Motiv-ARCHE: adaptive co-creation system with AR to motivate heritage education

Presented by:
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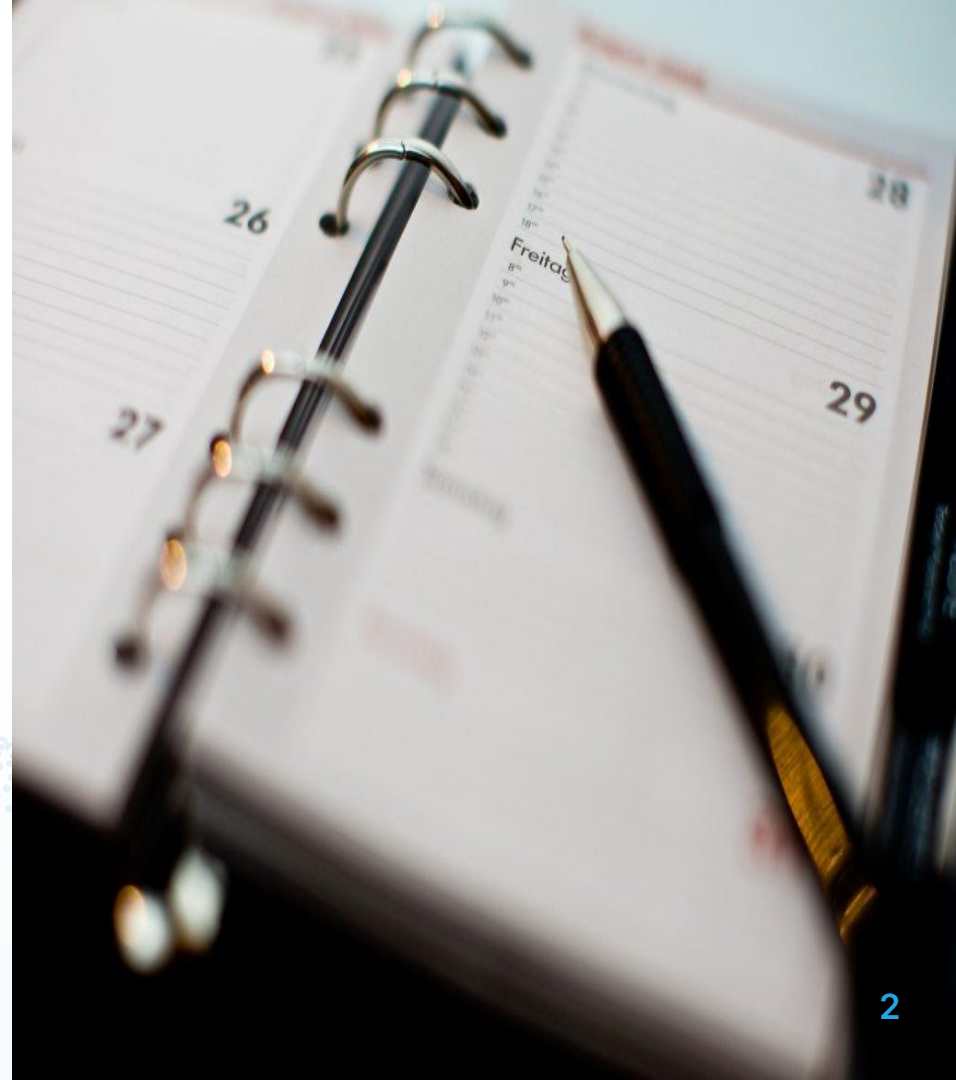Ramon Fabregat
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Doctoral Research Seminar 2022-30

Pontificia Universidad
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Universitat
de Girona

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Contextualization

Contextualization

- **Opportunity/problem**
- **Justification**

Opportunity / problem

Lack of flexible and personalized learning environments [1,5,6]

Lack of motivation to visit heritage sites [3,4]

Use of Information and Communication Technologies (ICT) [1,2]

Exhibits are not suitable for all users [3,4]

Information overload [5,6,7]

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Opportunity / problem

- **According to UNESCO there are 1007 heritage sites in 161 countries [8]**

- **Patrimonial elements in risk [8,9]**

Contextualization

- **Opportunity/problem**
- **Justification**

Justification

Adaptation of information [6,7,12,13]

Immersive technologies (AR)
[10,11,14,15]

Co-creation
[11,16,17,18]

Overload information

Participation   **Motivation**

State of the art

State of the art

- **Basic concepts**
- **Related works**
- **Hypothesis**

Basic concepts

Cultural and natural heritage

Immersive technologies

Adaptation of information

Co-creation

State of the art

- **Basic concepts**
- **Related works**
- **Hypothesis**

Related works

- **Classification**
  1. **Immersive technology**
     - AR
     - VR
     - Other
  2. **Recognition**
     - Image
     - Sensors
       - GPS
       - RFID
       - Beacon
       - NFC
       - Other

3. **Adaptation**
   - Content
   - Presentation
   - Profiles
4. **Application**
   - Android (A)
   - iOS(I)
   - Web (W)
   - Other (O)
5. **Execution environment**
   - Internal (I)
   - External (E)
6. **Multilanguage**
7. **Co-creation**

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Related works

Works	Immersive technology				Recognition						Adaptation									Application	Environment	Multilanguage	Co-creation
					Sensores						Presentación					Perfiles							
	AR	VR	Other	Image	GPS	RFID	Beacon	NFC	Other	Content	Audio	Image	Video	3D model	website	user	context	CH element				
[43]	X			X								X	X	X		X			A/I	I		
[44]			X			X					X	X				X			O	E		
[45]	X					X					X						X		O	I		
[46]	X				X					X							X		A	E		
[47]	X					X	X			X			X			X			O	I	X	
[14]	X			X							X	X	X						A	I		
[48]	X	X			X						X							X	O	E		
[49]	X			X							X	X	X	X		X	X		O	I		
[50]	X			X				X		X									A/I	I/E		X
[51]	X							X		X						X	X	X	W/A	I	X	

