Δημοκρίτειο Πανεπιστήμιο Θράκης
ΕΙΔΙΚΟΣ ΛΟΓΑΡΙΑΣΜΟΣ ΚΟΝΔΥΛΙΩΝ ΕΡΕΥΝΑΣ
Democritus University of Thrace
SPECIAL ACCOUNT FOR RESEARCH FUNDS

Interreg Greece-Bulgaria eHealth Monitoring
European Regional Development Fund
EUROPEAN UNION

D4.3.2 APPLICATION/ SOFTWARE DEVELOPMENT

(ICT Project Manager)

«Report on the coordination activities of the Design and Development of the Healthcare Monitoring system»

Reporting period: 06/12/2018 – 05/05/2019

WP 4 Joint Monitoring System

project

IMPROVING HEALTHCAREACCESSTROUGHAPERSONALHEALTH MONITORING SYSTEM

Nikolaos Markellos

November 2019

The project is implemented in the framework of INTERREG V-A "Greece-Bulgaria 2014-2020" CooperationProgramme and is co-funded by the European Regional Development Fund (ERDF) and by national funds of the countries participating in the Programme

http://www.ehealthmonitoring.eu/

The contents of this publication are sole responsibility of project partners and can in no way be taken to reflect the views of the European Union, the participating countries, the Managing Authority and the Joint Secretariat

Summary

The deliverable «Report on the coordination activities of the Design and Development of the Healthcare Monitoring system» is part of the project APPLICATION/ SOFTWARE DEVELOPMENT within the frame of WP 4 Joint Monitoring System of the project IMPROVING HEALTHCARE ACCESS TROUGH A PERSONAL HEALTH MONITORING SYSTEM, according to our contract (14/09/2018 – Ref. No: 44959) and is being implemented within the framework of the Programme INTERREG V-A Greece – Boulgaria 2014-2020.

The particular deliverable aims to highlight the activities performed within the period 06/12/2018 – 05/05/2019 concerning the coordination of the project team for the design and development of the Healthcare Monitoring System. The document describes the procedures and results of the work performed and the tools used to coordinate the design and development activities of the Health Monitoring System by the implementation team. During this phase of the project, the system architecture was finalized, design improvements were made and the development of additional functions was completed, while special emphasis was placed on ensuring the security of the system and enhancing its usability and acceptance by end users. Furthermore, additional functionalities were implemented, and the development of user applications (web and mobile app) was completed.

Table of Contents

Summary 2

Table of Contents 3

1 Introduction 4

2 Objectives and Activities 6

3 Infrastructure 7

3.1 Cloud infrastructure 7

3.2 Project team 7

3.3 Development tools and technologies 8

3.3.1 Web platform 8

3.3.2 Mobile app 8

3.3.3 Database 8

3.3.4 Server 8

3.3.5 Other Technologies 9

4 Management 10

4.1 Priorities 10

4.2 Methodology 11

4.3 Milestones 11

4.4 Monitoring of the activities 12

5 Deliverables 13

5.1 Deliverable «Healthcare monitoring system design» 13

5.2 Deliverable «Healthcare Monitoring System Development» 13

5.3 Deliverable «Feasibility Study of the Healthcare Monitoring System» 13

5.4 Deliverable «Testing report of the Healthcare Monitoring System» 13

1 Introduction

This deliverable concerns the coordination of the design and development work of the Medical Monitoring System for the above mentioned period. During this phase of the project, improvements were made to the design of the biosignal recording and processing system and to the management of health data, additional functionalities were implemented and existing ones were extended. In addition, the development of user applications (web and mobile app) and the development of horizontal subsystems that support their functions have been completed.

Overall, the services designed, developed and integrated into the prototype system offer the following capabilities:

- Contact management
- Communication of the user (via video) with the medical staff and relatives
- Recording the following parameters regarding the health and physical state of the user:
    - Oxygen Saturation Level (SpO2)
    - Heart rate
    - Arterial pressure
    - Glucose level
    - Daily physical activity (number of steps and sleep time)
- Electronic Health Record that incorporates historical measurements of the aforementioned parameters, as well as additional data, such as lab results, medication and allergies
- Visualization of the records of the above parameters and remote access to doctors, upon the user's authorization
- Automatic detection of deviations from predefined limits for the above parameters and notification of medical personnel
- Development of a personalized treatment schedule for each patient
- Smart reminders that encourage patient adherence
- Photo sharing between contacts

The services are addressed to chronic sufferers, people recovering post-operatively or in rehabilitation, as well as individuals (possibly elderly) who live independently and need communication or support in their daily needs and activities, especially in the case of people residing in isolated areas and do not have direct access to health services.

