



## HL7 in Personal Health System component's integration for Mental Health Treatment

HL7 como componente de integração em Sistema de PEP para tratamento em Saúde Mental

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### ABSTRACT

Help4Mood is a project inside 7th European Framework Programme (FP7) for developing a computational distributed system to support remotely the treatment of patients with major depression at home. Core components are integrated with Health Level Seven (HL7) standard. One of the main goals of this system is to use the paradigm of a Virtual Agent to support the first symptoms of clinician alert of a patient, to interact with him and to prevent some causes of relapse. The system processes inputs from different devices (to monitor sleeping, eating and motor activity) in a decision support system, and the Virtual Agent interacts with the patient before clinical support from hospital is needed. The technical framework is using the open source HL7-standard-based healthcare integration engine, Mirth Connect, to interact with the different subsystems, analyze data and give different priorities for messages in queues. Particularly, the use of standard HL7 will contribute to interest in the project results and the potential impact through the development, dissemination and use, as stated in the analysis of the European commission

**Descritores:** Sistemas de Saúde; Informática Médica; Nível Sete de Saúde

### RESUMO

Help4Mood é um projeto do 7º Programa de Framework Europeu (FP7) para desenvolvimento de um sistema computacional distribuído para apoio remoto de tratamento domiciliar de pacientes com depressão. Os principais componentes são integrados com o padrão Health Level Seven (HL7). Um dos objetivos principais deste sistema é a utilização do paradigma de um agente virtual para apoiar os primeiros sintomas de alerta clínico de um paciente, interagindo com ele de forma a impedir que algumas ocorrências de recaída. O sistema processa as entradas de dispositivos diferentes (para monitorar a dormir, comer e atividade motora) em um sistema de apoio à decisão, e o Agente Virtual interage com o paciente antes que o atendimento clínico hospitalar seja necessário. O framework usa o código-fonte "open source" como motor de integração baseado no padrão HL7, chamado "Mirth Connect" a fim de interagir com os diferentes subsistemas, analisar os dados, e dar prioridades diferentes para as mensagens enviadas. A utilização do padrão HL7, por certo, contribuirá para os resultados do projeto e o impacto potencial através do desenvolvimento, difusão e utilização, como referenciado na análise da Comissão Europeia do programa.

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## INTRODUCTION

HELP4MOOD<sup>(1)</sup> proposes to significantly advance the state-of-the-art in computerised support for people with Major Depression by monitoring mood, thoughts, physical activity and voice characteristics, prompting adherence and promoting behaviours in response to monitored inputs. These advances will be delivered through a Virtual Agent, which can interact with the patient through a combination of enriched prompts, dialogue, body movements and facial expressions. Monitoring will combine existing (movement sensor, psychological ratings) and novel (voice analysis) technologies, as inputs to pattern recognition based decision support system for treatment management. The main aim of the Help4Mood system is to provide an approach for supporting the control, communication and treatment management of patients with major depression. This approach will be a distributed system with the three main components (the Personal Monitoring System, the Virtual Agent component and the Decision Support System for Treatment Planning) deployed at patient's site.

One of the main technological objectives is to interconnect the different subsystems using standards, mainly HL7 in the application layer. For this purpose, i2Cat researchers have tested different engines that could be adapted for this heterogeneous environment. As an interesting comment, we must note that the Evaluation Summary report of the EC commission stated that "In particular the use of standard HL7 will contribute to interest in the project results", in the "Potential impact through the development, dissemination and use of project results" section.

### HELP4MOOD PROJECT AND 7TH EUROPEAN FRAMEWORK PROGRAMME (FP7)

Help4Mood is an initiative funded by the 7th Framework Programme on 2009, in the call FP7-ICT-2009-4.5.1 for Personal Health Systems<sup>(2)</sup>. Help4Mood is a collaborative initiative of several European institutions, based in United Kingdom, Spain, Romania and Italy.

This project is funded by the objective addressed by FP7-ICT for Mental Health, specifically for ICT based solutions for persons suffering from stress, depression or bipolar disorders, where interdisciplinary research will address the parallel development of technological solutions, as well as new management or treatment models based on closed-loop approaches. Help4Mood emphasises the use of multi-parametric monitoring systems, which monitor various metrics related to behaviour and to bodily functions (e.g. activity, sleep, physiological and biochemical parameters). The proposed system (Fig. 1) will aim at (i) objective and quantitative assessment of symptoms, patient condition,

