

investigations on

the Impact of Anthropomorphism and Gamification
on Breast Cancer Survivors' Expressed Preferences
in a Physical Activity Promotion Intervention

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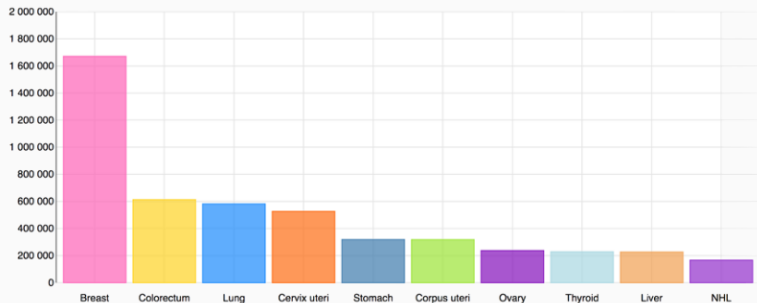
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eTELEMED 2019 : The Eleventh International Conference on eHealth, Telemedicine, and Social Medicine

context

on the contemporaneity

Estimated number of incident cases, females, worldwide (top 10 cancer sites) in 2012



Data source: GLOBOCAN 2012
Graph production: Global Cancer Observatory (<http://gco.iarc.fr/>)
© International Agency for Research on Cancer 2017

International Agency for Research on Cancer
World Health Organization

of ancient bulging tumours

“...when a cancer is in a site where total eradication is possible, such as a cancer of the breast or of the thigh, and in similar parts where complete removal is possible, and especially when in the early stage and small, then surgery was to be tried.”

excerpt from the Kitab at-Tasrif by Abu Al-Qasim Al-Zahrawi (936 - 1013 CE)

with a memory shaped

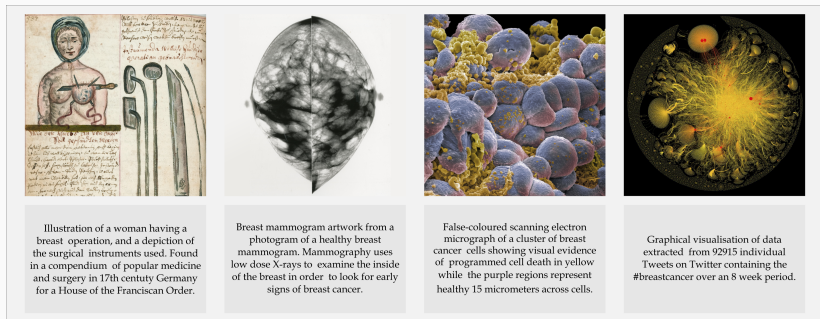


Figure:

An incomplete timeline of breast cancer research milestones

[Credits (from left to right): L0041077, Wellcome Library, London. B0010860, Chiara Salvi, Wellcome Images. B0006422, Annie Cavanagh; Wellcome Images. B0010876, Eric Clarke, Richard Arnett, Jane Burns, Royal College of Surgeons in Ireland, Wellcome Images.]

“In 2015, breast-cancer survival rates are at their highest ever. More than 6 million people worldwide are still alive 5 years after being diagnosed with breast cancer, although survival rates continue to lag in areas without reliable access to advanced medicine. Breast cancers are now treated with tailored combinations of surgery, chemotherapy and radiation, and continued research is making treatments more precise and minimizing side effects.”

Tauxe, W. (2015). A tumour through time. *Nature*, 527(7578), S102-S103.

so, what then?

On the one hand,

common breast cancer treatment techniques result in several impairments in women's upper-body function, and, consequently, **may contribute to a decreased quality of life.**

On the other hand,

although some methods for monitoring and assessing do exist, **an integrated approach able to achieve early detection, promote risk-reduction and self-management,** while engaging the user in an appropriate follow-up strategy, **is still missing.**

one attempt at something

What are the minimum constraints,
both on the set-up of acquisition,
as well as on the postures observed,
necessary to be established in order
to perform an evaluation of the upper body mobility
of breast cancer survivors from visual data,
while allowing the extraction of
clinically relevant information
to monitor such population through time?