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Related works

| Works | Immersive technology | | | | Recognition | | | | | | Adaptation | | | | | | | | | Application | Environment | Multilanguage | Co-creation |
| | | | | | Sensores | | | | | Content | Presentación | | | | | Perfiles | | | | | | | |
	AR	VR	Other	Image	GPS	RFID	Beacon	NFC	Other		Audio	Image	Video	3D model	website	user	context	element	CH				
[52]		X							X	X						X				W	I		
[53]			X						X		X	X								A/O	I		
[54]			X			X				X							X		X	W/O	I		
[55]		X							X	X				X		X				W	I		
[56]	X						X			X	X	X					X			O	I		
[57]	X			X						X	X	X	X			X				O	I	X	
[58]		X			X					X							X			W	I		
[59]			X		X					X							X	X		O	E	X	
[60]			X		X					X					X			X		A	I/E		
[61]			X		X					X					X					W	E		
[62]			X		X	X				X						X				W/O	I/E		
[63]			X		X					X							X			W	E		

Related works

✓

User characteristics

"One size fits all" [64]

✓

Involve the user

✓

Contents

Experts in technology

MADE TO MEASURE

16
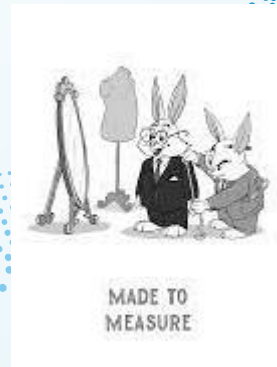
State of the art

- **Basic concepts**
- **Related works**
- **Hypothesis**

Hypothesis

- The **co-creation** of **adaptive contents** in topics related to cultural and natural heritage, as well as the use of **technological tools** motivate the student's learning
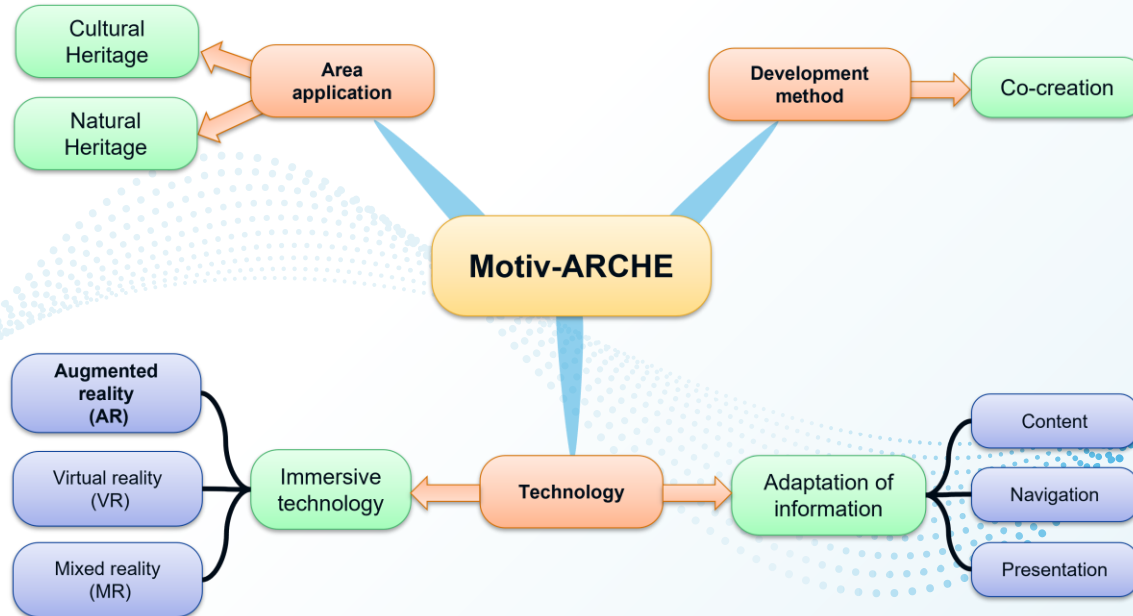
Research proposal

Research proposal

- **Motiv-ARCHE**
- **Objectives**
- **Research and development methodology**

Motiv-ARCHE

Co-creative system of **adaptive contents** with **AR**
to motivate the **heritage education**

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Research proposal

- **Motiv-ARCHE**
- **Objectives**
- **Research and development methodology**

General objective

Develop a co-creation system of adaptive contents using augmented reality with the aim of motivate the students in topics related to cultural and natural heritage considering their characteristics, context and co-created contents.

Specific objectives

OBJ 1: define the **methods** for **co-creation of adaptive contents** to support the heritage education.

OBJ 2: identify the **characteristics of augmented reality** that improve the user's motivation in topics related to heritage education.

OBJ 3: create a **adaptive model** that considers the user's characteristics, the context and the co-created contents with the aim of present contents that **motivate** the users in **heritage education**.

OBJ 4: develop a **system** that allows the **content co-creation** and it implements **adaptive services** in environments of heritage education.

OBJ 5: perform **system tests** **through** a functional prototype with users in heritage environments.

OBJ 6: evaluate the **co-creation system** and the **co-created contents**

Research proposal

- **Motiv-ARCHE**
- **Objectives**
- **Research and development methodology**

Research and development methodology

| Initial phase | Production phase | Implementation and construction phase | Evaluation phase |

Activities

1. Identification of contents

4. Identification of user characteristics

2. Co-creation process

3. Activation methods AR

5. Adaptive services

OBJ 1: define the **methods** for **co-creation of adaptive contents** to support the heritage education.

OBJ 2: identify the **characteristics of augmented reality** that improve the user's motivation in topics related to heritage education.

Deliverables

1. Kind of contents to co-create
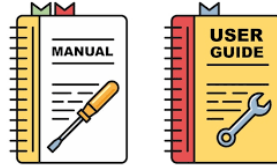
2. Manual of co-creation contents

3. AR activation methods

4. Characteristics to adapt the information

User

Context

Heritage element

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Research and development methodology

