

DISCIPULUS NEWS

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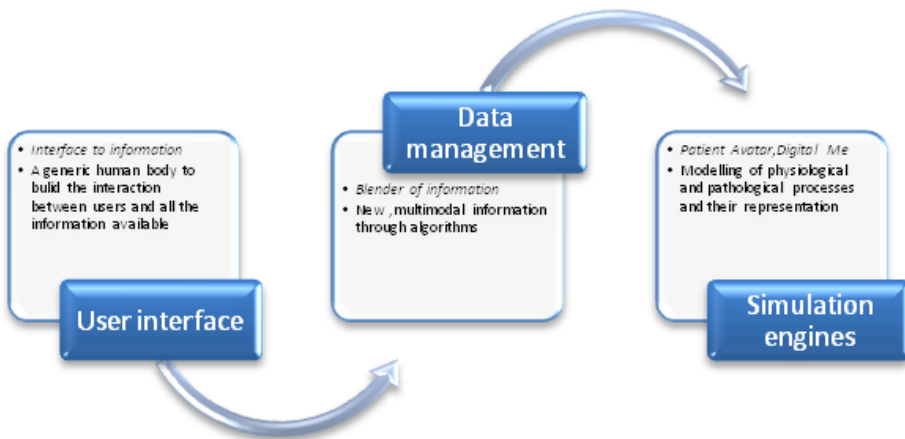
FIRST DRAFT: ROADMAP

The first draft of the Digital Patient Roadmap outlines the project's vision of the Digital Patient, aiming at the enhancement of medical practice and patient care. This draft roadmap is an evolving document; it will be further elaborated and updated on a regular basis to reflect ongoing discussions with key stakeholders including the DISCIPULUS Forum on BiomedTown.

A SHORT OVERVIEW

IN A FIRST PART, THE ROADMAP EXAMINES VISIONS AND CHALLENGES FOR THE DP.

One point of interest here is how to gather, combine and visualise the DP's data. Three levels of maturity are addressed, as it is pictured below.



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www.digital-patient.net

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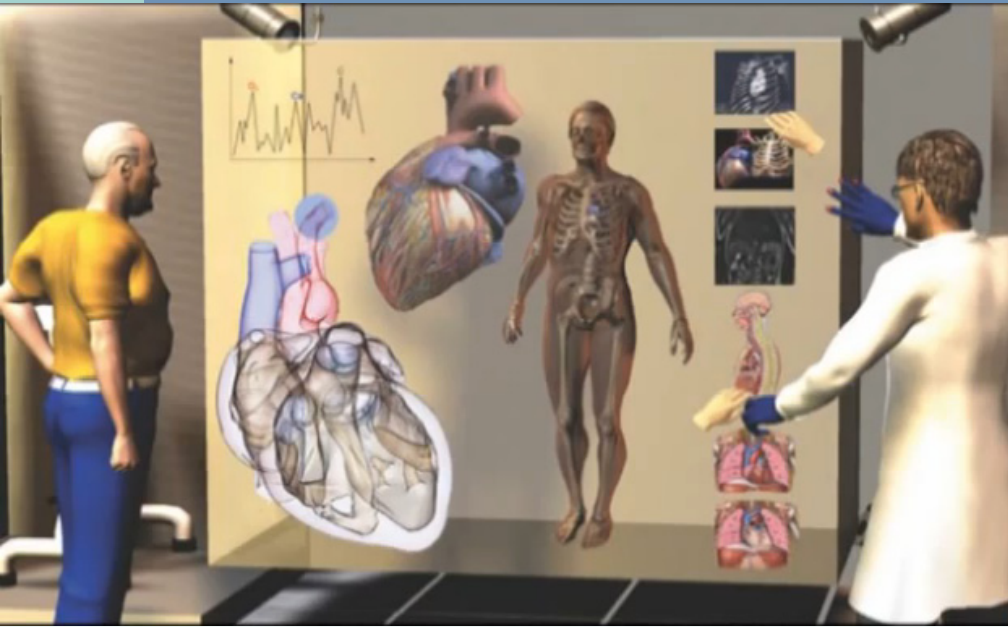
https://www.biomedtown.org/biomed_town/discipulus/reception/forum/discipulus-forum

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THE DIGITAL PATIENT

Patient and Clinician: Avatar used for explaining. (c) VPH Institute

VISUALISING DATA: INTERFACE

THE THREE STAGES OF MATURITY EXPLAINED.

