HEARTFAID

D 24 – 6th Quarterly Managerial Report

(MB and STAB meeting minutes)

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HEARTFAID

A KNOWLEDGE BASED PLATFORM OF SERVICES FOR SUPPORTING MEDICAL-CLINICAL MANAGEMENT OF THE HEART FAILURE WITHIN THE ELDERLY POPULATION

Project summary	
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Project Co-ordinator Name:	Domenico Conforti
Project Co-ordinator Organisation:	UNICAL University of Calabria (Italy)
Thematic Priority:	Information Society Technology-ICT for Health
Instrument:	Specific Targeted Research Project

Consortium

- UNICAL- Università della Calabria (Italy)
- UNICZ- Università degli studi Magna Graecia di Catanzaro (Italy)
- UNIMIB- Università degli studi di Milano Bicocca (Italy)
- JUMC- Jagiellonian University Medical College (Poland)
- VMWS- Virtual Medical World Solutions Ltd (United Kingdom)
- FORTHNET S. A.- Hellenic Telecommunications and Telematic Applications Company S. A. (Greece)
- SYNAP- Synapsis s.r.l. (Italy)
- CNR- Consiglio Nazionale delle Ricerche (Italy)
- FORTH-Foundation for Research and Technology Hellas (Greece)
- RBI- Rudjer Boskovic Institute (Croatia)
- AUXOL- Istituto Auxologico Italiano (Italy)

D24 – 6th Quarterly Managerial Report
MB and STAB meeting minutes

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Short Description
This document describes the activities of the Consortium during the sixth quarterly of HEARTFAID project and its future activities.

Change Record		
Version Number	Changes	Release date
1.0	First draft of the Document	19/07/2007
1.1	Contributions from partners	10/09/2007
2.0	Final version	14/09/2007

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Executive Summary

The sixth Quarterly Managerial Report describes the activities and the objectives achieved by HEARTFAID Consortium during the period May 1 2007- July 31, 2007.
The work has been carried out by each partner of the Consortium sharing the responsibilities and duties in order to effectively perform all the obligations and requirements of the period.

The following WPs have been involved :

- WP0: Management
- WP2: Biomedical Data Identification and Collection
- WP3: Middleware, Interoperability and Integration
- WP4: Knowledge, Representation, Discovery and Management
- WP5: Data processing and Decision support devices
- WP6: End-User application and Services
- WP8: Dissemination and Exploitation

The following deliverable has been produced during this quarter:

- D18: 5th quarterly managerial report

The subsequent interim period has been particularly intense from a technical point of view as the deadlines of M18 have involved the following WPs:

- WP2:
  - MS 2.2: Technological Infrastructure for the acquisition and the transmission of the relevant BM data.
  - Deliverable D19.
- WP3:
  - MS 3.2: Early mock-up prototype implementation of the Data Management and Exchange System.
  - Deliverable D20.
- WP4:
  - MS 4.1: Ontology and knowledge representation.
  - Deliverables D21 and D22.
- WP5:
  - MS 5.1: Early mock-up prototype of data processing and decision support services.
- WP6:
  - Deliverable D23.

At the end of the description of each WP, the objectives and the future foreseen activities, in the light of review outcome, for the subsequent quarter have been set and can be summarised as follows:

- WP0: monitoring of the overall technical and management activities and coordination and support for the next steering meeting in Cracow (hosted by JUMC).

- WP2: further development and testing of the prototype of the data acquisition and transmission infrastructure and development of the clinical data collection.
- WP3: further development and testing of the first prototypal version of the data management and exchange system.
- WP4: development of data preparation and knowledge discovery activity.
- WP5: implementation of the prototypes of the data processing and decision support services.
- WP6: development of end-user applications and services.
- WP8: further dissemination activities according to the early plan.

Consortium Management: WP0

WORK PACKAGE: 0
TITLE: MANAGEMENT
START DATE: MONTH 1
WORK PACKAGE LEADER:UNICAL
PARTNERS INVOLVED:UNICZ, UNIMIB , VMWS ,FORTHNET, SYNAPSIS , CNR,RBI

STATUS OF DELIVERABLES DUE IN THIS PERIOD

		DATE DUE	COMMENTS
DELIVERABLE	N°		
6th Quarterly Managerial Report	D 24	31/07/07	The Deliverable has been completed on time with the contribution of each WP leader

FORECAST STATUS OF DELIVERABLES DUE IN THE NEXT 3 MONTHS

		DATE DUE	COMMENTS
DELIVERABLE	N°		
7th Quarterly Managerial Report	D 25	30/10/07	The Deliverable is foreseen to be completed on time following the structure in use

MEETINGS OF THE PERIOD AND FORECASTED WP0- MB & STAB MEETINGS

	COMMENT	DATE/PLACE
FORTH/ FORTHNET/ UNICAL/CNR		Crete 28/05/2007
MB & STAB Meeting	Hosting: RBI & STAB Member Goran Krstacic Attendants: MB & STAB	Zagreb 21/23 June2007
MB & STAB Meeting	Hosting: JUMC Attendants: MB & STAB	Cracow 8/9 November 2007

Description of the activities

During this quarter the management of the Consortium has mainly focused on the outcome of the first reporting period, above all on financial issues and on the co-organisation and management, together with the hosting partner RBI and the support of the External Advisor Dr.Goran Krstacic, of the MB & STAB meeting held in Zagreb on June 21-23.
The meeting held in Crete among UNICAL/CNR/FORTH/FORTHNET has also highly contributed to clarify management issues and allowed to open discussion on the possibility of joint dissemination activities with ACGT project (see the bottom for details).