[Unconstrained Human Pose Estimation to Support Breast Cancer Survivor's Prospective Surveillance]

one collective attempt at somethings

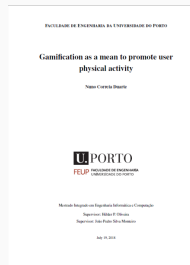
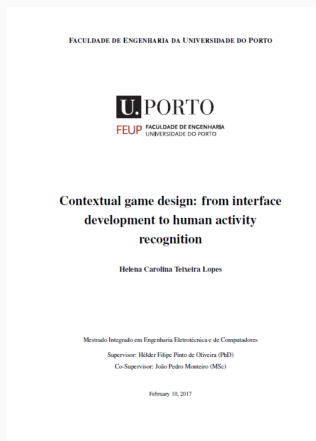


Figure:

Carolina T. Lopes, MSc (2017).

Contextual Game Design:
from Interface Development to Human Activity Recognition

<https://repositorio-aberto.up.pt/handle/10216/102454>

one collective attempt at somethings

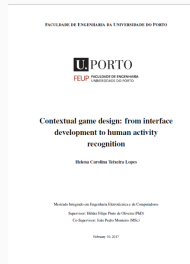
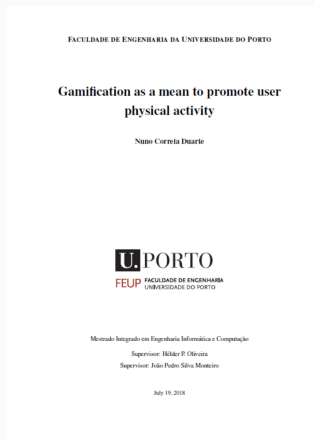


Figure:

Nuno C. Duarte, MSc (2018).

Gamification as a mean to promote user physical activity

<https://repositorio-aberto.up.pt/handle/10216/114215>

introduction

about gamification

On the one hand,

a game, overall, **aims to offer** the player **a challenge** of a physical or/and mental nature **that can be completed** using a set of rules, being able to install feelings of amusement or entertainment to the participant **while returning feedback** in a form of grades or scores, while possibly unlocking new challenges.

about gamification

On the other hand,

physical activity promotion programmes tested in patients with impairment problems demonstrate that patients' **functionality can improve with an intensive training** split that is contextualised and **oriented as a pursuit in the achievement of a well defined goal.**

However,

such approach is prone to present **a major set-back,** which **is the lack of interest** of the patient in performing repetitive tasks.

about gamification in a context

The concept of serious games is one that is hard to define, but it usually refers to games used for training, advertising, rehabilitation, simulation or education. A particular example of such a gamified approach, commonly referred to as exergaming or **exergames**, can be described as a type of video game, or multimedia interaction that **requires the player to physically move in order to play.**

about anthropomorphism

On the one hand,

different elements can be considered to be included **in games** as strategies to promote improved adherence, **such as**, virtual representations of the self, through which players are presented to the possibility of assuming the role of a character in the game.

On the same note, previous research tends to suggest that the effect of game players experiencing a sense of artificial body parts to be their own, within the context of an Virtual Reality setting may result from numerous factors, including **the virtual body realism** in terms of visual human resemblance.

about anthropomorphism in a context

On the other hand,

the Uncanny Valley hypothesizes that there should exist a positive relationship between how human a robot looks, and **how comfortable people are with its appearance**, up to the moment a robot would get too close to being **human in appearance**, at which point human reaction would become negative.