| Initial phase | Production phase | Implementation and construction phase | Evaluation phase |
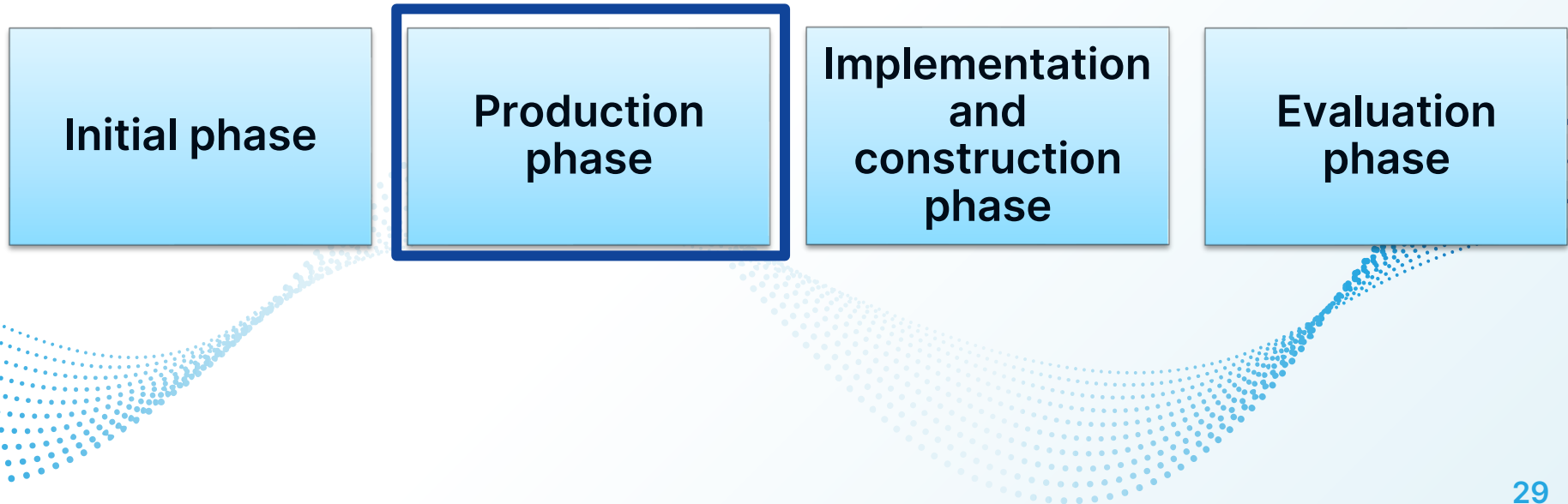
Activities

1. Student profile

OBJ 3: create a **adaptive model** that considers the user's characteristics, the context and the co-created contents with the aim of present contents that **motivate** the users in **heritage education**.

2. Context profile

3. Heritage element profile

6. Tools to obtain and update the characteristics

4. Design the adaptation process

5. Specification of adaptive services

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Deliverables

1. Student profile

2. Context profile

3. Heritage element profile

4. Process of adaptation

5. Adaptive services

Research and development methodology

Initial phase	Production phase	Implementation and construction phase	Evaluation phase
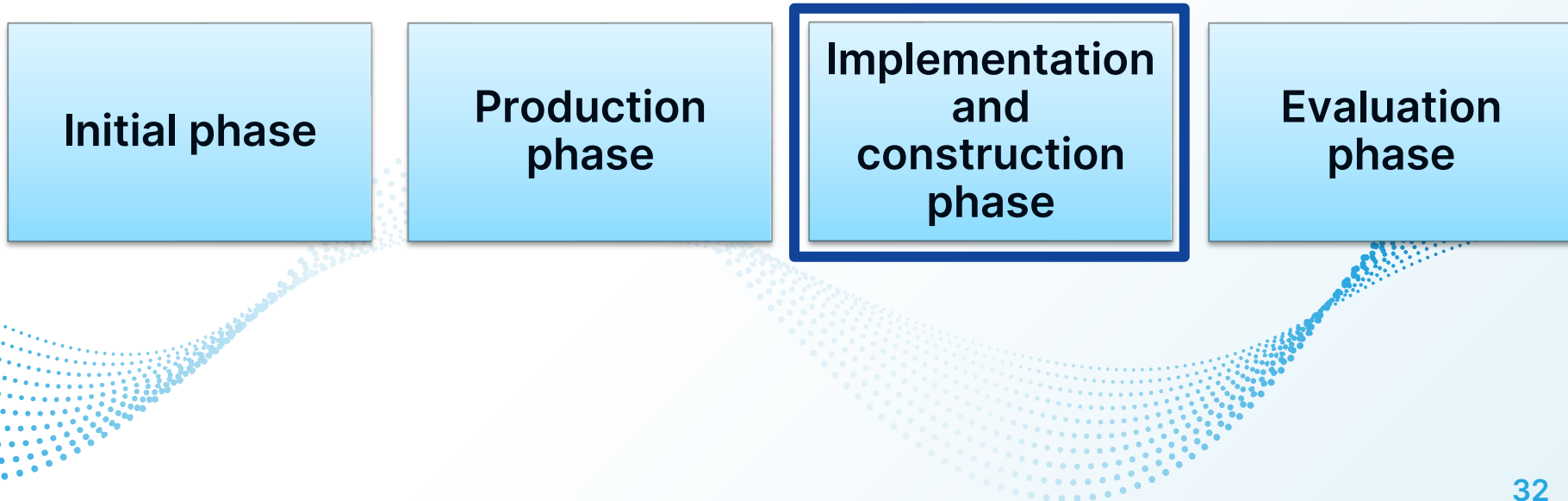
Activities

1. Design and development of Motiv-ARCHE

2. Integration of adaptation

OBJ 4: develop a **system** that allows the **content co-creation** and it implements **adaptive services** in environments of heritage education.

OBJ 5: perform **system tests** through a functional prototype with users in heritage environments.
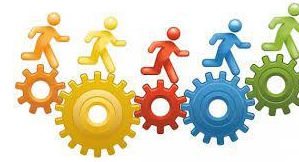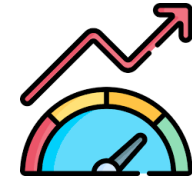
Functional

No functional

Usability

Adaptation

3. Design of test

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Deliverables
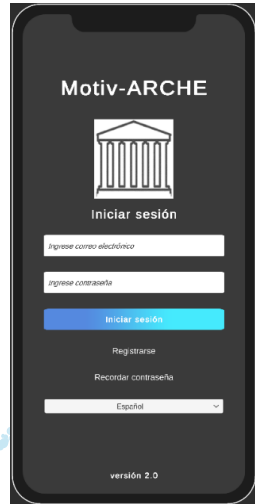
**1. Application
Motiv-ARCHE 2.0**
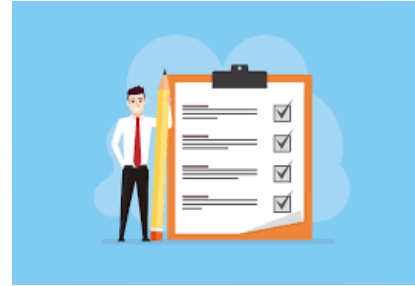
2. Test protocol