The deliverable produced in this quarter has been the following:

- D18: 5th Quarterly reporting period

The work plan does not currently foresee any deviation and still until next interim the overall management has been focussed on the following tasks:

T 0.1 Overall management of the Consortium

- Handling of Deliverables
- Cooperation with RBI for the organisation of MB & STAB meeting

T 0.3: Management of contractual, legal, financial and administrative procedure of the consortium

- Handling of financial and administrative procedures of review outcome
- Distribution of second pre-financing

T 0.2: Co-ordination of the Consortium technical activities

Also during this quarter, the coordination of the scientific and technical activities has been carried out on the basis of a quite effective collaboration among the several partners involved within each WP. In fact, the overall technical activity during the quarter has been mainly characterized by the finalization of the technical deliverables due by the end of the 18th month. To this end, a strong interaction among all the partners has been developed, with particular emphasis to the coordination of the activities between the technical and clinical partners.
Finally, each partner has been responsible for all other direct issues with the coordination unit within the deadlines.

T 0.4: Internal Communication infrastructure

The internal communication infrastructure has been mainly realized by the extensive use of e-mails and audio conference services.

Forecasted activities

During next three months management activities will mainly focus on the coordination and the handling of future deliverables.
A close cooperation will be performed with all partners and in particular with JUMC, who will host the MB & STAB meeting.
Attention will be paid to a closer interaction with WP8-Dissemination, in particular for the organization of a special session within the event HEALTHINF 2008 that will be held in Madeira at the end of January 2008.

Ongoing workpackages progress: WP2

WORK PACKAGE: 2
TITLE: BIOMEDICAL DATA IDENTIFICATION AND COLLECTION
START DATE: MONTH 3
WORK PACKAGE LEADER: VMWS
PARTNERS INVOLVED: UNICAL, UNICZ, UNIMIB, JUMC , FORTHNET, SYNAP, AUXOL

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 2.2	Design and Development of the Data Acquisition and Transmission Infrastructure	The task was completed at the end of this reporting period inline with the DoW. The modules comprising the data acquisition and transmission infrastructure were developed and tested.

STATUS OF MILESTONES DUE IN THIS PERIOD

		COMMENTS
M.S.2.2	Technological Infrastructure for the acquisition and transmission of the relevant biomedical data	The technological infrastructure for the acquisition and transmission of the relevant biomedical data has been defined inline with the DoW. The results are reported in D19, which will be submitted at the end of this reporting period.

STATUS OF DELIVERABLES DUE IN THE NEXT 3 MONTHS

		DATE	COMMENTS
DELIVERABLE	N°		
Prototype of Data acquisition and transmission infrastructure	D 19	31/07/07	Deliverable D19 describes the prototype of the Data Acquisition and Transmission Infrastructure based on the outcome of D14 (requirements and specifications). In this deliverable, the technological infrastructure is defined and its various modules are presented in detail. D19 is jointly prepared by the partners involved in WP2 and will be submitted at the end of this reporting period.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Data Collection	T 2.3		During the next 3 months, the scenarios related to the collection of the biomedical data in all the identified healthcare environments are expected to have been defined. These scenarios will be based on the outcome of D19 as well as on validated international clinical protocols and guidelines.

Description of the activities

In the current reporting period, the activities of WP2 are related to Task 2.2, Design and Development of the Data Acquisition and Transmission infrastructure, which is concluded in the end of this reporting period. These activities were carried out by VMWS, FORTHNET, SYNAP and JUMC. In the following paragraphs, a more detailed description of these activities is given:

a) Testing of modules for data acquisition and transmission (VMWS, FORTHNET)

The software modules for data acquisition and transmission were tested regarding their proper functionality. The testing procedure involved standalone tests as well as integration oriented tests in order to verify the correct collaboration of the modules. The results of these tests are reported in the Deliverable D19, which will be submitted at the end of this report period. Furthermore, a preliminary demo was presented to the HEARTFAID consortium during the STAB meeting in Zagreb, 21-23 June 2007

b) Development and Integration of eCRF (JUMC, SYNAP)

eCRF (electronic Case Report Form) is a web application, used by medical personnel only (nurses, caregivers and doctors) for manual insertion of measurements and other information to the platform, due to the fact that not all medical devices can be automatically integrated with the platform as it has been described in D19/4.2.1.1.

Web access module of eCRF is implemented using the Model-View-Controller (MVC) architectural design pattern, allowing the integration of many popular web presentation technologies.The data model of the eCRF is organized according to the EAV (Entity-Attribute-Value) schema.