The above functionalities of the system are designed taking into account the conclusions drawn from the feasibility study. In particular, the system is designed with flexibility in place, so that it can be deployed in both participating countries and in other countries in the future, without the need for substantial modifications to the hardware used and with limited additional investment in software and business development. To this end, the use of well-established standards for the creation of an interoperable solution that leverages existing reliable sensor and medical data management technologies to create new innovative models of health care delivery was crucial.

Finally, at this stage, the development team collaborated with the Greek pilot contractor to integrate selected wireless medical sensors to be used by the pilot users. The devices, which have been proposed by the contractor, have been selected according to the specifications set by the Greek pilot partner. The contractor, having at his disposal the communication protocols of the devices, implemented appropriate mechanisms for their communication with the mobile application of the Health Monitoring System. The devices' communication mechanisms were integrated into the application, and extensive testing was carried out to ensure their proper operation.

2 Objectives and Activities

During the reporting period, the objectives of the design and development of the Health Monitoring System were as follows:

- Development of the working prototype of the Health Monitoring System, which will be used during the pilot activities of the project
- Implementation of the designed functions and the various mechanisms that support them
- Design and implementation of web and mobile user interfaces
- Integration of wireless communication devices for measuring biosignals
- Development of functions that allow doctors to define personalized treatment and monitoring schedules for their patients
- Implementation of a smart reminder functionality to ensure patient adherence
- Determine the infrastructure to be used for the deployment of the platform
- Determination the minimum technical specifications for the hardware
- Configuration of the system and translation so that it is available in two languages (Greek and English)
- Development of a flexible technology infrastructure to integrate new innovative services in the field of eHealth

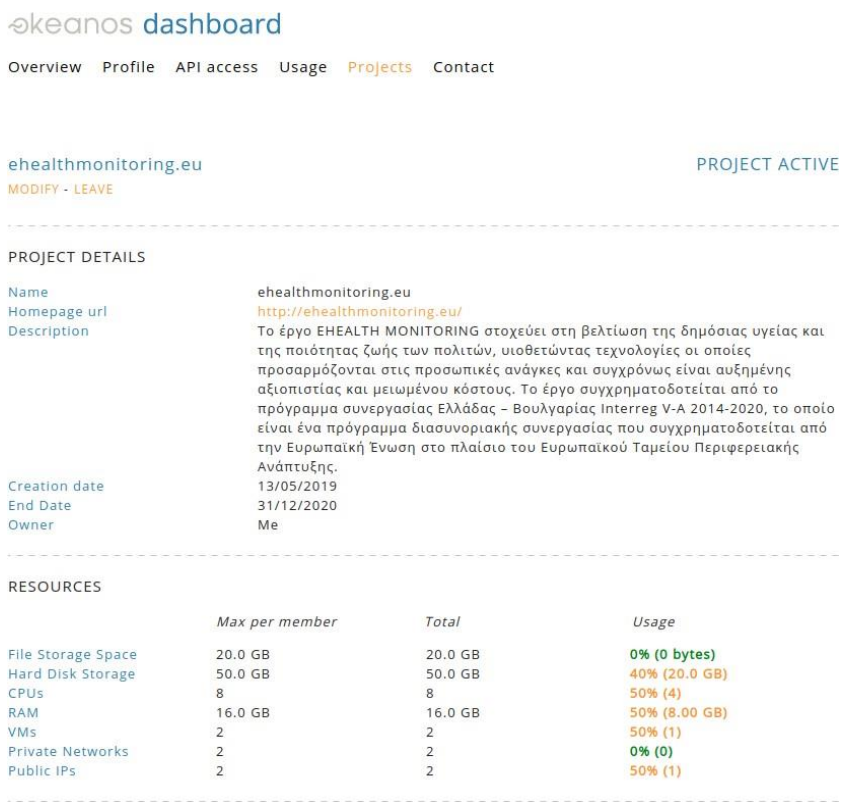
Along with development activities, additional activities were carried out, which include:

- Feasibility study, which contributes decisively to the design of the system
- Algorithm research and design
- Interface design for end-user applications, taking into account the usability requirements and studying relevant literature
- Continuous testing to ensure that the system is functioning properly, but also to ensure its reliability and to meet functional and non-functional requirements

