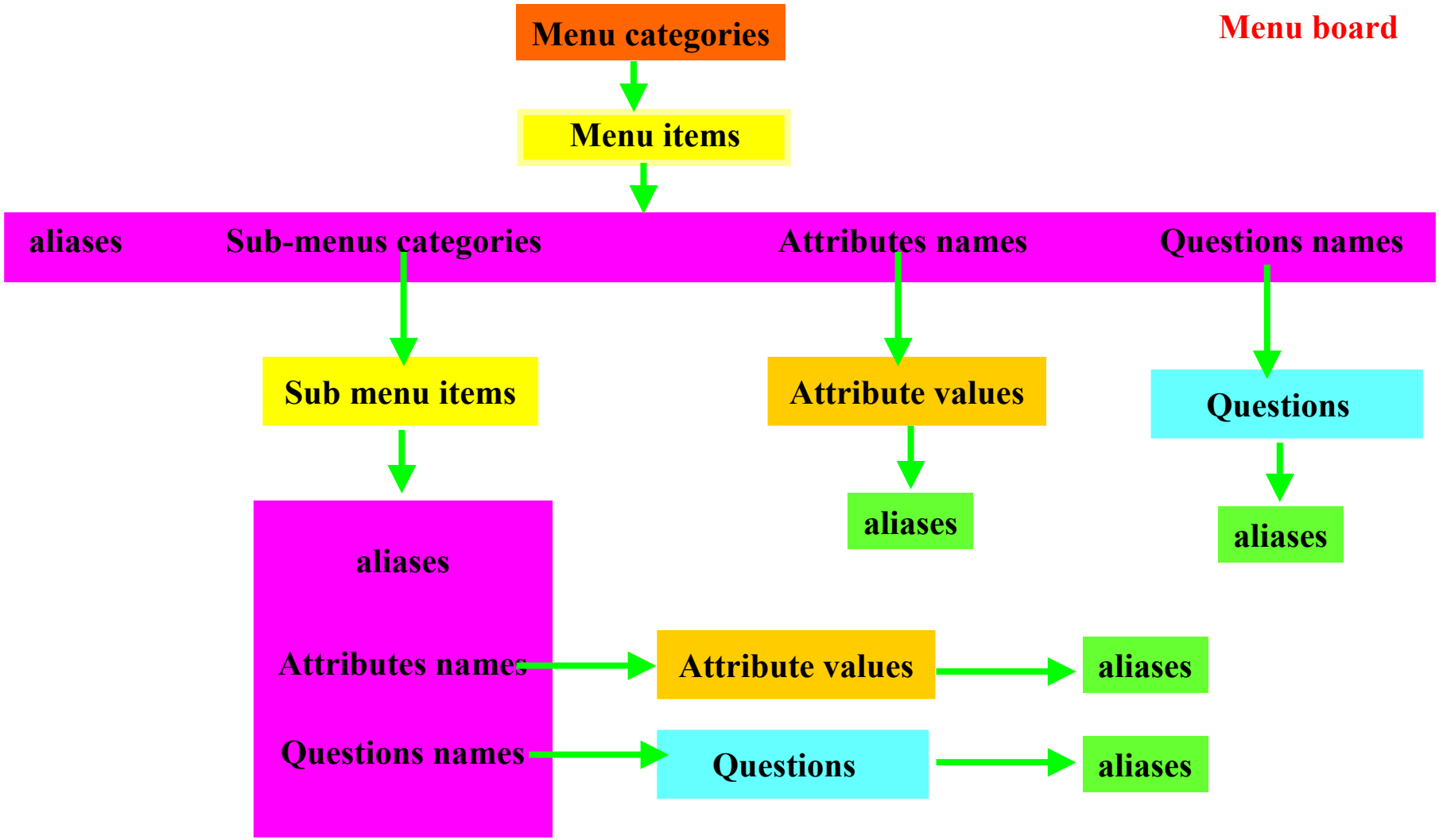
- Aliases are shown dynamically through commando board and menu board when needed.



1

2

Layered structure?



