Iconic Communication System by XML Language (SCILX)

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ABSTRACT
Traditional iconic systems establish direct iconic communication between a user and his environment by translating iconic sentences in sentences of a natural language, or by translating them into SQL (Structured Query Language) queries for relational data bases. This approach is limited because it is not suitable for communicating through the Internet which allows users of diverse background and culture to communicate all over the world. This paper presents SCILX, a XML-based iconic communication system which in addition to the functionalities of existing iconic systems enables communication through the Internet using the World Wide Web and the XML technologies. The approach has a formal foundation based on formal grammars of icons. A case study of an iconic interface for a multi-media database in traditional medicine (MEDITRA) is presented.

Categories and Subject Descriptors
D.3.4 [**Programming Languages**]: Processors – *code generation, interpreters, run-time environment.*

General Terms
Design, Human Factors, Languages.

Keywords
Iconic systems, XML documents, icon algebra, Web semantics, traditional medicine.

1. INTRODUCTION
An icon can be defined as a graphical symbol displayed on a screen and associated with a program to do a particular task. At the level of the interaction between users and appliances, icons:

- Permit a best training of the interface.
- Facilitate the recognition of the same commands used in different contexts.
- Permit to find the information in the screen quickly.
- Do not require a lexical comprehension of the information, and usually can be generalized from a language into another.
- Tend to a universal normalisation of interfaces.
- By their size, take less space than their lexical equivalent.

Figure 1 presents icons we usually see on our mobile phones and their lexical equivalents.

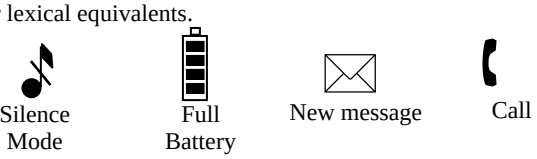


Figure 1: Icons and their lexical equivalent

Iconic communication is the base of the most arts and rituals, which by their major power of evocation make possible communication between people when the natural language is unusable [11]. When we look at Latin alphabet, Chinese alphabet, Japanese alphabet or Egyptians symbols, we observe that the last three use characters close to iconic characters.

The quantity and the diversity of iconic alphabets emphasize the difficulty to elaborate a universal code and put also in evidence the existence of two categories of iconic alphabets:

- The first category has to generalize non oral communication and to become a standard of symbolic exchanges. We can talk for example of iconic alphabet of SWIM (See What I Mean) system [4], developed in LIMSI Laboratory and which objective is to represent by icons, tense of verbs that a user wants to use.
- The second category is essentially for handicapped people. For example, we have iconic alphabet of Edith system [7] constructed for people who cannot express themselves by signs or speaking.

Other types of iconic alphabets have been developed in the case of technologic assistance. These iconic alphabets are generally integrated into graphic interfaces and make up for communication deficit. We can mention for example the Minspeak System [3] which uses an iconic keyboard where combined selection of keys permits the construction of sentences semantically extensive.

Iconic systems have many applications. For example, Edith system [7] is a system conceived to help patients communicate

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with their environment. The IBS system [6] offers possibilities to medical doctors to query a relational data base although they do not know how to write SQL queries. We can also mention Minspeak System [2] which is prosthesis of language conceived for persons who cannot express themselves by signs or speaking.

These iconic systems are based in a particular form of communication: direct communication with the environment of the user, either with a computer or with a person. These systems thus translate iconic sentences into natural language, or translate iconic queries into SQL queries.

It is interesting to generalize iconic communication by translating iconic sentences in a language that can be used to communicate through the Internet and that is easy to translate into a natural language. XML is a language designed to structure information to be sent through the Web.

This paper presents SCILX, a XML-based iconic communication system which enables communication through the Internet using the World Wide Web and the XML technologies. The approach has a formal foundation based on formal grammars of icons. It allows to translate an iconic sentence into a XML document and reversely. A detailed case study of an iconic interface for a multi-media database in traditional medicine (MEDITRA [5]) is presented.