The prototype of the eCRF application has been deployed on an Apache Tomcat (version 5.5.12) application server running under the control of a Windows 2003 Server operating system. For data storage a MySQL (version 5.0.24) RDBMS server has been chosen.

The current version of the eCRF prototype may export the data as XML messages to other components of the platform.

Ongoing workpackages progress: WP3

WORK PACKAGE: 3
TITLE: MIDDLEWARE,INTEROPERABILITY AND INTEGRATION
START DATE: MONTH 2
WORK PACKAGE LEADER: SYNAPSIS
PARTNERS INVOLVED: VMWS, FORTHNET, CNR, FORTH

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 3.3.1	Early mock up prototype implementation	The activities of subtask T3.3.1, started at month M6, are about to be concluded with a slight delay of one month with respect to the project Gantt. During the reporting period, the open source frameworks related to SOA and ESB, investigated during the previous RP, have been selected among the available technologies and the most suitable solutions for the purposes of the HF project have been adopted for the implementation of the early mock up prototype of the integration middleware. This preliminary prototype was presented during the General Assembly Meeting held in Zagreb on June 2007.
T 3.4	Interoperability Middleware	The activities of Task T3.4, started at month M8, have been carried out during the reporting period as expected from the Gantt of the Project. According and in strict correlation with the studies performed in Task T3.3.1, the technologies investigated during the previous RP have been adopted to implement a first part of the Interoperability Middleware architecture.

STATUS OF MILESTONES OF THE PERIOD

MS	TITLE	COMMENTS
MS 3.2	Early mock-up prototype implementation of the Data Management and Exchange System	A preliminary prototype of the Data Management and Exchange System able to interact with external devices for data measurements and with an alarm/notification system, was presented at the General Assembly Meeting held in Zagreb in June 2007.

STATUS OF DELIVERABLES DUE IN THE PERIOD

		DATE	COMMENTS
DELIVERABLE	N°		
Clinical standards and first middleware prototype	D 20	31/07/07	The deliverable D20 will be delivered with a slight delay of one month with respect to the due deadline.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Prototype refinement	T 3.3.2		The activities of subtask T3.3.2 will be stated at month M19, in accordance with the gantt of the Project
Interoperability Middleware	T 3.4		The activities of task T3.4 will be continued during the forthcoming reporting period, in accordance with the gantt of the Project.

Description of the activities

During the reporting period, the activities of tasks T3.3.1 and T3.4, started at month M6 and M8 respectively, have been continued. The progress of the work carried out is described in the following paragraphs.

T3.3: Integration Middleware

T3.3.1: Early mock up prototype implementation

This Task, has the goal to design and develop a Data Management System that is responsible to guarantee the following features:

- all the data flowing within the entire platform is compliant with the standards identified in Task 3.2
- management of the heterogeneous repository allowing the organization of raw data, laboratory data, structured information (EPR, data entry services, and so on), multimedia/other data (reports, images, ultrasound signals, and so on).

The early prototype developed during the previous RP has been further refined. In this reporting period we consolidated the adoption of Service Oriented Architectures (SOA), Enterprise Service Bus (ESB) architecture, and Open Geospatial Consortium specifications as reference information model, for the implementation of the Integration Middleware.
Concerning the web services architectures, we implemented both the two open source framework experimented in the previous RP, that is Axis2 and XFire, which have been adopted in the prototype.
As far as the ESB is concerned, we adopted both the two implementations of messaging bus experimented in the previous RP: OpenJMS and JBoss Messaging, both compliant with Java Message Service (JMS) specification.

This preliminary prototype developed, provides the external systems with a communication protocol that is flexible and based on the XML standard. The developed protocol allows these external systems to be easily integrated into the HF platform as well as to interact each with the other through the platform itself.
In particular, we have integrated the prototype with some devices that have been selected in the context of WP2 as suitable for the purposes of the HF project, as well as with a notification system able to rise an alert message that can be sent to a set of recipients using different mechanisms (such as e-mail or SMS).
In other words, this prototype is able to acquire and store the real time measurements provided by the medical devices, to process the received data and, if it is the case, to generate an alarm by sending a message to a set of recipients using the notification system.
All the interactions with this Data Management prototype are web based and, therefore, both the set of devices for data acquisition and the notification system can be located anywhere, assuming that an Internet connection is available.

The prototype was shown in a demo session at the General Assembly Meeting held in Zagreb on June 2007.

T3.4: Interoperability Middleware

As reported in the DoW, the Interoperability Middleware will be responsible of guaranteeing a seamless integration among the end-user services of the HEARTFAID Platform. The activities of this task, started at month M8, have been continued during the reporting period.

By implementing the technologies investigated in the previous RPs, a first kernel of the prototype has already been developed as well a mock-up of the Interoperability middleware general architecture. In addition, a first integration with an existing commercial EPR was implemented.

In more details, the interoperability middleware will split to two different modules the responsibility related to the management of raw data (both simple and structured data) and the management of documents (e.g. medical reports). In the first case the data will be stored in a database whose structure will be accurately defined according to the characteristics of the data that will be acquired by the medical devices. In the second case we will refer to a documental repository able to provide advanced services for storing and recovering clinical documents.