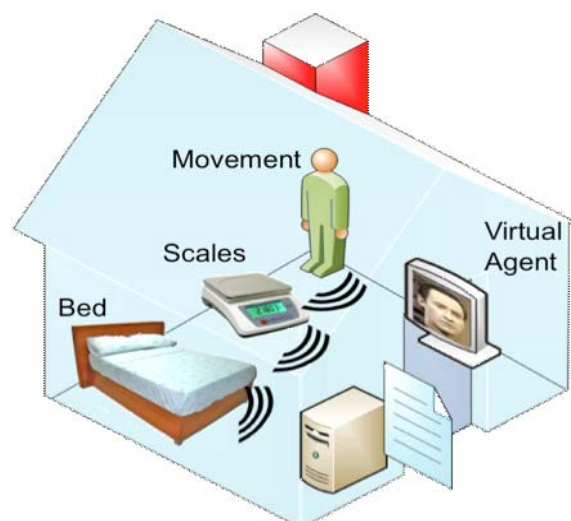
effectiveness of therapy and use of medication; (ii) decision support for treatment planning; and (iii) provision of warnings and motivating feedback. In the case of depression, the system will also aim at prediction of depressive or manic episodes. The solutions will combine portable or implantable devices, with appropriate platforms and services. They will promote the interaction between patients and doctors and facilitate self-treatment and cognitive behavioural therapy where necessary.

For such project, with different components to be integrated, standardisation is a very important key issue for the European commission, as it is summarised in the Evaluation Report of the CE for the project, as seen in previous paragraphs. HL7 messages will be used in the communication of this distributed system, principally using HL7 v2.6 messages with XML syntax (or v3.0 if the context support the applicability of v3.0 standard) and CDA for exchanging clinical documents across specialists.

## METHODOLOGY

In a general perspective, the research group of i2Cat Foundation has tested some HL7 engines to reach the desired functionality in such a distributed system. This task implies the evaluation of different solutions, but two principal products have been detected to fulfill the needs of the project.

In earlier phase in project, we have focused in the analysis and study several tools for analyze HL7 messages and extract useful information contained in it.



**Figure 1** - Architecture of the Help4Mood distributed system to support Mental Health treatment at patient home.

However, why do we need these tools? In HL7 context there are, basically, two worlds: computer world and human world. HL7 v2.x messages use a difficult syntax for human world but easy syntax for computer world. Each message is divided into segments, fields, components and subcomponents divided by separator symbols like '|' or '^' that they identify different chapters in semantic

world (world where syntax gets meaning in human world). Below we show an example of normal HL7 2.x message.

As we can see in Figure 2, handle data with that syntax can become difficult. For this reason, from 2.5 and newer versions (like 3.0) that syntax becomes specific-XML syntax. Obviously, this syntax improved over the older. But, as usually happens in computing, most users still use the old, as human and economic cost does not compensate them.

If we think in normal HL7 actor (computer or human user) needs we can think in that workflow:

1. There are HL7 messages travelling through a network. That network should not necessarily be Internet, can be any network, both private and public.

2. There is an OSI level 7 application interested in specific encoded data of any of these messages.

Clearly, we need tools that help us to get data we need from HL7 messages.

### Interfaceware Chamaleon

Chamaleon<sup>(3)</sup> is a privative option we have tested. Chamaleon is HL7 parsing core of Iguana (a full HL7 toolkit).

Chamaleon works analyzing HL7 messages travelling through over a network and catching HL7 messages we are interested and select data we need applying programmer-defined filters. In the end of process, we get several specific programming language classes that they generate a server that listens network and detect HL7 messages for handle data in them. This way we can add these classes to our project worrying only to work with well-known data structures. All process can be summed up in seven easy steps:

1. To acquire information for working. This involves agreeing with the HL7 messages sender. Each sender can make specific changes to HL7 standard. We need to know our HL7 specific syntax.

2. Chamaleon checks all HL7 messages travelling through over the network and map from HL7 messages to well-known user-defined data structures.

3. Chamaleon generate specific programming language code to include these data structures into our application

4. Another possibility is to not have a server listening a network. If we want, Chamaleon has an automatic process for building a server listening incoming HL7 messages.

5. In this point, we are able to handle known messages. And, what happens with unknown HL7 messages? Chamaleon has a process where we define what to do with these kind of messages. We can apply specific logic when we catch unknown messages.

6. Perhaps, we want to modify a HL7 message data before we map to programming language data structures. Chamaleon lets do that. We can define little Python scripts for changing strings or other kind of data contained in HL7 message.

7. The last step involves how can we work with repeated messages. Repeated messages are a problem for simpler data structures. We need to create specific complex data structures for this kind of messages. Chamaleon has an automatic process for defining these data structures.