The remaining of the paper is organised as follows: Section 2 details the architecture of SCILX. Our approach is illustrated with a case study in Section 3. We conclude the paper in Section 4.

2. ICONIC COMMUNICATION SYSTEM BASED ON XML (SCILX)

The architecture of SCILX is presented in Figure 2. The iconic interface is used to establish communication between human beings and computers.

The XML document generator and the iconic sentence generator are the core of the system, they allow respectively to translate iconic sentences into XML documents and XML documents into iconic sentences.

In the architecture we use a relational-object data base instead of a native XML data base. In this case, a middleware XML is needed to store XML documents and to support queries in XQuery language.

The user enters iconic sentences through the iconic interface. Those iconic sentences are transmitted to the XML document generator which translates the iconic sentences into a tree. The Icons knowledge base is used to replace iconic information into lexical information and the tree is then used to do the semantic interpretation of the iconic sentences by using the inference engine contained in the icons knowledge base. Then, the XML document is constructed and stored in the middleware XML.

3. APPLICATION DOMAIN: AFRICAN TRADITIONAL MEDICINE

One of the main motivations of this work is to develop an iconic communication system in traditional medicine to favour the dissemination of this practice in regions such as Africa where the illiteracy rate is high. In fact, XCILX is an important component of a larger project MEDITRA (MEDecine TRAditionnelle) [5] that aims at developing a knowledge base on Cameroonian/African traditional medicine. MEDITRA stores knowledge on diseases, medicinal plants, and natural medicines (potions). Considering the fact that traditional healers are mostly illiterate therefore cannot read or understand international natural languages such as English or French, it is nearly impossible for them to use classical interface based on menus written in such international natural language. In this section we show how the XML document generator is developed for the fabrication of potions. The readers are referred to [8] for a more detailed presentation of the architecture.