The preliminary prototype developed is composed of the following modules:

- a module to access an external archive of demographic data (typically belonging to the Health Information System of a clinical structure) in order to univocally identify the patient who is being enrolled in the HF study or whose physiological data is being acquired within a monitoring context;
- a module to interact with the documental repository to store and recover clinical reports/documents, which is able to rebuild the clinical history of a patient;
- a module, fully configurable, that upon an external request to recover a complex set of information, is able to identify and recover the necessary data both from the HF internal repositories (i.e. either the internal database or the documental repository) and from an external Health Information System, to combine the available information and finally report the answer.

This prototype represents a first step toward the definition of the HF Electronic Health Record that will be accessed using the functionalities that are being defined in the context of WP6.

Ongoing workpackages progress: WP4

WORK PACKAGE: 4
TITLE: KNOWLEDGE, REPRESENTATION, DISCOVERY AND MANAGEMENT
START DATE: Month 8
WORK PACKAGE LEADER: RBI
PARTNERS INVOLVED: UNICAL, SYNAP, CNR, FORTH

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 4.2	Data understanding and preparation	A new ANMCO retrospective data set with more than 18000 examples has been cleaned and appropriately transformed. Based on data understanding a large set of possible classification KD tasks (more than 50) has been defined. The work with UNICZ data has been finished, some complex feature construction tests performed, and Deliverable D21 prepared.
T 4.3	Implementation of Knowledge Discovery in Database Processes	An implementation of Random Forest algorithm in C# has been done. First experiments on retrospective ANMCO data set using Kernel based Support Vector Machine algorithm and subgroup discovery algorithm has been done. Publications about contrast mining have been prepared.
T 4.4	Ontologies and medical knowledge representation in the domain	The complete procedural (actionable) knowledge has been transformed into ontological form and than integrated into one procedural OWL ontology prepared for reasoning. Consistency of rules has been checked using the developed interpreter. The development of medical plans has been finished. Deliverable D22 has been prepared.

STATUS OF MILESTONES OF THE PERIOD

MS	TITLE	COMMENTS
MS 4.1	Ontology and knowledge representation	The work has been done on time. The results are: descriptive HF ontology, procedural knowledge in the form of rules, procedural knowledge in the ontological form, set of 48 interconnected medical plans for handling HF patients. The knowledge is prepared for integration with DSS.

STATUS OF DELIVERABLES DUE IN THE PERIOD

		DATE	COMMENTS
DELIVERABLE	N°		
Functional Specifications of data warehouse implementation and data preparation	D 21	31/07/07	Prepared on time. The deliverable has about 90 pages.
Ontologies and knowledge representation	D 22	31/07/07	Prepared on time. The deliverable has about 130 pages and includes CD with most relevant results.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°	COMMENTS
Data understanding and preparation	T 4.2	Data understanding of numerical sequences for continuously monitored data and short sequences collected as follow-up data. Transformation of sequences into sets of attributes prepared for KD. Definition of relevant events in sequences for on-line Web based KD.

Implementation of knowledge discovery in database process	T 4.3	Knowledge discovery on retrospective data. Testing of the SVM and the Random Forest methodology on ANMCO data set. Preparation of the algorithms for on-line KD.

Description of the activities

The work on WP4 included tasks T4.2 - T4.4 in parallel with special attention on the approaching milestone MS4.1 which means the end of the work on knowledge representation.
RBI organized MB and STAB meeting in Zagreb on June 21.-23. and coordinated preparation of two deliverables D21 and D22.
There have been continuous communication and discussion between RBI and JUMC on procedural medical knowledge and ontology integration with e-CRF, and RBI and UNICAL on data preparation of the ANMCO retrospective data set.

T4.2 – Data understanding and preparation

The work was determined by the newly acquired retrospective data set. It is a big data set representing prognosis evaluation for more than 18000 HF patients collected in Italian hospitals in the period of 1995.-2005. It is an unusually big medical data set and its preparation for the KD process has been a real challenge. The work has started with data cleansing of each attribute by specifying normal ranges which are acceptable. Out of range values have been treated as mistakes and converted into unknown values. It followed checking of consistency among different time events resulting by elimination of some examples with unexpected time order. Two new attributes for ejection fraction have been introduced after that. The one based on squared formula has been used, together with age, to eliminate not relevant HF patients (EF >55 or age<18). Finally, date attributes have been eliminated and substituted by time intervals. From the cleaned dataset more than 50 different knowledge discovery tasks has been generated as the result of the data understanding process.
We have also finished with data preparation work on the UNICZ dataset. Iterative machine learning for complex feature construction has been tested but without significant improvements in final prediction quality. The results have been prepared for presentation in deliverable D21 in its part on retrospective data. Additionally, detailed process of data understanding and data preparation for the platform data has been elaborated for the deliverable.

T4.3 – Implementation of knowledge discovery in database process

We have worked on the development of novel kernels for Support Vector Machines. The procedures have been tested on retrospective data. In parallel we have finished with development of the Random Forest implementation. On the UNICZ retrospective data set we have tested subgroup discovery approaches, association rule learning and their combinations with complex feature construction but without significant results.
In the next period we plan to test the same methodologies on the large ANMCO retrospective data set, with special care devoted to testing Random Forest and Support Vector Machines implementations.