Research and development methodology

Initial phase	Production phase	Implementation and construction phase	Evaluation phase
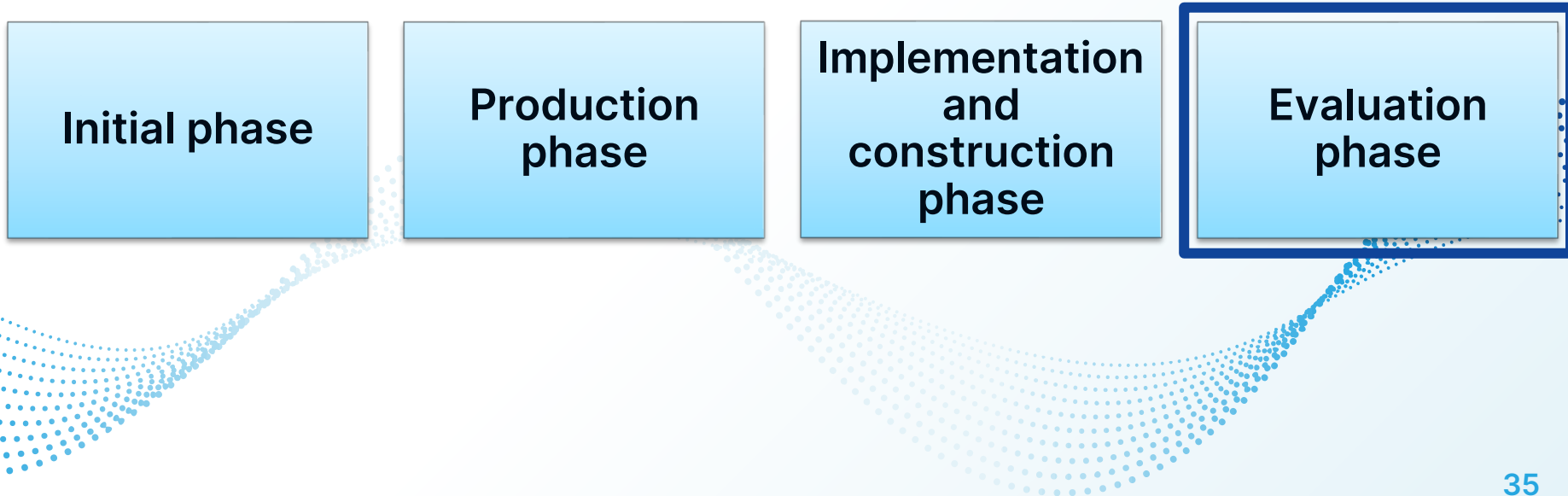
Activities

Co-created contents

Adaptation

Usability and acceptance

Motivation

1. Evaluation

2. Analysis

OBJ 6: evaluate the **co-creation system** and the **co-created contents**

Deliverables

1. Acceptance test of the system

2. Adaptive test

3. Usability test

Research and development methodology
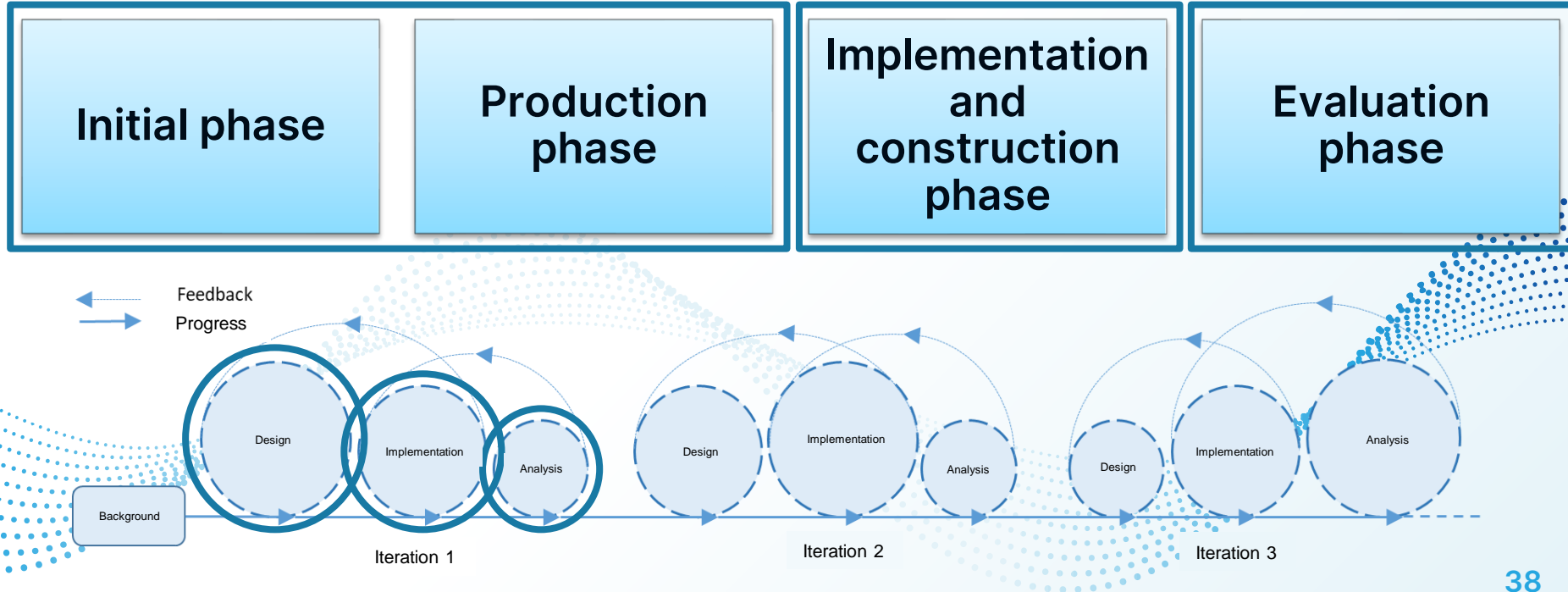
| Initial phase | Production phase | Implementation and construction phase | Evaluation phase |

Feedback
Progress

Background

Design — Implementation — Analysis
Iteration 1

Design — Implementation — Analysis
Iteration 2

Design — Implementation — Analysis
Iteration 3

Project progress

Project progress

- **Contributions**
- **Development progress of Motiv-ARCHE**
- **Video Motiv-ARCHE**