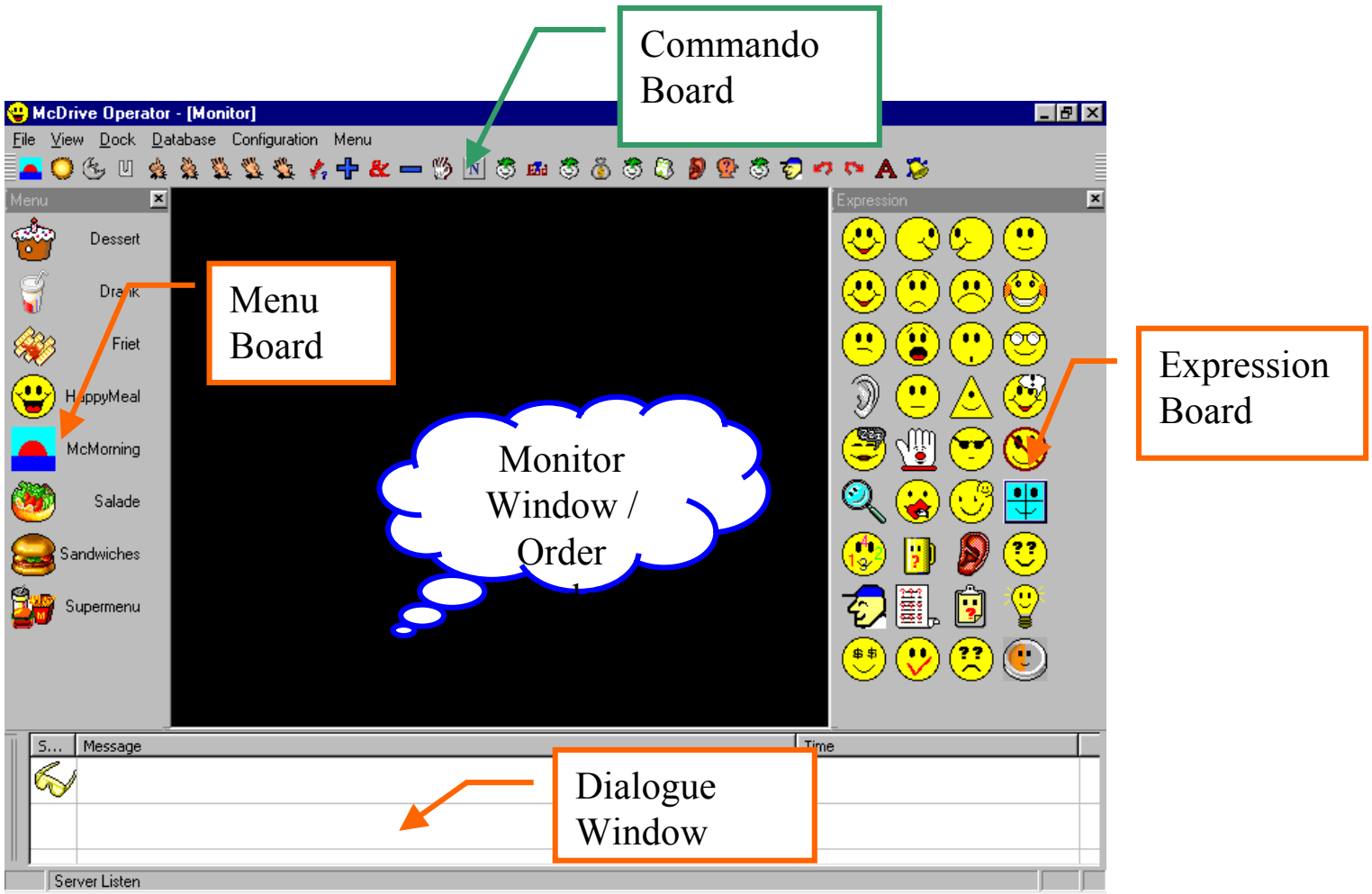
Why?

- A BigMac menu can have 6 layers. If the cuatomer orders a BigMac menu, the operator want to know the drink size, or he just want to use “small”.
- Why just put “small” in the 6e layer, not direct on the board? Why so complex?
- Preparation for the semi-automated and automated system.
- Reasoning process.

