

A Collective Intelligence Platform to Support Older Cancer Survivors: Towards the Definition of LifeChamps System and Big Data Reference Architecture

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Abstract

Within the most recent years, most of the cancer patients are older age, which implies the necessity to a better understanding of aging and cancer connection. This work presents the LifeChamps solution built on top of cutting-edge Big Data architecture and HPC infrastructure concepts. An innovative architecture was envisioned supported by the Big Data Value Reference Model and answering the system requirements from high to low level and from logical to physical perspective, following the “4+1 architectural model”.

Keywords:

Big Data; Cancer Survivorship; Quality of Life; Artificial Intelligence.

Introduction

Cancer prevalence during the past two decades has dramatically increased as people get older with 70% of cases diagnosed in men and women over the age of 50 [1]. In 2012, 6.7 million new cancer cases were diagnosed among older adults, representing 47.5% of the total number of new cancer cases worldwide [2]. Consequently, age is a risk factor for chronic complications of treatment, including chemotherapy-induced acute leukemia and chronic cardiomyopathy, with obvious implications for QoL or HRQoL [3] [4]. Within this context, LifeChamps EU H2020 project (<https://lifechamps.eu/>) aims to intelligently fuse heterogeneous sources of clinician- and patient-generated data (incl. EHR, IoT and electronic patient-reported outcome measures (ePROMs)) with the use of Artificial Intelligence algorithms for Big Data, in order to develop a computerized, clinical decision support tool that could provide comprehensive geriatric assessment while promoting behaviour change towards healthier lifestyles in cancer patients.

Methods

It is paramount that any system addresses the end-users' expectations, needs and requirements. For this to end, an iterative and co-creation approach [6] was followed to collect end-users inputs and transform them into the LifeChamps system descrip-

tion and design. This feedback has been translated into technical and functional requirements and will be crucial to develop all the system components. The “4+1 architectural view model” was chosen for the architecture [5]. It represents a simplified description of a software-intensive systems architecture, based on the use of five simultaneous visualisations. The diverse views correspond to different perspectives of stakeholders, such as end-users, developers, system engineer, and project managers [5].

Results

The vision of LifeChamps system is to address the inherent complexity caused by cancer treatments and to act in the monitoring of health status and improvement of quality of life by using emerging developments in the fields of Big Data, Data Analytics and Artificial Intelligence. Its innovative components are built upon three pillars: prediction, care, and advice. It targets older adult cancer patients, caregivers and healthcare professionals with a comprehensive solution capable of offering tools and mechanisms to promote patients' empowerment and improved QOL via timely and more accurate clinical decision support.

LifeChamps System

To this end, the LifeChamps system is composed by its actors, the LifeChamps Platform, the Edge which includes everything deployed at patient's homes, and the Data Warehouse. The LifeChamps Platform comprises all the central components and services of the LifeChamps system.

LifeChamps Architecture

To answer the LifeChamps ambition, it was needed to define different levels of the architecture, from high to low level and from logical to physical views. The “4+1 architectural view model” supports an integrated approach, ensuring that all the pieces fit together, and provides the standards and guidelines for each technical development.

Logical view

The Logical view includes the main components of the LifeChamps System from the point of view of the end-users. The LifeChamps system delivers and collects information

to/from the end-users through the two the end-users' applications, the LifeChamps (LC) Dashboard and the mHealth Application for QOL Assessment (see Figure 1).

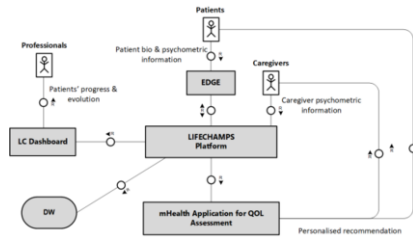


Figure 1 LifeChamps architecture: Logical view main components

Process view

The Process View considers non-functional requirements; it shows processes of the system and how they communicate with each other [5]. Below it is included an example of the process view for the LC Dashboard component for a concrete user story. A registered healthcare professional wants to access to the analytics of her/his site through the LC Dashboard.

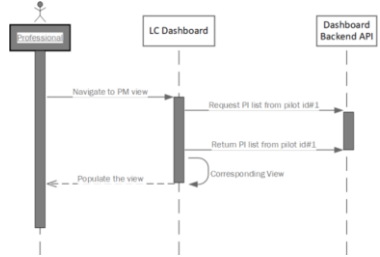


Figure 2 Example of a process view

Development view

The development view shows the most relevant building blocks of the system. Figure 3 represents an example of the component details for the Dashboard Backend API.

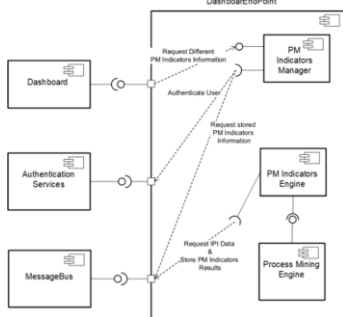


Figure 3 Development view – components detail for the Dashboard Backend API

Physical view

The physical view is concerned with the topology of software components on the physical layer. The components that contribute to this view were the patient sensors, the end-user application, the home location sensors, the High Performance Computing system, the Edge Storage, and the Data Warehouse.

Scenarios

This "plus-one" view of the 4+1 view model consolidates the other views. From the healthcare professional perspective the

proposed scenario shows a user completing the goal of analysing data for the dynamic modelling of patients.

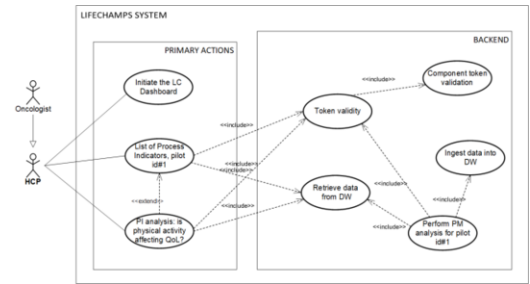


Figure 4 Scenario view: analysing data

Conclusions

LifeChamps system will contribute decisively towards (a) increasing treatment safety, (b) improving efficiency of resource utilization, and (c) minimising the conduct of unnecessary clinical procedures. The LifeChamps Platform and its reference architecture will allow realising the person-led care by understanding and abiding by the unique needs (and interactions thereof) of older people (and families) living with and beyond cancer. Paving the way towards predicting which older people (and families) living with and beyond cancer are at risk for decline in independent living post-treatment to prevent/minimise long-term ill health.

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