The user interface can be compared with those touch screen units currently used for instance in hybrid cars, where you see your car as a graphic model and can easily switch between information on energy fluxes, A/C control, multimedia and so on. Instead of a car, the DP user interface, at an early stage, will look like a generic human.

As in the car, the interface needs data to visualise. In case of the DP, such data can include images, patient history, genetics, lifestyle, public/private databases et cetera. The combinatory potential of this data is not exploited fully yet, in order to be more useful, this data needs to be analysed and blended. Algorithms for

both analysing and blending have to be developed and thoroughly tested. The level of uncertainty should be visualised as well.

The ultimate outcome would be a Patient Avatar, or Digital Me, as VPH NoE puts it. The Avatar should act as a repository of all of the clinically-relevant information that has been collected about the individual. Over the years, the Avatar becomes an increasingly accurate representation of the individual as new measurements are made, or as inferences are made about missing items by operations on the information that is available.

WHAT ABOUT SECURITY?

It is quite obvious, that such propositions will arouse security concerns as well as questions of standardisation, semantic interoperability, infrastructure and so on.

Discipulus is following VPH-Share and VPH NoE on these topics and will make appropriate use of its outcomes in the final DP Roadmap.

DR. VANESSA DÍAZ, PI, UCL

“Although it seems science fiction, the Digital Patient is not only a real possibility, it will happen. It is not a matter of if, but when. And what a difference the DP will make in healthcare! It is almost impossible to understand all the repercussions in science, medical practice and healthcare. It will have a profound societal impact” (Vanessa Díaz, PI)



IN USE: CLINICAL DIMENSION

IN A SECOND PART, THE CLINICAL USE DIMENSION IS EXAMINED AND RESEARCH CHALLENGES ARE SHOWN. GENERALLY, THE CLINICAL USE OF DP TECHNOLOGY CAN BE SEPARATED IN THREE PARTS AS WELL:

Decision making (the clinical specialist decides the best course of action)

Explanation (the clinical specialist explains her /his decision to others: peers, carers, patient her-/himself)

Execution (the clinical specialist plans, carries out and monitors the treatment).

For each part, technological research challenges are depicted:

DECISION MAKING

Interface for exploration of large results space

Visual analytics to explore very large, multidimensional collections of simulation results.

Multiscale visualisation

As above, but for results that are defined over radically different space-time scales.

Generalised stochastic/probabilistic frameworks

Quantitative predictions should be presented together with an associated confidence interval or intrinsic physiological variability.

Reasoning querying

The option to query the hypermodel to find out which knowledge sets have been used to develop each component module, with links to relevant literature, validation results etc.

EXPLANATION

Representing complex processes at variable level of detail

Load on demand mechanism. Go from a simple, cartoon-like representation that everyone can understand to more and more complex and detailed visual representations by simply moving a slider on the interface.

Logical zoom

The possibility to be able to hide entire branches of the sub-model, leaving only those outputs that effect other branches visible.

Search the match

A highly individualised avatar could be used as a search template to identify similar cases within the hospital database. This requires a definition of similarity and this will depend on the question posed.

Avatar lookalike

Develop rapid, automatic and low-cost strategies to individualise the physical appearance of the Avatar to that of the patient. This provides emotional intensification, as used in Microsoft's Xbox Live Service or Nintendo's Mii, which can affect individual behaviour, including healthy behaviour.

Show the outcome (treatment)

Use the avatar to simulate the possible outcome of the various treatment options, and represent the outcome as a functional animation.

Show the outcome (lifestyle)

Use similar animation technologies to show the patient the predicted effect of certain (in-)appropriate lifestyle choices.

EXECUTION

(Quasi-)real-time VPH hypermodel response

Surrogate modelling, efficient execution of multi-scale models. Efficient restart of pre-computer hypermodels to support q sessions, i.e. where computers are embedded in surgical simulation environments.