Contributions

Articles

- González Vargas, J. C., Fabregat, R., Carrillo-Ramos, A., & Jové, T. (2020). "*Survey: Using Augmented Reality to Improve Learning Motivation in Cultural Heritage Studies*". Applied Sciences, 10(3), 897. MDPI AG. http://dx.doi.org/10.3390/app10030897 . Q2 – Web Of Science, Q2 – Scopus

- González Vargas, J. C., Fabregat, R., Carrillo-Ramos, A., & Jové, T. (2021, Mayo). "*Motiv-ARCHE: an augmented reality application to co-create cultural heritage resources with teenagers*". European Journal of Post-classical Archeologies (PCA), 11, 387-397. http://www.postclassical.it/PCA_Vol.11_files/PCA11_GonzalezVargas-et-al.pdf . Q2-Scopus

Contributions

Conferences

- González Vargas, J.C., Fabregat, R., Carrillo-Ramos, A. (2020). "*Motiv-arch: A cultural heritage co-creation system to motivate gifted students*". III Conference of Pre-doctoral Researchers Abstract Book, ISBN 978 84 8458 573 2, pág. 117.
  https://dialnet.unirioja.es/servlet/articulo?codigo=7637731

- Fabregat, R., Gascons, N., Jové, T., González-Vargas, J. C. & Coris, L. (2022). "*Cocreación de contenidos con Motiv-ARCHE en el proyecto PECT Costa Brava y Pirineo de Girona: Naturaleza, Cultura e Inteligencia en red*". 17 Congreso CIMED, II Congreso Internacional de Museos y Estrategias Digitales UPV, 19 -28 de Octubre de 2022, Doi: https://doi.org/10.4995/ CIMED22.2022

Contributions

- **Fabregat, R., Gascons, N., Jové, T., González-Vargas, J. C. & Coris, L. (2022).** "*Motiv-ARCHE: Pruebas piloto de cocreación de contenidos por expertos patrimoniales*". 17 Jornades Antoni Varés , Girona 16-19 Noviembre de 2022

Contributions

Articles to publish

- **Co-creating cultural heritage resources for museums with teenagers using the platform Motiv-ARCHE**

- **Motiv-ARCHE: Sistema adaptativo basado en realidad aumentada para el aprendizaje de la herencia cultural**

Project progress

- **Contributions**
- **Development progress of Motiv-ARCHE**
- **Video Motiv-ARCHE**

Development progress of Motiv-ARCHE

- **Process of co-creation contents**
- **Adaptive profiles**
- **System architecture of Motiv-ARCHE**
- **Implementation of Motiv-ARCHE v. 1.0**

Process of co-creation contents

1. Select heritage element

1b. Tag heritage element

2. Select the AR methods

3. Add contents to the heritage element

3b. Tag the contents
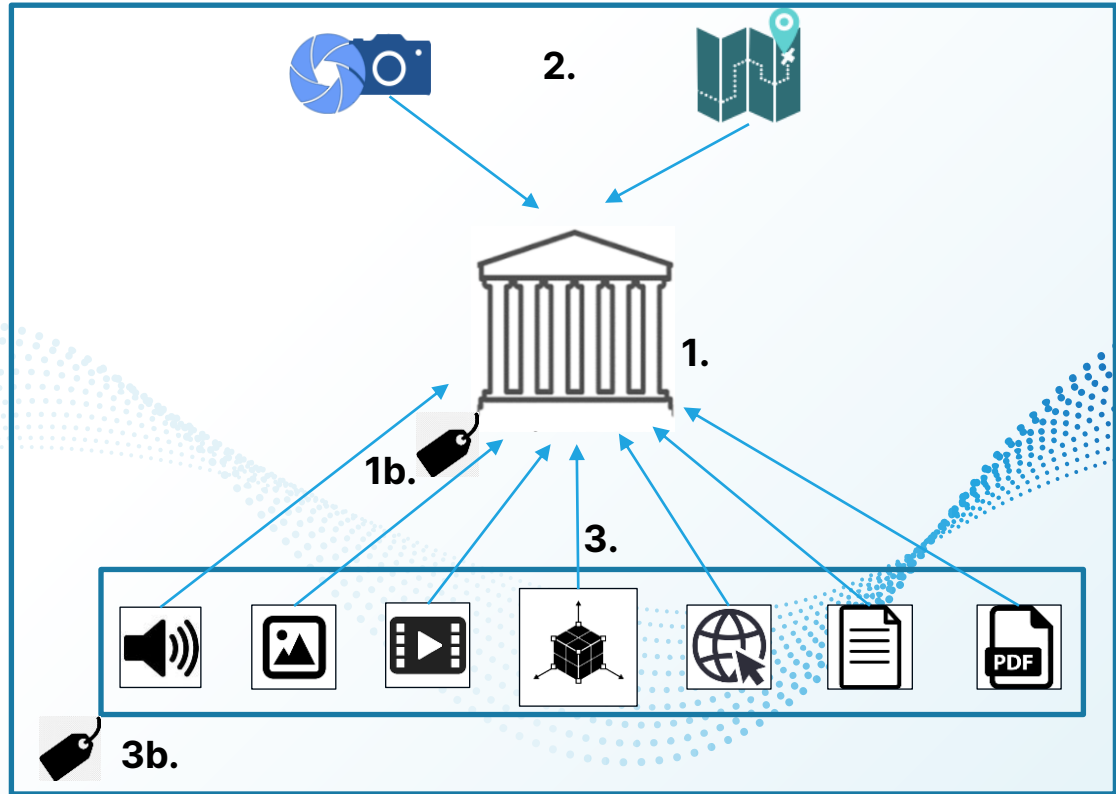
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Development progress of Motiv-ARCHE

- **Process of co-creation contents**
- **Adaptive profiles**
- **System architecture of Motiv-ARCHE**
- **Implementation of Motiv-ARCHE v. 1.0**