T4.4 – Ontologies and medical knowledge representation in the domain

We have finished the work on medical plans ending with 38 medical plans for signs, symptoms, and diagnoses and 10 for medication prescription and dosage. All of them are available in the graphical form and most of them also in the textual form.

We have finished with the transformation of procedural knowledge into ontological form. It is now available as one *procedural OWL ontology* prepared for reasoning. Consistency of rules has been checked using the developed interpreter. During transformation significant effort has been made to ensure consistency among different rule subsets. Special attention is devoted to rules which produce outputs relevant as inputs for rules in other sets.

Finally, we prepared D22 in which we tried to present state of the art in medical knowledge representation, give motivation for decisions we had to do, and finally present both concepts and details of results of the work on HF knowledge representation.

Although the work on T4.4 has been formally finished, the resulting knowledge base will need constant improvements. The first real test will be after the integration with DSS and first real experiments on real data. Especially improvements in the content of procedural knowledge can be expected. Besides that, up to now not sufficient attention has been devoted to the problem of integration of the DSS with real patient data (extraction of factual knowledge), especially to the extraction of complex patient features needed for procedural knowledge execution. In this sense we expect the work on T4.4 will continue but in significantly smaller intensity.

Ongoing workpackages progress: WP5

WORK PACKAGE: 5
TITLE: DATA PROCESSING AND DECISION SUPPORT DEVICES
START DATE: MONTH 5
WORK PACKAGE LEADER: CNR
PARTNERS INVOLVED: UNICAL,UNICZ, SYNAPSIS,FORTH, RBI

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 5.2	Design and development of models and methods for signals and images processing	▪ Study of a comprehensive showcase involving ECG processing and echocardiography workflows ▪ Requirements of an Image Archive for HEARTFAID platform ▪ Study of available open-source implementation of DICOM servers and installation of a preliminary HEARTFAID Image Archive ▪ Study of the interactions between HEARTFAID Image Archive and Image Analysis modules ▪ Algorithms for QRS detection and left ventricle segmentation in US apical image sequences for the extraction of geometrical parameters.
T 5.4	Implementation of the Decision Support System	▪ Selection and definition of a comprehensive showcase for testing the CDSS prototype functionalities ▪ Implementation tests in Bossam, Pellet and Jena for assessing the basic and functional primitives of the CDSS *Brain*. ▪ Study of problems related to the integration of the HF ontology developed within WP4

STATUS OF MILESTONES DUE IN THE PERIOD

MS	TITLE	COMMENTS
MS 5.1	Early mock-up prototype of data processing and decision support services	Implementation of CDSS basic functionalities and first tests on components integration

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Design and Development of models and methods for signals and images processing	T 5.2		▪ Refinement of the algorithms for image segmentation and QRS classification ▪ Testing of modules for image uploading and retrieving in the validation sites ▪ Development of a first image analysis module integrated with HEARTFAID Image Archive ▪ Echocardiography Data collection from the clinical partners
Implementation of the Decision Support System	T 5.4		▪ Further refinement of the showcase ▪ Implementation of the required CDSS functionalities ▪ Integration with the other platform components

Description of the activities

Task 5.2 - Design and development of models and methods for signals and images processing

In view of the early mock-up of HEARTFAID data processing and decision support services, a comprehensive showcase was developed in order to study the interactions among the several modules of HEARTFAID *Brain*. In the showcase, the activity related to task 5.2 focused on the integration of methods for signal and image processing for parameters extraction in an automated or semi-automated fashion (for example for the computation of ejection fraction from ultrasound data).
In this framework, the problem of accessing data to perform signal and images analysis has also been addressed, leading to the idea of a HEARTFAID Image Archive. More in detail, after a preliminary careful analysis of echocardiography workflows, the requirements for an Image Archive have been identified as follows:

- DICOM network services
- Web access to DICOM objects
- Easy development of web interfaces for Image Archive Management
- Easy development of web interfaces for image uploading
- Implementation of IHE actors
- Extendibility to meet HFP needs (interaction with CDSS and Image Analysis Tools)
- Multi-platform or platform independent

Among different open-source implementations (CONQUEST, DCMTK, DCM4CHE), the Java based implementation of DICOM proposed by DCM4CHE has been chosen according to the previous requirements list.
Besides being an image archive, DCM4CHE provides a toolkit of standalone applications and methods to make network communication and interface development easier.
In the current installation at the CNR, DCM4CHE has an underlying MySQL database, though other choices (e.g. PostgreSQL) are conceivable.
The image analysis modules may interact with HEARTFAID image archive through standard DICOM network services (e.g. using C-FIND to retrieve images and C-STORE to save the resulting annotated images, according to DICOM terminology).
Finally, several improvements were made to the algorithms for signal and image processing. For left ventricle segmentation in US sequences (2 and 4 chambers views), a suitable initialization method for an active contour was obtained by mimetic criteria. The method has been described in a paper accepted to the Open German Russian Workshop on Pattern Recognition and Image Understanding. For ECG processing, the already available QRS detector was refined. This QRS detector is based on a pre-filtering of a two-lead ECG with a moving average linear filter in the 5-15 Hz band followed by a derivative filter applied on each channel. A complex signal is then generated summing the absolute value of each derivative signal and an adaptive threshold method is applied. The method features in particular a best channel selection algorithm based on a noise rating system. The method has been tested on MIT database, giving satisfactory results with a PPV=99.81% and a sensitivity=99.76% and has been reported in an