3 Infrastructure

3.1 Cloud infrastructure

Okeanos has been selected for hosting the eHealth Monitoring platform and its various components. Okeanos is an environment that provides high quality virtual infrastructure (computers, network, storage) to the Greek Academic and Research Community and is designed and developed by the National Research and Technology Network (GRNET) for the benefit of the Greek academic community.



okeanos dashboard

Overview Profile API access Usage Projects Contact

ehealthmonitoring.eu — PROJECT ACTIVE

MODIFY - LEAVE

PROJECT DETAILS

Name	ehealthmonitoring.eu
Homepage url	http://ehealthmonitoring.eu/
Description	Το έργο EHEALTH MONITORING στοχεύει στη βελτίωση της δημόσιας υγείας και της ποιότητας ζωής των πολιτών, υιοθετώντας τεχνολογίες οι οποίες προσαρμόζονται στις προσωπικές ανάγκες και συγχρόνως είναι αυξημένης αξιοπιστίας και μειωμένου κόστους. Το έργο συγχρηματοδοτείται από το πρόγραμμα συνεργασίας Ελλάδας – Βουλγαρίας Interreg V-A 2014-2020, το οποίο είναι ένα πρόγραμμα διασυνοριακής συνεργασίας που συγχρηματοδοτείται από την Ευρωπαϊκή Ένωση στο πλαίσιο του Ευρωπαϊκού Ταμείου Περιφερειακής Ανάπτυξης.
Creation date	13/05/2019
End Date	31/12/2020
Owner	Me

RESOURCES

	Max per member	Total	Usage
File Storage Space	20.0 GB	20.0 GB	0% (0 bytes)
Hard Disk Storage	50.0 GB	50.0 GB	40% (20.0 GB)
CPUs	8	8	50% (4)
RAM	16.0 GB	16.0 GB	50% (8.00 GB)
VMs	2	2	50% (1)
Private Networks	2	2	0% (0)
Public IPs	2	2	50% (1)

1 Okeanos dashboard

3.2 Project team

The design and implementation project team consists of persons that cover a wide range of experience and know-how related with the project services. The project team consists of the following:

- Nikolaos Markellos
- Georgios Pistikos

- Vasileios Mitsios
- Sotirios Serdenis
- Soultana Toumpalidou

3.3 Development tools and technologies

3.3.1 Web platform

The following technologies were used to develop the Health Monitoring System platform as well as the end-user web application:

- JavaScript
- TypeScript
- MEAN Stack, which consists of:
    - MongoDB
    - Express
    - Angular
    - Node.js

3.3.2 Mobile app

The following technologies were used to develop the mobile application of the Health Monitoring System:

- Java
- Android
- Bluetooth Low Energy Protocol (BLE)

3.3.3 Database

The following technologies were used for the system's database:

- MariaDB
- MySQL
- Redis

3.3.4 Server

For the various background applications of the system, the following technologies were used:

- Python

- Web Services & RESTful API
- JSON
- WebSocket

3.3.5 Other Technologies

Some additional technologies used to develop the Health Monitoring System platform and to conduct testing activities are the following:

- Gradle
- Git
- Docker (Container)
- WebRTC

4 Management

This section describes the managerial issues of design and development tasks such as priorities and milestones, deliverables, and time plan.

4.1 Priorities

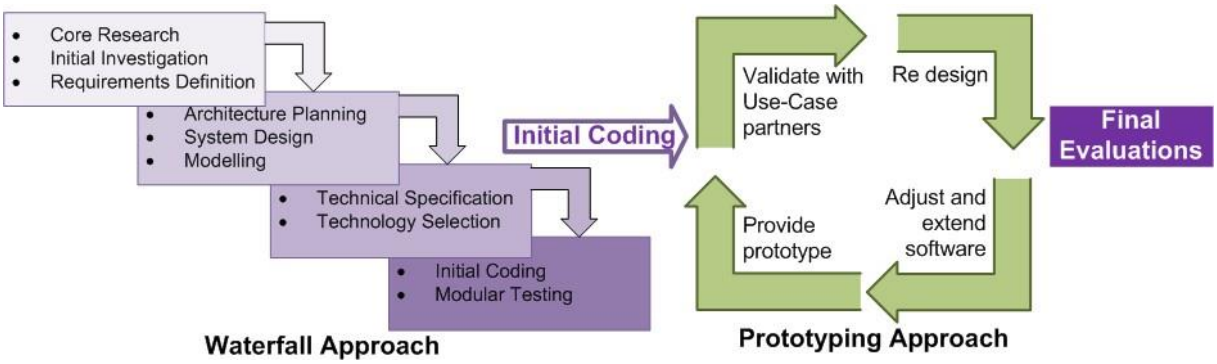
During the reporting period, the priorities for the strategic coordination of system design and development work are summarized as follows:

- Satisfaction of functional and non-functional requirements
- Enhance the capabilities of the system with new useful functionalities
- Incorporate the findings of the feasibility study into the design of the system and in particular utilize established standards for interoperability
- Provide support to the Greek pilot contractor and respond promptly to technical support requests in order to integrate regional devices (biosensor sensors) in a timely manner, with the aim of:
    - Performing extensive tests in a timely manner to ensure the proper functioning of both the device communication mechanisms and related functions of the Health Monitoring System (e.g, data management and visualization, reminders, etc.)
    - Debugging and completing necessary enhancements to minimize the risk of errors for real users
    - Producing an functioning prototype of the Health Monitoring System in a timely manner to ensure the smooth running of the pilot tests

The following is a breakdown of the work coordination methodology, activities and deliverables that have been developed, contributing to the achievement of the above objectives as well as the project objectives. In addition, some tools for monitoring the progress of the project and the timetable for implementation are presented.

4.2 Methodology

The methodology followed during the design and development activities combines innovative, established project design and implementation methodologies such as the 'waterfall' methodology during the early stages of the project and the 'agile' method (agile) at the stage when the pilot testing of the project will begin. The combination of these methods aims to adapt the functions and capabilities of the system as they can change significantly during project implementation.



2 Methodology

The use of the above methodologies allows for better design of the prototype by gradually developing applications that meet the maximum of user requirements. The work related to this deliverable refers to the stage of developing the system prototype.

4.3 Milestones

The key milestones for the development of the system, as well as their duration, are presented in the table below. Milestones are defined by the various subtasks.

Activity	Responsible
Feasibility Study – Best Practices Reviews	Sotirios Serdenis
Information System design	Georgios Pistikos
Specification of Electronic Health Record	
Definition of hardware and software requirements	
Platform deployment on cloud infrastructure	Vasileios Mitsios
Web Application Development	
Mobile Application Development	
Integration of peripheral devices	Greek pilot subcontractor
Functionality testing	Soultana Toumpalidou

Preparation of the system infrastructure and installation of the pilot test platform	Project team

4.4 Monitoring of the activities

The following tools were used to coordinate and monitor the various tasks:

- GitLab
- Trello

Coordination of the team effort follows a weekly planning process, with meetings of directly collaborating members, and meetings of the entire team on a monthly basis at least. The software version of the platform is also updated on a weekly basis. The activities coordinator is responsible for monitoring the progress of the tasks of the software development phase and maintaining the timetable, as well as to take appropriate corrective action if this is not observed.

5 Deliverables

5.1 Deliverable «Healthcare monitoring system design»

The deliverable describes the design of an integrated system for record and analysis of biosignals that facilitate effective patient monitoring at home. The main contributions of the system are the standardization of biosignals collection and the introduction of Cloud Computing concepts and tools for data managements and analysis utilizing point-of-care decisions. The deliverable also describes the methodologies for the effective management of health data and of the infrastructure, as well as the overall architecture of the system and the database model.

5.2 Deliverable «Healthcare Monitoring System Development»

The deliverable describes the system as a whole and focuses on issues that affect its subsystems horizontally. Special reference is made to the platform subsystem that is installed and operates on cloud computing infrastructure and supports the specific applications of the system.

5.3 Deliverable «Feasibility Study of the Healthcare Monitoring System»

The deliverable presents the results of the second phase of the feasibility study for the system under development and the required research. Following the first phase, which focused ont he analysis of the expected benefits, as well as a thorough market analysis, this second phase involved identification and review of best practices with regard to the digitization of healthcare systems and services throughout Europe. The outcome of this study was a set of valuable lessons and guidelines that will form the design of the system and its application, both within the frame of the project's pilots, as well as for its potential commercial exploitation after the completion of the project.

5.4 Deliverable «Testing report of the Healthcare Monitoring System»

The deliverable describes the methods, tools and the results of the testing procedure of the eHealth platform (and its subsystems) along with the necessary activities for the software updates and the Version Control that have been undertaken during the reference period.