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User profile
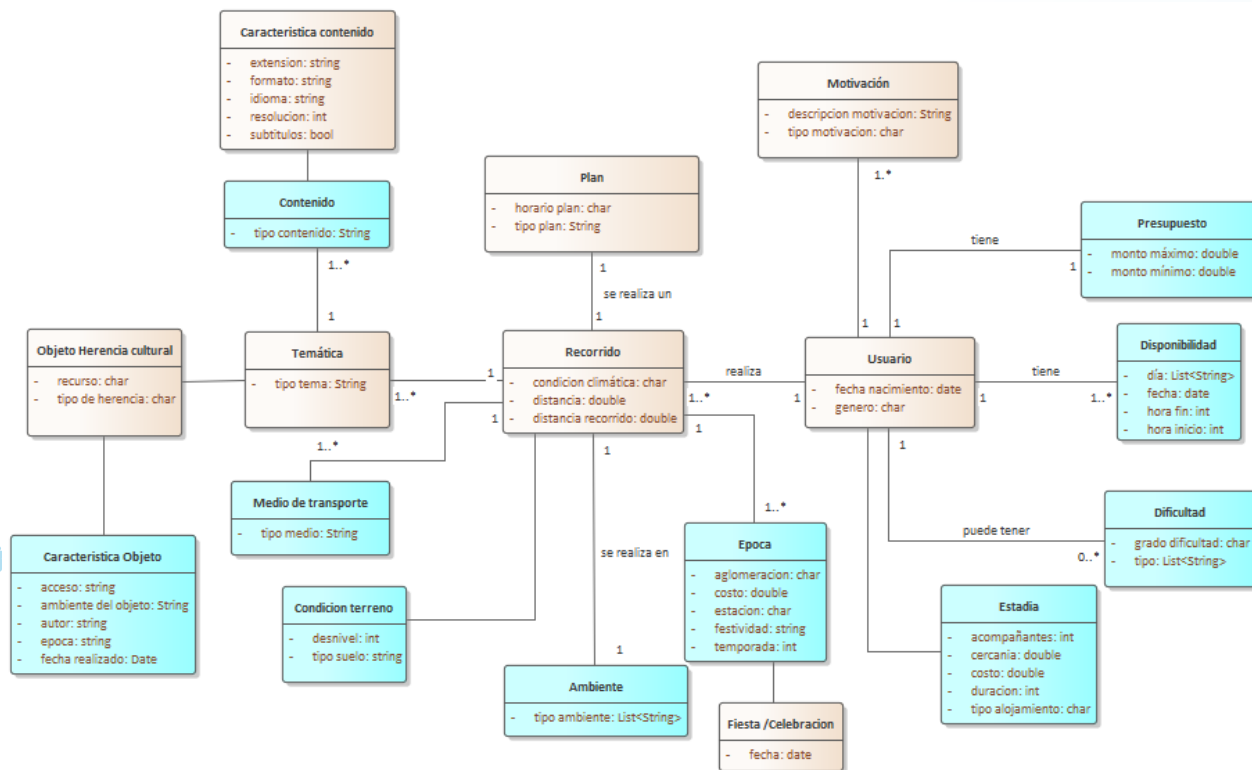
Heritage element profile
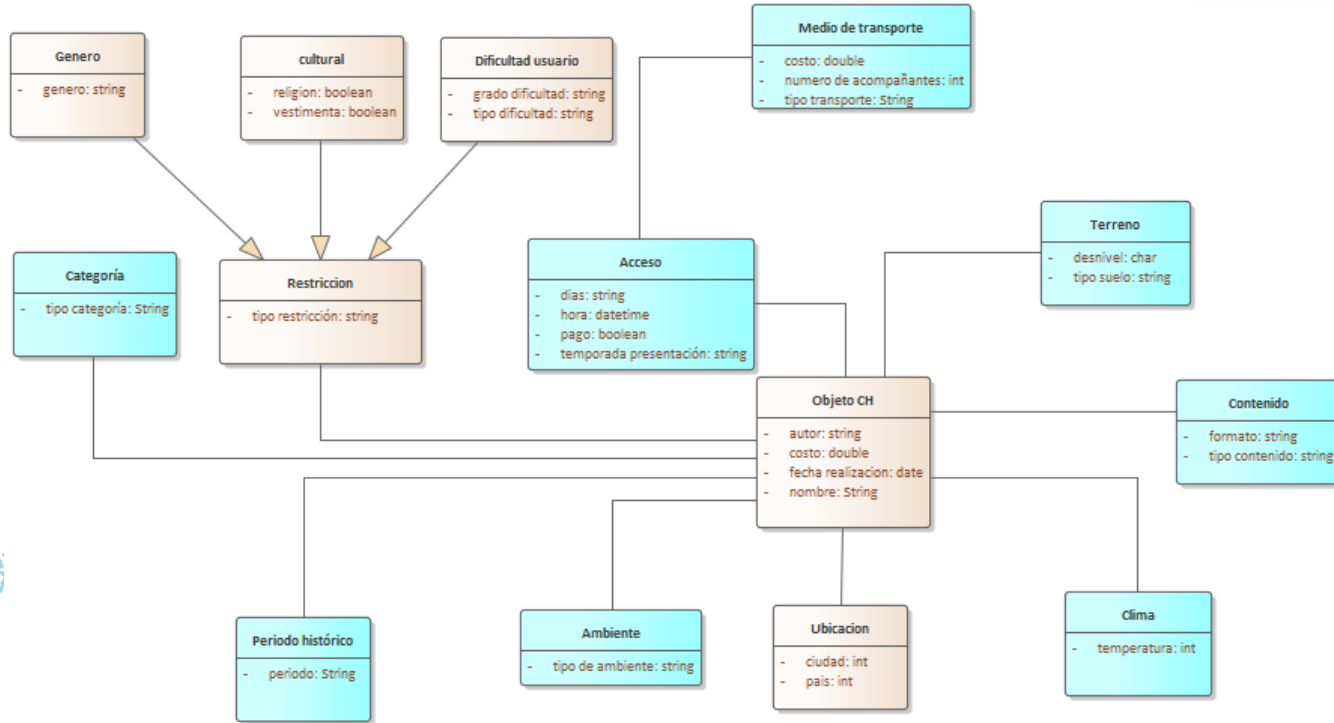
Context profile