abstract submitted by FORTH to Computers in Cardiology 2007. In the close future, the method, currently implemented in MATLAB, will be ported in C for better performance. Further, FORTH is adapting the QRS detection method to process the ECG data acquired at the HEARTFAID validation site in Catanzaro. Such data consist of short-time 12 leads recordings, instead of 30min 2 leads recordings available in MIT database. Future research activity in signal processing will focus on QRS classification.

Task 5.4 - Implementation of the Decision Support System

Under CNR coordination, the activity concentrated on the early mock-up of the decision support services, moving along two main directions:

- the design and development of CDSS basic functionalities;
- the selection of significant showcases for a more precise implementation and testing purposes.

First steps towards the early mock-up have been the definition of the work program, the evaluation of the results of the interrelated WPs and the load distribution among involved partners. To this end, several meetings were organized with SYNAP and UNICAL. Moreover, a member of the CNR staff spent one-month at FORTH between May and June with the aim of discussing several problems related to the CDSS prototyping. In the same period, a meeting was held in Crete (two CNR members, two FORTH members) for evaluating the adoption of Machine Learning techniques as computational reasoning methods (i.e. Bayesian Networks).

A computer scientist from the SYNAP staff worked until the middle of June for evaluating the ontology resulted from the WP4 activity and for studying how to develop the inferential reasoning tools.

An engineer of the UNICAL staff came to Pisa and worked for implementing the basic functionalities of the CDSS inference apparatus. More precisely, Bossam and Pellet based tools were developed in conjunction with Jena (*InferenceE*). Moreover, an activity started for testing how to map processes, requests and datatypes onto the CDSS sequences of procedures (*MetaLevel*). As a result, the basic inferential reasoning functionalities were developed. Further, FORTH started the study of a Bayesian Network based DSS to be used as reference for verifying the performance of the CDSS.

Besides, a comprehensive showcase was studied and detailed, in cooperation with UNICZ, as a representative situation useful for testing the CDSS. It regards a worsening event during a HF patient's clinical course and depicts a complete scenario that entails almost all the CDSS functionalities, i.e. telemonitoring, visits/examinations scheduling, data exchange management, signal and image processing, therapy planning, and drug uptitration suggestions. This way, all the components of the CDSS architecture (i.e. the Strategy Controller, the Meta Knowledge Base, the Model Manager, the Model Base, the Inference Engine and the Domain Knowledge Base) are involved in the development and can be then tested. For these reasons, such a showcase was selected as a reference scenario for further developing the CDSS and testing its functioning.

For the implementation of the comprehensive showcase, UNICZ, CNR and RBI are cooperating in reviewing the ontology developed within the WP4 for identifying missing terms and adding opportune types to the existing ones.

MEETINGS OF THE PERIOD

	COMMENT	DATE/PLACE
SYNAP		Pisa, 08/05/2007
SYNAP		Pisa, 23/05/2007
FORTH/ FORTHNET /CNR		Crete, May-June 2007
UNICAL/UNICZ/ CNR		Cosenza/ Catanzaro 24/07/2007
CNR/RBI	e-meeting	June/July 2007

Ongoing workpackages progress: WP6

WORK PACKAGE: 6
TITLE: END-USER APPLICATION AND SERVICES
START DATE: MONTH 10
WORK PACKAGE LEADER: FORTHNET
PARTNERS INVOLVED: UNICAL,UNIMIB, JUMC, CNR,FORTH,RBI

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 6.1	Design end-User Services Interaction Functionalities	The activities of Task 6.1 started at M10 and were completed at M16 of the project. A major part of the design of the high level services, necessary for the users to interact with the functionalities provided by the HEARTFAID platform, has been completed. A lot of effort has been applied on the Graphical User Interface (GUI), in order to provide a user-oriented and user-friendly outcome, considering at the same time the wide variety of users.
T 6.2	Development of end user applications and services	The activities of Task 6.2 have started on M16. An important part of the development of the Alert & Notification system of the HEARTFAID platform of services is already in progress. Various tests have already taken place, in order to ensure the interoperability of the system with the central middleware platform, followed by successful results.
T 6.3	Knowledge discovery system for web-based data extraction and analysis	The specification of tasks necessary for web-based data preparation process has been done. Random forest and subgroup discovery algorithms have been selected for implementation.

STATUS OF DELIVERABLES DUE IN THE NEXT REPORTING PERIOD

		DATE	COMMENTS
DELIVERABLE	N°		
User needs analysis and functional specifications of the Heartfaid platform services	D 23	31/07/07	Throughout the Deliverable, a number of important factors have been analysed, ranging from user needs and description of the HEARTFAID services, up to graphical user interfaces, security issues and quality assurance.