Self-refining Avatar by intra-operative measures

Detailed measurements collected during the treatment are used to refine the hypermodel and improve its predictive accuracy for the treatment outcome.

Self-refining Avatar by monitoring

Post-treatment monitoring data are used to refine the long-term outcome prediction and feedback to the knowledge repository when significant deviations are observed between predicted and actual outcomes.



Avatar as used on Xbox Live.
(c) Microsoft Corp.

AVATARS

VPH-Share's vision: within 10 years, every person will have such an avatar which will be used as the basis of the presentation to the investigator (clinician or researcher) of all patient information, and it will serve as the basis of predictive simulations to evaluate the probability of a certain disease developing or progressing as well as predicting the effects of present or future interventions.

The Walking Avatar

The screen represents the animation of a generic human walking and switches to an individualised Avatar (including individualised stochastic models) when the Patient ID is entered.

The clinical user can visualise the simulations that predicted the highest risk of fracture, and use the avatar to understand what the primary source of such risk is, as the system displays bone stresses and strains predicted by the VPH model.

All parts of the walking avatar are pickable according to pre-defined standard interaction: for example, left click displays detailed information associated to that organ or tissue. A double click could "zoom in" to the next dimensional scale.

UPDATE: GET THINGS GOING...

IN ORDER TO GET THINGS GOING, A SOLID INFRASTRUCTURE HAS TO BE ESTABLISHED, INCLUDING:

Accessing the data

FAST ACCESS to all data, clustered by area in order to help visuals.

INTERACTION with data via mobile devices.

DIFFERENT SPECIALISTS at different locations at the same time, in much the same way multi-player games work online.

APPLICATIONS FOR PATIENTS to upload data and keep track of progress. Constant feed of EHRs.

USER FRIENDLY INTERFACES; should use touch screen technology, 3D-visualisation techniques.

Interactive holograms as a future model.

ADVANCED GRAPHICS to create an illusion of reality.

Approaching the data

UNIFIED AND CLEAN visuals of dirty data.

STANDARDISATION of EHRs wide range of information about the patient (environmental, genetic, etc.) as well as population data for direct comparison.

OVERLAPPING OF MARKERS at the individual and the population level will be useful if they take a graphical form.

Ideally MOVING AWAY from using numbers alone.

TIME-HISTORY of patients and unified charts or evolution of biomarkers, acute events and disease progression

Analysing the data

STARTING FROM GENOTYPE as the baseline, visualisation of the disease progression via accepted clinical indexes.

INFORMATION MUST BE COMBINED using sophisticated individual predictions, resulting in a fan of possible scenarios for further exploration. This information must be displayed in the interfaces described above.

How to develop such a DP system? The core suggestion is: consider developing the DP as an open platform, which constantly grows through contributions by the global VPH community at large, like other OpenSource endeavours. By building in feedback loops and options to integrate new knowledge created by the Avatar to real patients, it could become a kind of a self-learning system.

FORUM: EMERGING THEMES

What value could the Digital Patient offer to CLINICIANS?

What value could the Digital Patient offer to PATIENTS?

How could INDUSTRY best contribute to the process of building the Digital Patient?

Other opportunities?

Challenges to ACCEPTANCE, and possible solutions.

Recommended ACTION.

Feel free to READ THE ENTIRE DRAFT of the roadmap at www.digital-patient.net, leave your very much appreciated COMMENTS on <http://vph-institute.org/news/the-discipulus-wiki> and DISCUSS WITH US on https://www.biomedtown.org/biomed_town/discipulus/reception/forum/discipulus-forum

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The second DISCIPULUS Consultation Meeting, a *think-tank* style workshop, will take place at Universitat Pompeu Fabra (UPF) in Barcelona. The MAIN EVENT will be held on **Tuesday November 27th 2012**, following a networking/DISCUSSION SESSION on **Monday, 26th**. The aim of this meeting is to compile and discuss information about the requirements and needs for the DP and to determine the key bottlenecks to be tackled in the next ten years to achieve the DP vision.