Operator Interface

- Keyboard
  - Menu board
  - Expression board
  - Commando board
- Dialogue window
- Order window
- Monitor window

Layout


Commando Board
McDrive Operator - [Monitor]
File View Dock Database Configuration Menu
Menu
Dessert
Drank
Friet
HappyMeal
McMorning
Salade
Sandwiches
Supermenu
Menu Board
Monitor Window / Order
Expression
Expression Board
S...
Message
Time
Dialogue Window
Server Listen

Menu board

- Click a button on the menu board →
  - Add the text to the dialogue window
  - Add code to the code sequence:

button	code	type
• Menu items on the board:	code,	menu
• Attributes on the layers:	code,	attribute
• Menu items on the layers:	code,	menu / submenu
• Questions on the layers:	code,	commando
• Aliases on the layers:	code of parent,	m /a /c /sm

Expression board

- Smileys can be added selectively to the expression board.
- Smileys has
  - Level 1
  - Level 2
  - Level 3
- Smileys have property “Show”
- The choice can be made through configuration.

Commando board

- Questions button
  - Predefined question about attributes
- Functional buttons:
  - Undo: go back to the begin of this sentence.
  - Redo
  - Text: add text that is not provided.
  - Send: send the response, add a new customer row in dialogue window
- other prompts
- Can have many aliases

Dialogue window

- Keep track of dialogues.
- Three fields:
  - Speaker: icon

    Shows the current operator expression in the operator row.
  - Prompt
  - Time

Monitor window

- Monitors the screen of the customer interface in real time.
- The operator can find out there is something wrong immediately.