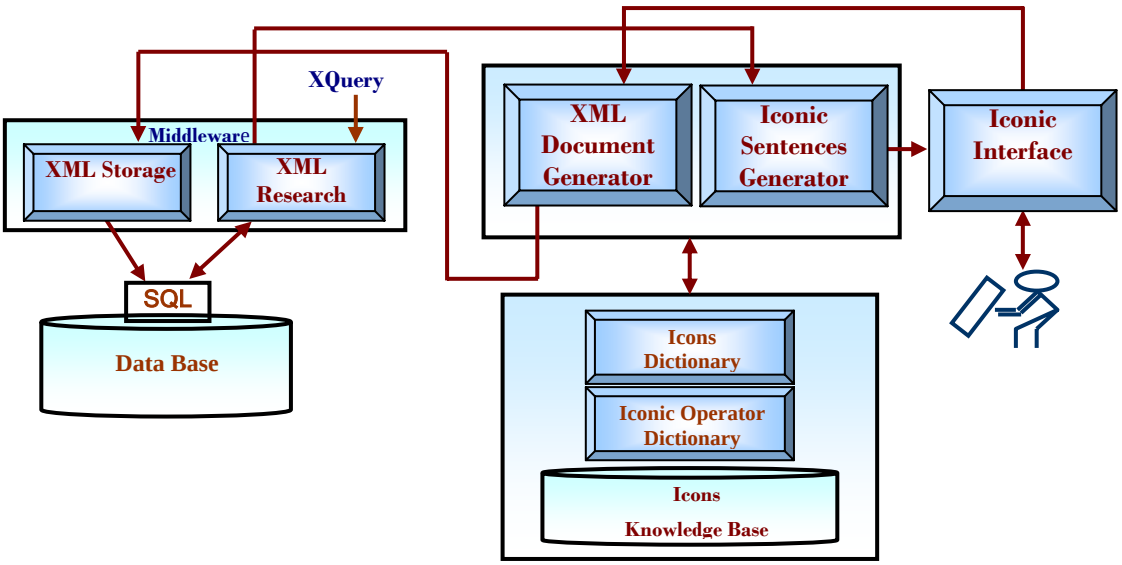


Figure 2: The components of SCILX

3.1 The Design of the alphabet

The fabrication of potions requires an alphabet to describe the ingredients (e.g medicinal plants), the preparation method (e.g. infusion, maceration), the time of the day (morning, midday, afternoon, evening), quantities of ingredients used, and so on. First of all, we have scanned a set of medicinal plants [9]. Then, we have conceived icons that are meaningful to traditional healers as depicted in Figure 3. For example, some old African habit consists to count with our fingers. This inspires us to draw icons of quantity. We have also borrowed from modern medicine some icons, to express the time of the day (morning, midday, afternoon, evening), which are usually seen on some packaging of medicines. Figure 3 shows some icons of the iconic alphabet for the fabrication of potions.

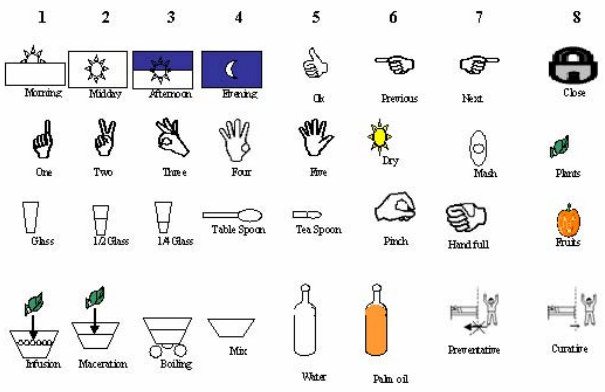


Figure 3: Sample of iconic alphabet for SCILX-MEDITRA

3.2 The grammar

An iconic sentence is built from iconic alphabet and two binary operators' **ver** and **hor** that specify the graphical arrangement of icons. If X and Y are icons, X **ver** Y means that these icons are aligned vertically with X on the top of Y. Similarly, X **hor** Y means that the icons are aligned horizontally with Y at the right of X. The syntax of iconic sentences for the fabrication of potions is given by the following context-free grammar, where terminal symbols are in small letters, non-terminal symbols are in capital letters, the axiom is POTION and ε denotes an empty string.

POTION := LIST_INGREDIENT hor PREPARATION hor MODE hor FACTEUR hor FINALITE

LIST_INGREDIENT := NOM ver QUANTITE ver UNITE ver TRANSFORMATION INGREDIENTS

INGREDIENTS := hor LIST_INGREDIENT | ε

PREPARATION := DESC ver QUANTITE ver UNITE

DESC := infusion | decoction ver LIQUIDE | maceration ver LIQUIDE

MODE := morning ver QUANTITE ver UNITE hor MIDI | MIDI

MIDI := midday ver QUANTITE ver UNITE hor APRESMIDI | APRESMID

APRESMIDI := afternoon ver QUANTITE ver UNITE hor SOIR | SOIR

SOIR := evening ver QUANTITE ver UNITE | ε

FACTEUR := pregnant-woman | empty-stomach

FINALITE := preventive | curative

NOM := aloes | bidens | oreille-chien | ...

QUANTITE := 1 | 2 | 3 |...

UNITE := glass | handful | pinch | litre |...

TRANSFORMATION := mash | carve | dry |...

LIQUIDE := water | palm-wine | palm-oil | ...

3.3 XML document generation

In order to generate an XML document corresponding to an iconic sentence, we decorate the grammar presented above with semantic actions. These actions are executed by the parser during the analysis of an iconic sentence. The actions are denoted here by action1, action2, and so on.