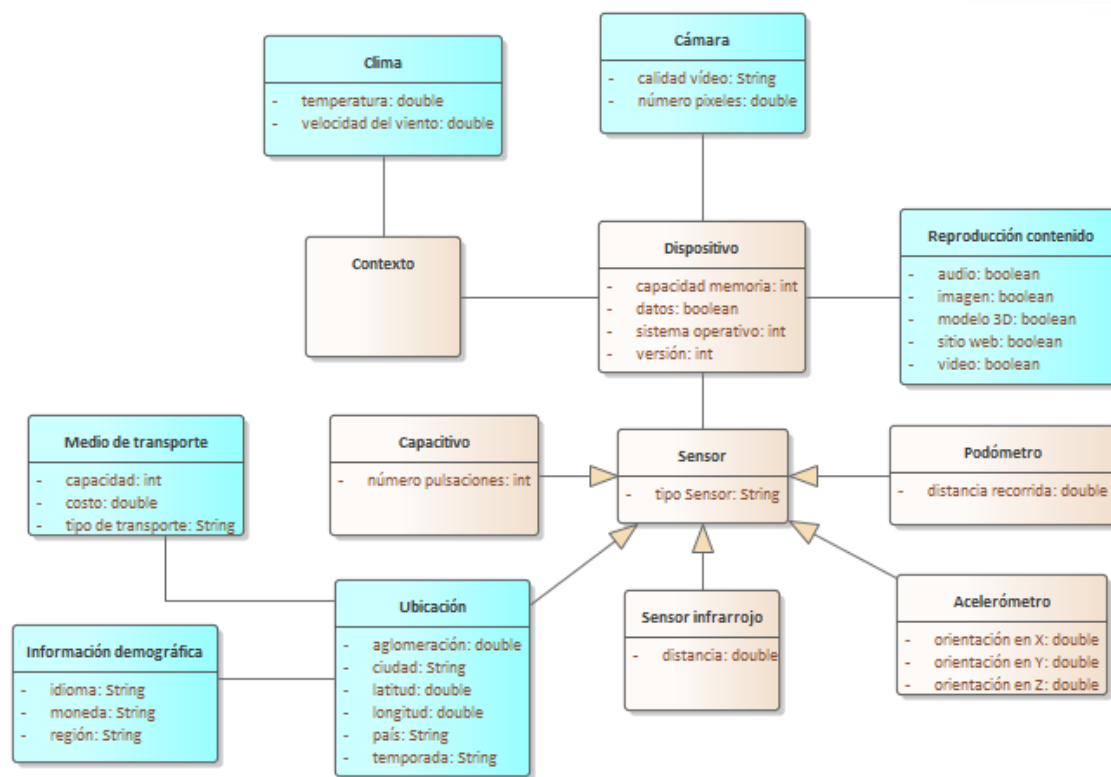
Relation between profiles
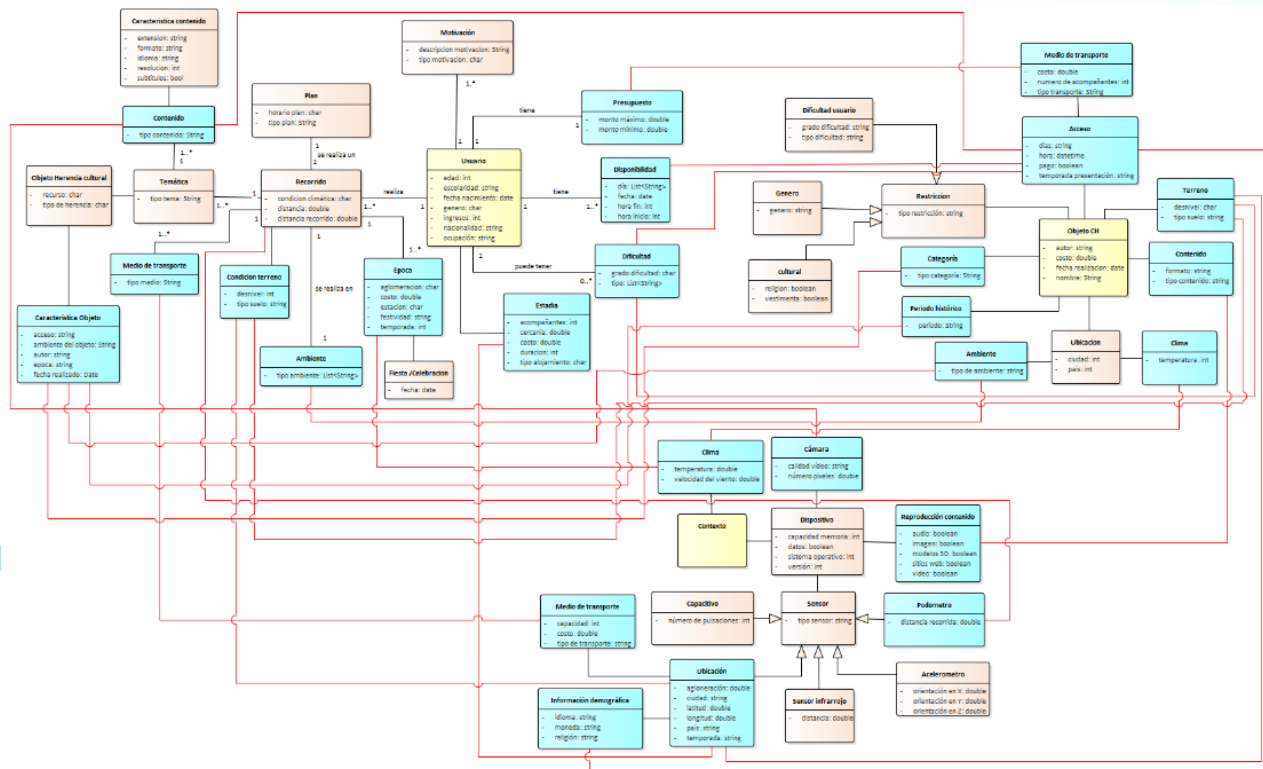
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Development progress of Motiv-ARCHE