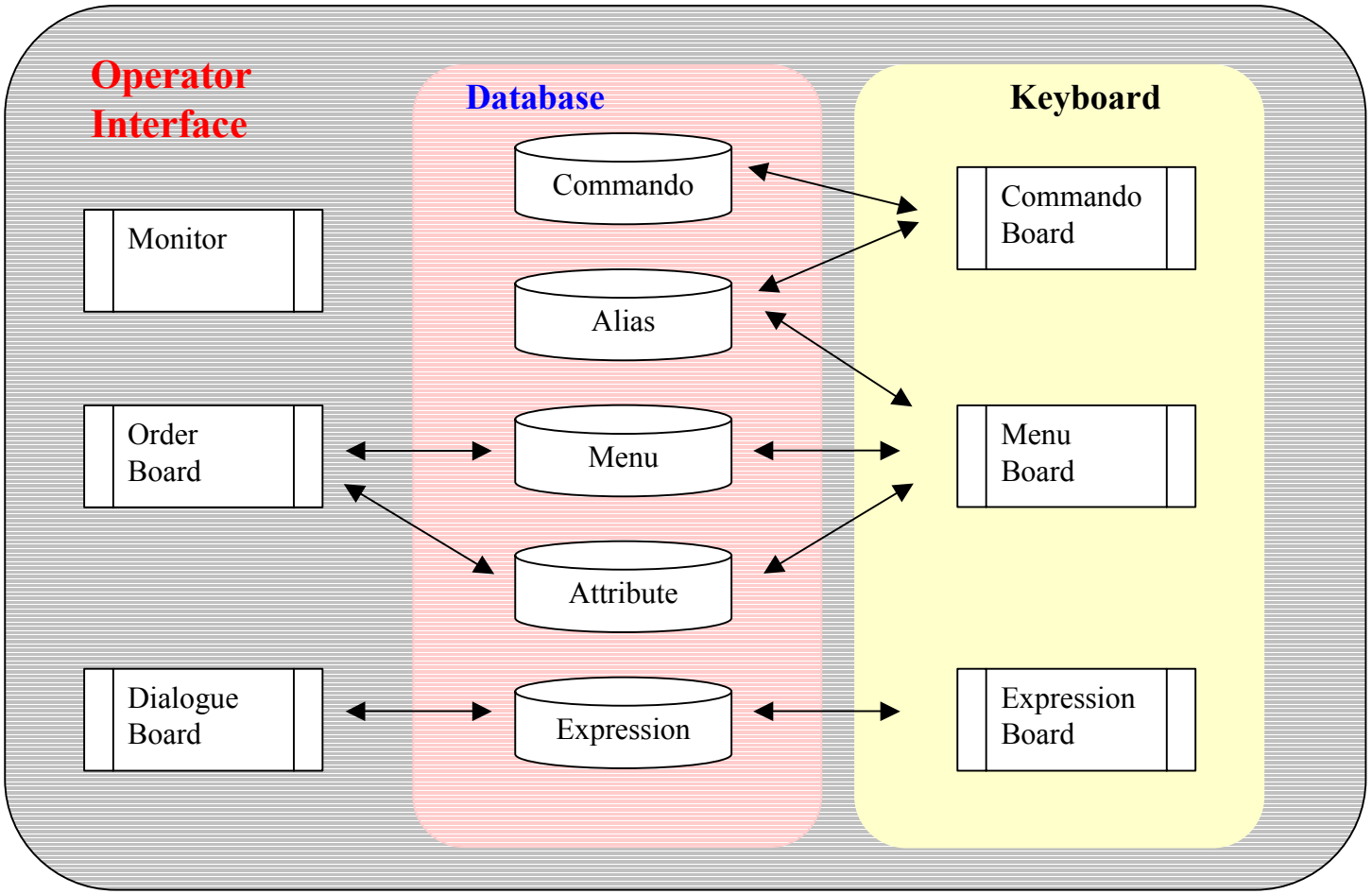
Order window

- A tree structure.
- The menu items and quantities are added after the customer confirms his order.

Status

- Informs the operator about the process of the server.

Interaction between interface and database



Server functions

- Configurations
  - Screen capture configurations
  - Expression board configurations
- Show IP address
- Configuration file
  - McDrive.ini
    - The settings of server, capture and etc.
  - Atttribute.ini
    - Bridge between the menu board and the tables menu, commando, attibute

Server functions (2)

- Real time remote client control
- Send system response sequence

	Type	code	text
Menu:	m	mxxxx	menu name
Submenu:	s	mxxxx	menu name
Attribute:	a		attribute value
Alias	l	m/a/cxxxx	alias text
Commando	c	cxxxx	commando text
Text	t		text

Sever functions (3)

- Real time remote monitor client screen
- Find out immediately if something is wrong

Customer interface

- Four separate sub-boards according to the feedbacks.
  - Text board
  - Graphical board
  - Wizard board
  - Smiley board
- Fixed size and location

Layout


440 pixel
360 pixel
Customer Interface
Connect View Configuration Window
Goeie morgen, dit is Multimodal McDrive Systeem. Wilt u alstublieft uw bestelling geven?
Server Connected
320 pixels
250 pixels
510 pixels
250 pixels

Graphical board

- Shows the pictures of menu items.
- Shows movies over the order process, pre-defined questions.

Wizard board

- Lisa is always on the screen.
- Lisa show the right facial expression at the right moment.
- Examples:
  - Lisa smiles when she greets the customers.
  - Lisa listens when the customer orders.

Text board

- Show the text response.
- Using different colors with different type prompts.
  - Menu items: red
  - Attributes: green
  - Submenus: blue
  - Others: yellow

Smiley board

- Show the smileys.
- Functions as a supplementary to the wizard.