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°	COMMENTS
Development of end user applications and services	T 6.2	More tests must take place in the following months in order to ensure a complete and stabilized interoperability of the HEARTFAID services. An important next step is also to incorporate the available services to the Front end of the platform, in order to be accessible by the end users. The design of a proper and user friendly interaction with the Alert & Notification system is one of the top priorities.
Knowledge discovery system for web-based data extraction	T 6.3	Experiments with web-based data preparation for retrospective data will be performed.

and analysis		

Description of the activities

T 6.1: Design end-User Services Interaction Functionalities

The end-user services consist of the interfaces and applications offered to the users, in order to access the application's utilities. As illustrated by the project's architecture, HEARTFAID encompasses many different processing modules, which all require means of effective, bi-directional communication with the users. The challenge of providing this communication successfully lies in identifying user needs, determining functional specifications, and finally designing and implementing a comprehensive and convenient User Interface to address them.
Many groups of people will be affected by the services that HEARTFAID offers. These groups have been individually identified and classified into user profiles, to assist in user rights and accessibility management. The user groups range from specialized nurses and general practitioners, up to specialized doctors, the patients and their relatives. The requirements of each user profile have been studied separately and the facilities to be offered are based on the conclusions drawn from the analysis that took place in the previews months.
The front end layer of the HEARTFAID platform is the Graphical User Interface that conforms to the common conventions of most popular web applications. The front-end is divided into modules and sub-modules, but cross-references between sections have also been included, where they enhance usability. Implementing clean interfaces to connect software components has been a quite important task in the project. Considering that in many cases the project encompasses distributed computing resources, be it software like processes and data or hardware resources like embedded micro or nano-devices, gateways, servers or storage devices, the design complexity for component interfaces grew rapidly involving mechanism for inter-processing communication, design of information exchange protocols, remote service requests and remote service discovery, synchronization, as well as the general handling of heterogeneity. One of the main priorities in the design of the front-end was to adapt an intuitive hierarchical structure, in order to allow users to reach the desired functionality with the minimum possible effort, keeping always in mind that most of these users are not familiar with various technological aspects.

T6.2: Development of end-user application and services

Personalised access technologies to the HEARTFAID platform are currently under the development process, in order to ensure that access to medical data from the professionals and the patients will be easy and secure.
The HEARTFAID platform should be able to provide advanced alert and notification communication services through an interface dedicated to mobile devices (mainly mobile phones and PDAs) for both patients and medical staff.

The instant communication method of Short Messaging System (SMS), is being used in order to provide HEARTFAID platform with enhanced one and two-way communication services available over GSM network for mobile users.
The main issues for the alert and alarm service will be the existence of an advanced user profiling and cognitive techniques which should be used, in order to dynamically compose and send alert and notification messages to HEARTFAID users according to their attributes and depending on their particular personal profile.

T6.3: Knowledge discovery system for web-based data extraction and analysis

In the previous period both retrospective and platform data have been completely defined. They present potential inputs for the web-based knowledge discovery. Now we have also specified the procedure in 11 steps for data set selection, attribute selection, patient subset selection, statistical analysis, and finally data preparation for knowledge discovery process and its execution. In the next period we plan to test the procedure on available retrospective data. Additionally, we have tested the Random Forest algorithm for potential implementations and it will be used in the foreseen experiments

Ongoing workpackages progress: WP8

WORK PACKAGE: 8
TITLE: DISSEMINATION AND EXPLOITATION
START DATE: MONTH 1
WORK PACKAGE LEADER: UNICAL
PARTNERS INVOLVED: ALL

STATUS OF TASKS DUE IN THIS PERIOD

TASK	TITLE	COMMENTS
T 8.1	Dissemination activities	Contributions to the dissemination have been given by the clinical partners, in detail below

FORECAST STATUS OF TASKS DUE IN THE NEXT 3 MONTHS

TASK	N°		COMMENTS
Dissemination activities	T 8.1		Specific initiatives have been planned, specifically related to the dissemination of the Heartfaid activities during HEALTHINF 2008 event in Madeira (Portugal) Contribution for dissemination activities in detail below from: • UNICZ • JUMC • RBI & External Advisor Dr Lavrac • CNR • FORTH
Exploitation activities Investigation of new models for Healthcare processes	T 8.2.1		The exploitation activities will start by the assessment of the new organization and management model proposed in the deliverable D8.

Description of the activities

During this quarter, the dissemination activities have been carried out according to the general plans defined in the Deliverable D6.