However,

and despite its impact in game design has been evaluated, **there seems to not exist absolute evidence to support, or disprove it.**

proposed research

overall architecture

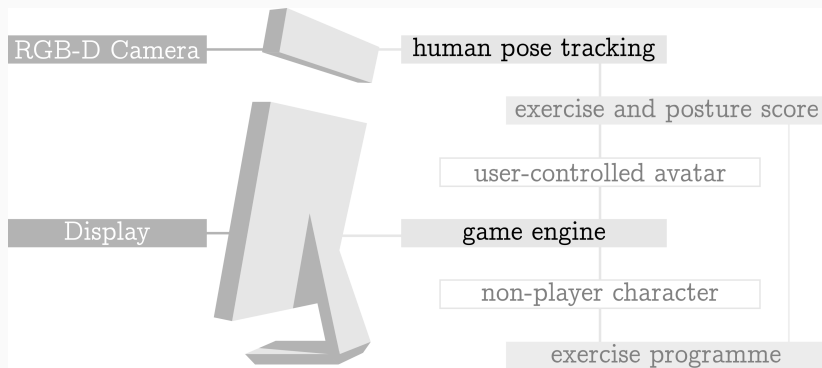


Figure: Gamified Aid for Monitoring Exercise (GAME)

exercise programme

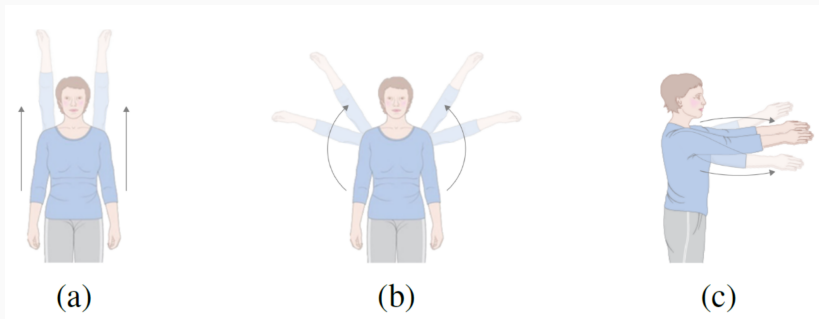


Figure: Illustration of the exercise programme consisting of shoulder flexion (a), abduction (b), and horizontal adduction (c) selected in accordance to the National Institute for Health and Clinical Excellence (NICE) guidelines for breast cancer survivors physical activity promotion intervention.

expressed acceptance assessment

- c_1) suitability for the task,
- c_2) information accessibility,
- c_3) continuity correction,
- c_4) visual pleasingness,
- c_5) self-descriptiveness,
- c_6) adequacy of user workload.

Based on that criteria, a questionnaire composed of six questions was formulated in Portuguese, and a five point scale, ranging from strong disagreement (1) to strong agreement (5), considered for range of response options.

main elements for exploratory work

1. anthropomorphism as a strategy to engage and promote adherence
2. gamification as a mean to promote physical activity practice

study on anthropomorphism

participants and design

Seventy-two adults (mean age of the cohort was 57.79 ± 11.16 years, all female) participated.

Participants were recruited via personal invitation from surgeon-led follow-up consultations of breast cancer survivors.

Written informed consent was obtained from all participants. All participants were fluent in Portuguese and did not get paid for their participation.

procedure and materials

Participants were invited to participate in this study via personal invitation at the end of a follow up consultation at the Breast Center of São João Hospital (Porto, Portugal) during the period from the end of October until the beginning of December, 2016. Participants were informed that the study was part of the development of an aid designed to promote physical activity recommend for BCS. The recruited participants were prompted to use the system, in an adjacent room to the consultation room.

procedure and materials

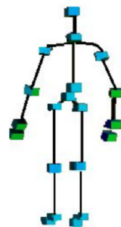
**Levels of user
controlled avatar
anthropomorphism**
(while exercising)

no visual feedback

skeleton $a_1)$

humanoid avatar $a_2)$

mirror



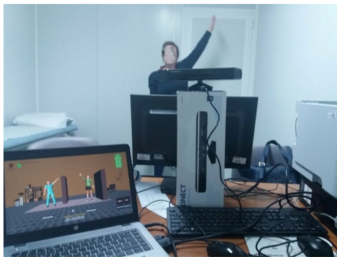
$a_1)$



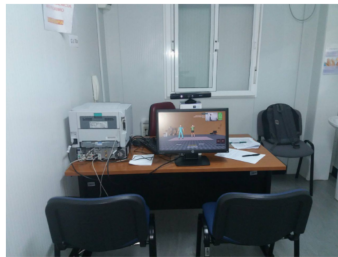
$a_2)$

Figure: Illustration of the user controlled character: avatar based characters animated with the user's tracked movement with different levels of anthropomorphism.