POTION := **{action1}**LIST_INGREDIENT hor PREPARATION hor MODE hor FACTEUR hor FINALITE **{action2}**

LIST_INGREDIENT := **{action3}** NOM ver QUANTITE ver UNITE ver

TRANSFORMATION **{action4}**INGREDIENTS

INGREDIENTS := hor LIST_INGREDIENT | ε _

PREPARATION := **{action5}** DESC ver QUANTITE ver UNITE **{action6}**

DESC := infusion **{action7}** | decoction **{action8}** ver LIQUIDE | maceration **{action9}** ver LIQUIDE

MODE := **{action10}** morning **{action11}**ver QUANTITE ver UNITE hor MIDI | MIDI

MIDI := midday **{action12}** ver QUANTITE ver UNITE hor APRESMIDI | APRESMIDI

APRESMIDI := afternoon **{action13}** ver QUANTITE ver UNITE hor SOIR | SOIR

SOIR := evening **{action14}** ver QUANTITE ver UNITE **{action15}** | ε ….

The semantic actions that generate the XML code corresponding to an iconic sentence are defined in a pseudo language as follows:

action1 = Print("< ?xml version='1.0' encodage 8.0>") ;

Print ("<- !exemple document XML relative à une potion- !>") ;

Print ("<potion code=001>") ;

x = 1 ;

action2 = Print ("</potion>") ;

action3 = Print ("<ingredient code=",x,">") ; x = x+1 ;

action4 = Print ("</ingredient>") ;

action5 = Print ("<preparation>") ;

action6 = Print ("</preparation>") ;

action7 = Print ("Infusion: ") ;

action8 = Print ("Decoction: ") ;

action9 = Print ("Maceration: ") ;

action10 = Print ("<mode> ") ;

action11 = Print ("Morning: ") ;

action12 = Print ("Midday: ") ;

action13 = Print ("Afternoon: ") ;

action14 = Print ("Evening: ") ;

action15 = Print ("</mode> ") ;

This technique can easily be implemented using tools such as YACC [1][12].

3.4 Example

Let us now give an example of construction of a potion to treat stomachache with the medicinal plant "centella" (Take five handfuls of centella and boil it with four glasses of water then drink one glass of the decoction in the morning, one glass midday and one glass in the evening).

The iconic sentence associate to this sentence is shown in figure 4.

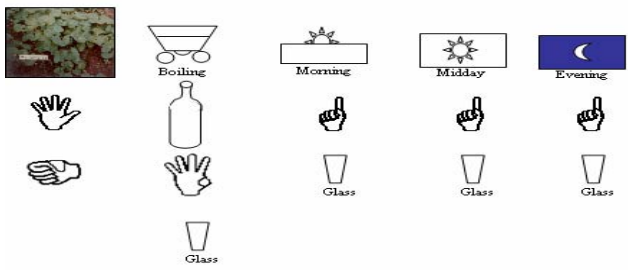


Figure 4: Example of iconic sentence

The literal sentence associated to this iconic sentence is: (Centella **ver** 5 **ver** Handful) **hor** (Boiling **ver** Water **ver** 4 **ver** Glass) **hor** (Morning **ver** 1 **ver** Glass) **hor** (Midday **ver** 1 **ver** Glass) **hor** (Evening **ver** 1 **ver** Glass).

The analysis of this iconic sentence generates the following XML document:

```
<? xml version='1.0' encodage 8.0>
<- !example XML document relative to a potion- !>
<potion code=001>
    <ingredient code=1>
        <name> Centella </name>
        <quantity> 5 </quantity>
        <unity> Handful </unity>
    </ingredient>
    <preparation>
        Boiling: 4 Glass of Water
    </preparation>
    <mode>
        Morning: 1 Glass Midday: 1 Glass Evening: 1 Glass
    </mode>
</potion>
```

4. CONCLUSION

We have presented in this paper an Iconic Communication System by XML Language abbreviated SCILX. Unlike other iconic communication systems, SCILX allows the translation of an iconic sentence into a XML document and reversely. This makes it possible to use SCILX to communicate through the Internet.

In future work, we aim at integrating SCILX and the Semantic Web which is a promising technology backed by the W3C.

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