In detail the following contributions have been given by:

- UNICZ

Submission of the abstract about HEARTFAID project to 68° National Congress of Italian Society of Cardiology (SIC) that will be held in Rome, from 15 to 18 December, 2007
The work will be presented and discussed in the Congress as oral communication or poster presentation.
Submission of the abstract about HEARTFAID project to 108° National Congress of Italian Society of Internal Medicine (SIMI) that will be held in Rome, from 20 to 23 October, 2007
The work will be presented and discussed in the Congress as oral communication or poster presentation.
On 12th September UNICZ (Cardiovascular Disease Unit) will have a meeting with the chiefs of the most important Cardiology Divisions in Calabria that belong to scientific societies such as ANMCO (Hospital Cardiologists National Association), SIC (Italian Society of Cardiology), ANCE (Out-hospital

Cardiologists National Association), in order to discuss about Heartfaid project and for disseminating Heartfaid activities.
In this period (september-october) and in the next months UNICZ activity will be mainly based on involving the other hospitals and Cardiology, Internal Medicine and Geriatry Units in Calabria about Heartfaid activity and progresses, with periodic meetings in the University of Catanzaro and on the territory.
Dissemination of Heartfaid project will be made on 28-29 September, during "The Magna Græcia Meeting", that will be held in Crotone (Italy). This meeting is organized by our Cardiovascular Disease Unit and it is an important appointment about the "news" in cardiovascular diseases. It involves national and international experts about the issues of interest, as speakers, and a lot of specialized doctors from different parts of Italy as participants.

- FORTH

Dissemination activities performed by FORTH in this period were:

- Collaboration to the final review of the HEARTFAID leaflets.
- Collaboration in starting the organization of a special session at HEALTHINF 2008 (Madeira, Portugal), that will be also part of the clustering activities of the project.
- Invited presentation at pHealth 2007 in Thessaloniki:
  - C. E. Chronaki. "Interoperability Standards in the Medical Device Industry and the Implications for pHealth".
- Submission of two abstracts to Computers in Cardiology 2007 (Durham, North Caroline, USA). The two abstracts have been accepted for oral presentation:
  - F. Chiarugi, V. Sakkalis, D. Emmanoulidou, T. Krontiris, M. Varanini, I. Tollis. "Adaptive Threshold QRS Detector with Best Channel Selection Based on a Noise Rating System".
  - A. Schloegl, F. Chiarugi, E. Cervesato, A. Apostolopoulos, C. E. Chronaki. "Two-Way Converter between the HL7 aECG and SCP-ECG Data Formats Using BioSig".

  Presentations and full papers will be delivered at the conference time (September 30 – October 3, 2007).
- Publication of a survey paper in the "Health Information Systems" section of the IMIA Yearbook of Medical Informatics 2007:
  - S. Sfakianakis, C. E. Chronaki, F. Chiarugi, F. Conforti, D. G. Katehakis. "Reflections on the Role of Open Source in Health Information System Interoperability" (pp. 50-60).

Planned activities for the next three months:

- Two oral presentations at Computers in Cardiology 2007 (Durham, North Caroline, USA):
  - F. Chiarugi, V. Sakkalis, D. Emmanoulidou, T. Krontiris, M. Varanini, I. Tollis. "Adaptive Threshold QRS Detector with Best Channel Selection Based on a Noise Rating System".
  - A. Schloegl, F. Chiarugi, E. Cervesato, A. Apostolopoulos, C. E. Chronaki. "Two-Way Converter between the HL7 aECG and SCP-ECG Data Formats Using BioSig".
- Publication of a paper in IEEE Transactions on Biomedical Engineering (issue of August 2007):

- F. Chiarugi, M. Varanini, F. Cantini, F. Conforti, G. Vrouchos. "Noninvasive ECG as a Tool for Predicting Termination of Paroxysmal Atrial Fibrillation".

- CNR

Paper: Colantonio S., Moroni D., Salvetti O. – Extraction and Deployment of New Features for Cardiac Shape and Function Representation. In: The Digital Patient, I. Tollis and N. Ayache eds., Ercim News, 69, pp. 36-37, 2007

- JUMC

The information on HEARTFAID is placed on the webpages of the I Cardiac Dept. at JUMC (http://www.kardiologia1.cm-uj.krakow.pl/naukowa/badania.htm) website as dissemination knowledge channel.
JUMC is providing information about HEARTFAID also directly to patients with chronic heart failure which are currently enrolled into the Heartfaid Substudy, to their families and relatives'.

Date	Channel	Event	Place/ Country	Partner responsible	Nature and size of audience
21.-25. May 2007.	paper presentation	MIPRO - International Convention 2007	Opatija, Croatia	RBI	150 participants
22.-25. May 2007.	paper presentation	PAKDD 2007, 11th Pacific-Asia Conference on Knowledge Discovery and Data Mining	Nanjing, China	JSI + RBI	350 participants
25.-28. June 2007.	paper presentation	ITI 2007, 29th International Conference Information Technology Interfaces	Cavtat, Croatia	RBI	200 participants
26.-30. June 2007.	paper presentation	MEDICON 2007, 11th Mediterranean Conference on Medical and Biological Engineering and Computing	Ljubljana, Slovenia	JSI + RBI	250 participants
07.-11. July 2007	paper presentation	11th Conference on Artificial Intelligence in Medicine AIME2007	Amsterdam, The Netherlands	RBI	100 participants
20.-28. August 2007	poster presentation	ACAI 2007 Logic for Artificial Intelligence	Leuven, Belgium	RBI	50 participants