procedure and materials



(a) Experimental set-up



(b) Perspective of the user

Each patient was inquired of its satisfaction level of the usage of the system through a questionnaire that required the user to rate each of the tested interfaces according to a five point scale ranging from least preferred (1) to most preferred (5). Each session took approximately 30 minutes.

TABLE I. AVERAGE AND STANDARD DEVIATION (SD) OF EXPRESSED PREFERENCES OVER THE INTERFACES COMPRISING VARIATIONS FOR THE USER CONTROLLED CHARACTER TESTED BY SEVENTY-TWO BCS IN A CLINICAL SETTING.

	avatar			
	no visual feedback	skeleton	humanoid	mirror
Average	4.10	4.22	4.22	4.19
SD	0.77	0.88	0.77	0.82

study on gamification

Sixty-eight adults (mean age of the cohort was 59.09 ± 10.92 years, all female) participated.

The same recruitment method mentioned for the study on anthropomorphism was used.
The recruitment took place from the beginning of November until the end of December, 2017.

A sub group of 22% of participants (15 out of 68) were randomly assigned to receive printed information resources, in form of a pamphlet produced at the Breast Center of São João Hospital.

procedure and materials

The user controlled avatar was animated with the human pose provided by a Kinect^{ToF}, and the gesture builder tool available in the Kinect SDK used to create a database containing the movements selected for the exercise routine, which allows to perceive to which degree of completion is a given movement being performed.

The **scoring** used for the GAME attributed **1 point for every 1% of progress in each repetition**, and a final score was presented as a percentage of the routine completed **(the complete routine corresponds to 3000 points)**.

procedure and materials



(a) Experimental set-up



(b) Printed pamphlet

TABLE II. AVERAGE AND STANDARD DEVIATION (SD) OF EXPRESSED ACCEPTANCE FOR BOTH THE PROPOSED GAME, AND A PRINTED PAMPHLET CONTAINING INFORMATION ABOUT THE SELECTED EXERCISE PROGRAMME.

Criteria	GAME		pamphlet	
	Average	SD	Average	SD
c_1)	4.60	0.74	4.00	1.11
c_2)	4.72	0.50	4.08	1.27
c_3)	4.92	0.32	5.00	0.00
c_4)	4.88	0.29	4.60	0.84
c_5)	4.96	0.19	4.60	0.84
c_6)	4.88	0.39	4.00	1.11

closing wrap-up

on investigating anthropomorphism

In the presented context,

results seem to agree with the hypothesised Uncanny Valley effect, in the sense that a more anthropomorphised representation of the self (a mirror), seems not to be the preferred interface.

Although not possible to assess from the presented results, but also supported considering previous research, subjectively constructed proprioceptive body representations of the self, seem to be an apparently worth considering factor, with potential impact to adherence to systems using anthropomorphised avatars.

on investigating gamification

Overall,

the collected expressed acceptance suggests that
the proposed **Gamified Aid For Monitoring Exercise (GAME)**
seems suitable for the task,
informative,
visually pleasing,
self-descriptive, and
providing an adequate workload to the user.

on the attempt at something

What are the minimum constraints ,
both on the set-up of acquisition,
as well as on the postures observed,
necessary to be established in order
to perform an evaluation of the upper body mobility
of breast cancer survivors from visual data ,
while allowing the extraction of
clinically relevant information
to monitor such population through time
while engaging (or promoting adherence among)
the users in the process?

acknowledgements

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