Parse the system response

- Parse the received system response sequence

  [type : code : text]*

- Acts according the type of the system response

  m- show picture, text is red

  a - show text in green

  s - show menu picture, text is blue

  l – show alias text, picture / movie /nothing

  depends on the alias owner

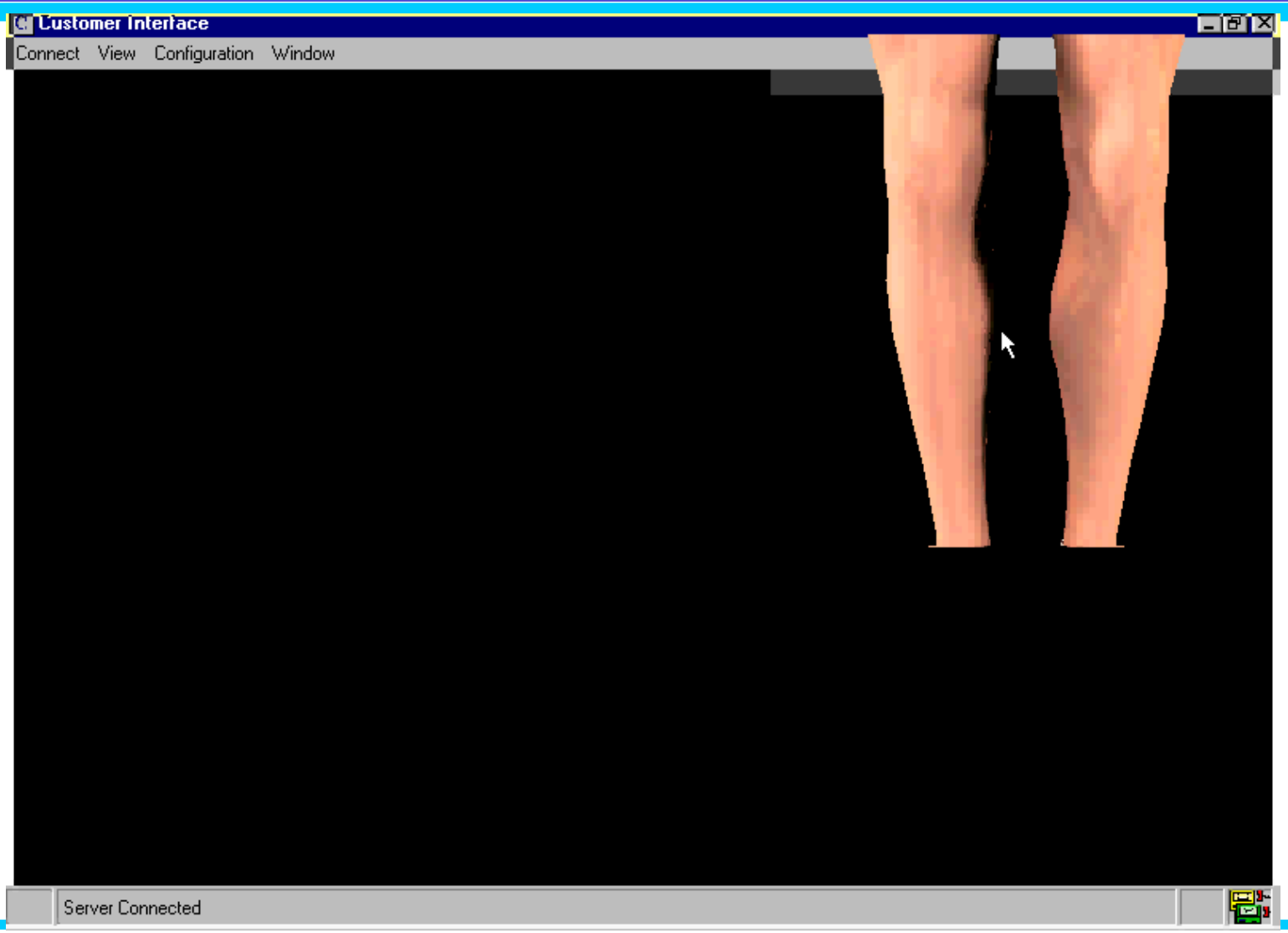
  t – show text

Screen capture

- Saves the current screen to an image file and sent to the Server.