### Mirth Connect

Mirth Connect<sup>(4)</sup> is an open source option for a full HL7 message handling framework. It is a rich interface channel development and real-time connection monitoring environment.

Mirth Connect supports a lot of protocols for connecting to external systems. Any of this protocols are: MLLP, HTTP, S/FTP, Email, Files (PDF, RTF), JMS or Web Services. It also uses a variety of standard messaging protocols like HL7 v2.x, HL7 v3, X12, XML, DICOM, EDI or NCPDP, allowing to perform message filters for catching interesting data contained into messages. Like Chamaleon, it allows transform message before apply a certain filter, too. User can create user-defined rules which Mirth will take a specific action when matching with certain rule. That action can be sending an email, storing data in a database, call a remote procedure in a Web Service, and much more. Mirth Connect works with a self contained application Jetty server. For this, it is written entirely in Java. Channels are deployed into Mirth Server and can be monitoring and configured remotely through Mirth Administration interface.

```
MSH|^~\&|1100^KC^MLI^KC000077^200602011322||ORU^R01^213629236638167|P^2.3^||AL|||||
PID|1|3075826579^|3075826579^|Greco^Alexander^D^19751019^M|709
NTE|1|PATIENT NOT FASTING|
ORC|RE|03141314470^LAB^|200601310000^|F60390^ADAMS^K^U|
OBR|1|03141314470^LAB^|03141314470^LAB^|102277^Gestational Diabetes Eval^L^|200601311450
NTE|1|Clinical Information: DRAW AT 320PM|
OBR|1|NM|102278^Gestational Diabetes Screen^L^|1105|mg/dL^|65-139||N|F|19980406^|200602011127
ORC|RE|03141314470^LAB^|200601310000^|F60390^ADAMS^K^U|
OBR|2|03141314470^LAB^|03141314470^LAB^|005041^Hemoglobin^L^|10.7|g/dL^|11.5-15.0|L|N|F|20010530^|200602010120^KC
OBR|1|NM|005041^Hemoglobin^L^|10.7|g/dL^|11.5-15.0|L|N|F|20010530^|200602010120^KC
ORC|RE|03141314470^LAB^|200601310000^|F60390^ADAMS^K^U|
OBR|3|03141314470^LAB^|03141314470^LAB^|005058^Hematocrit^L^|30.8|L|N|F|20040701^|200602010120^KC
OBR|1|NM|005058^Hematocrit^L^|30.8|L|N|F|20040701^|200602010120^KC
ORC|RE|03141314470^LAB^|200601310000^|F60390^ADAMS^K^U|
OBR|4|03141314470^LAB^|03141314470^LAB^|015180^Hematology Comments:^L^|200601311450
NTE|1|CE|015180^Hematology Comments:^L^|200601311450
NTE|2|L|^Performed At: KC, LabCorp Kansas City~1706 N Corrington Avenue Kansas City, MO 641200000-Na
```

Figure 2 - Typical example of HL7 v2.x message.

## RESULTS AND DISCUSSION

Today, in medical environments there are different ways to represent medical data in computer world. This is a real problem if we need to share certain data. For instance, patient information needs to be revised by two or more area specialists to perform a diagnosis. To avoid this problem hospitals and medical clinics use HL7 as a standard to represent medical information in computer world. As we said before, HL7 has a very complex syntax for a human and we need tools that monitoring messages through over the network, parse it extracting interested data for us and take any action with data (send an email, store information in any physic medium, store data in database).

Mirth works under self contained server called Mirth Server (Jetty application server). We can deploy different channels for each different data we need. We can perform one or many actions for each channel. This means that when a channel detects an interesting type of information for us (previously configured), it will extract that information and will take one or many actions.

However, how can we configure a channel? Mirth provides Mirth Administration Tool which can monitor state of channels and configures each channel (including actions).

This way, we can focus us in our specific problem and delegate HL7 messaging problems to Mirth. For instance, if we store HL7 messages data in a database (Mirth problem), we only have to handle that information for our needs (our problem). Other example can be if

we have our logical in a web service. We can do that Mirth send a request to our procedure in web service with right parameters (extracted from HL7 messages) and send an email to certain email address to alert someone.

In short, for all this advantages and because it is open source Mirth is tool we have selected for HL7 messaging functions.

## CONCLUSION

Nowadays, the Personal Healthcare Systems (PHS) is one of the emerging fields<sup>(5)</sup>. In PHS there are several fields where lot of research has to be done and still going on in the future there endless scope to do work in personal healthcare too.

There are future directions of the development of this home health systems, and integration and interoperability of the components that collect, transmit and processes these data, will use standards as HL7 to maintain the compatibility of the whole system.

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