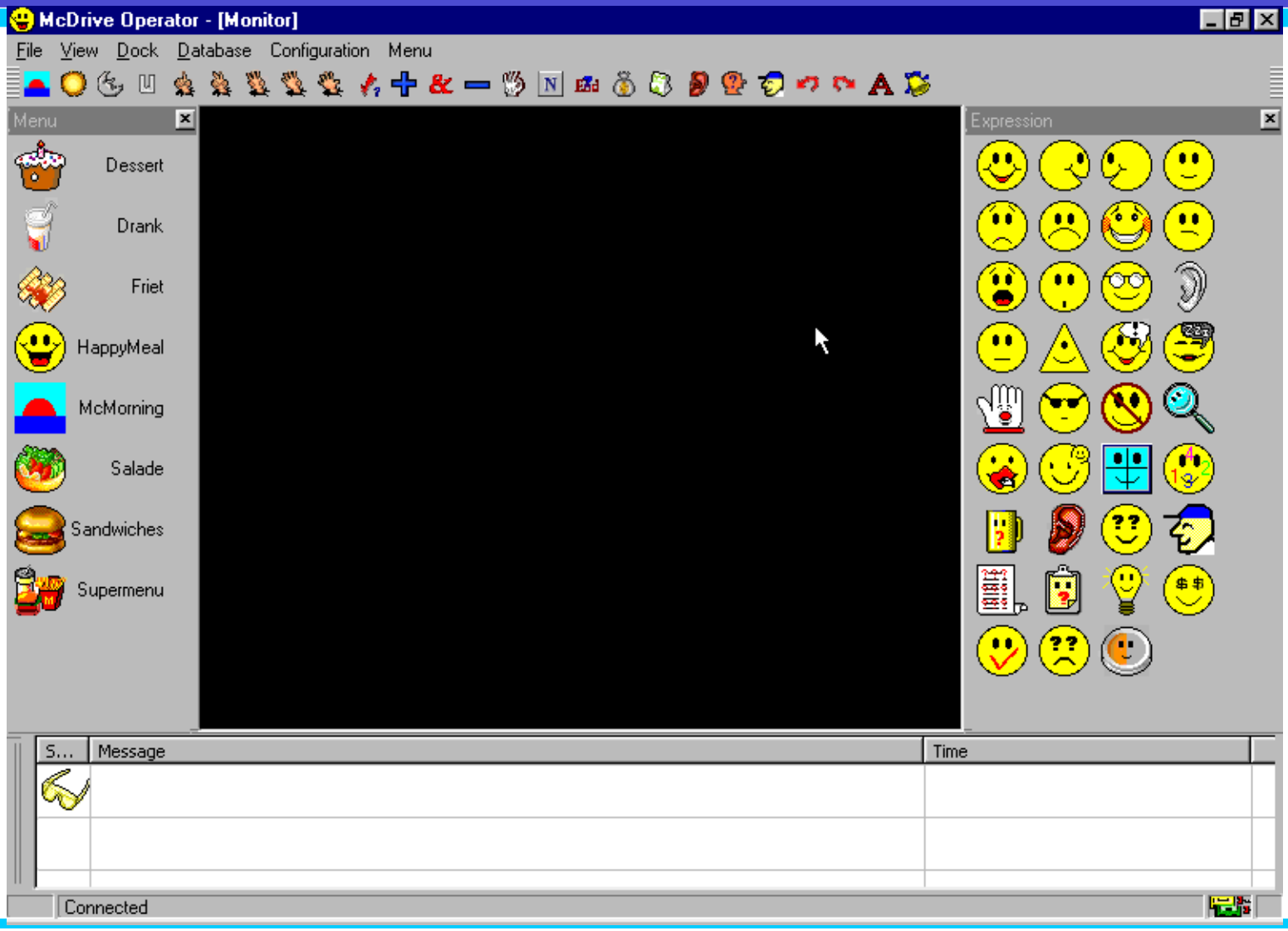
Simulation

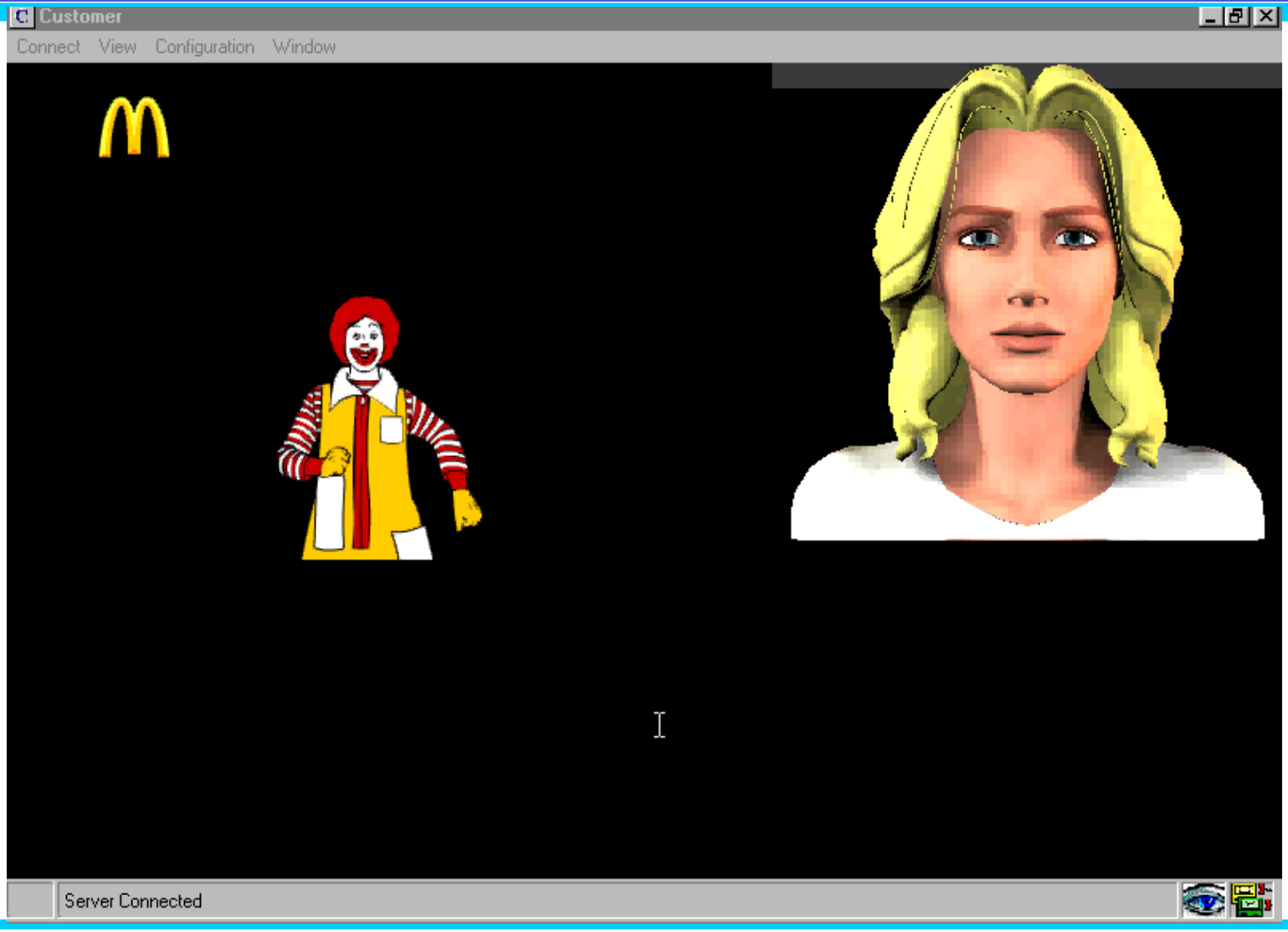
- Customer drives in


Customer Interface
Connect
View
Configuration
Window
Server Connected

- Operator: *Goeie morgen, dit is het Multimodal McDrive Systeem. Wilt ut alstublieft uw bestelling geven?"*

- *Customer: Ik wil een bigmac en een cola.*


McDrive Operator - [Monitor]
File View Dock Database Configuration Menu
Menu
Dessert
Drank
Friet
HappyMeal
McMorning
Salade
Sandwiches
Supermenu
Expression
S...
Message
Time
Connected


Customer
Connect View Configuration Window
Server Connected


Customer
Connect View Configuration Window
U heeft een BigMac besteld, klopt dat?
Server Connected

Conclusion

- Manual prototype is a flexible and dynamic system.
- Developed with logical thinking.
- A good basis of the semi-automated and automated system.

What we have done?

- Case study
- Dialogue analysis
- Dialogue model en minimal prompts sets
- Multimodal system
- Wizard and smiley
- Parsing
- Oz of test

What we have done? (2)

- Database
- Operator keyboard
- Operator interface
- Customer interface
- tests

Implemented system feedbacks

- Text
- Graphical
- Wizard
- smiley

Recommendations for the future

- More graphical stuffs.
  - A movie for every predefined question.
- A wizard for the operator.
  - Guide, assistant
- Smileys with degree : emotions of degree
  - smile degree 1 : smile lightly
- Layered expression board.
- Text window of Client screen self-scrolling.

Recommendations for the future

- Automated system:
  - Parse the order into a XML tree and search the XML to decide the next question.
  - XML tree can also be used to full the order form.

Many thanks

- Drs.dr. L.J.M. Rothtkrantz
- Graduation Committee

Multimodal McDrive System

End