- **Process of co-creation contents**
- **Adaptive profiles**
- **System architecture of Motiv-ARCHE**
- **Implementation of Motiv-ARCHE v. 1.0**

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System architecture of Motiv-ARCHE
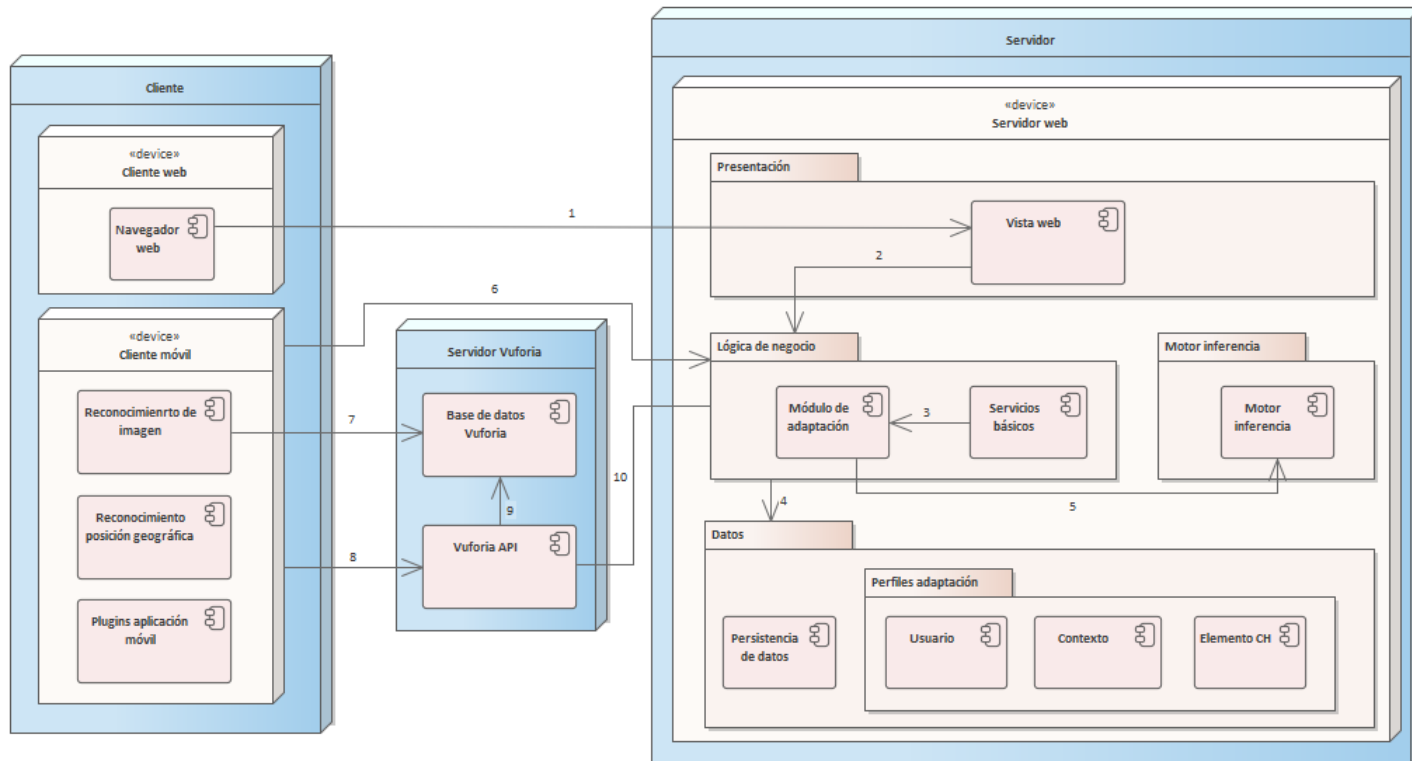
Development progress of Motiv-ARCHE

- **Process of co-creation contents**
- **Adaptive profiles**
- **System architecture of Motiv-ARCHE**
- **Implementation of Motiv-ARCHE v. 1.0**

Implementation of Motiv-ARCHE v 1.0

- **Web and mobile application**
- Implemented services
- AR activation
- Tools of motivation and acceptance

Web and mobile application
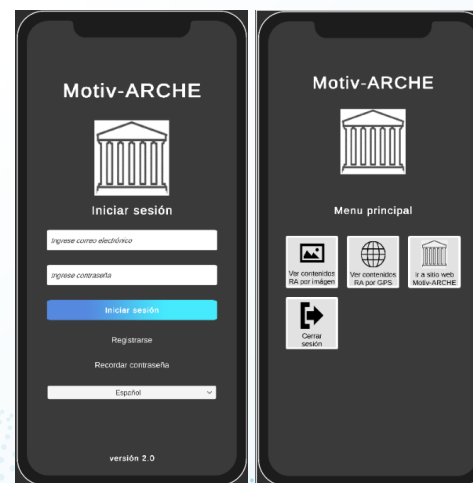
Implementation of Motiv-ARCHE v 1.0

- Web and mobile application
- **Implemented services**
- AR activation
- Tools of motivation and acceptance

Implemented services

Basic services

- Register
- Login
- Remember password
- Change password
- Create/edit tags
- Change language
- Add/edit/delete point of interest
- Generate routes

Vuforia services

- Create/edit/delete targets Vuforia
- Get targets Vuforia
- Summary Vuforia database

Implemented services

Funcionalidades básicas

Puntos de interés

Rutas

Visualizar contenidos de un punto de interés.

Esta funcionalidad solamente está disponible para dispositivos móviles.

Otras funcionalidades

Gestionar etiquetas

Test IMMS

Test TAM

Resumen de uso (administradores)

Service add/edit/delete point of interest

Tag service of heritage element and contents

Check a route

Summary Vuforia database
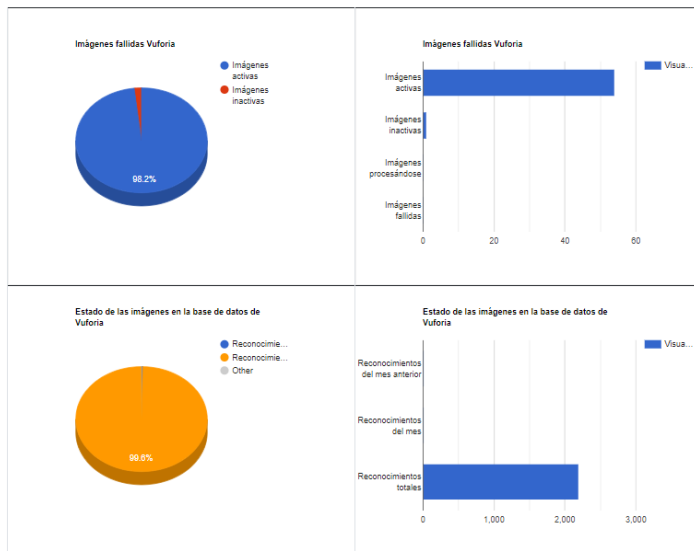
Implementation of Motiv-ARCHE v 1.0

- **Web and mobile application**
- **Implemented services**
- **AR activation**
- **Tools of motivation and acceptance**

Activation AR by image and geographical position
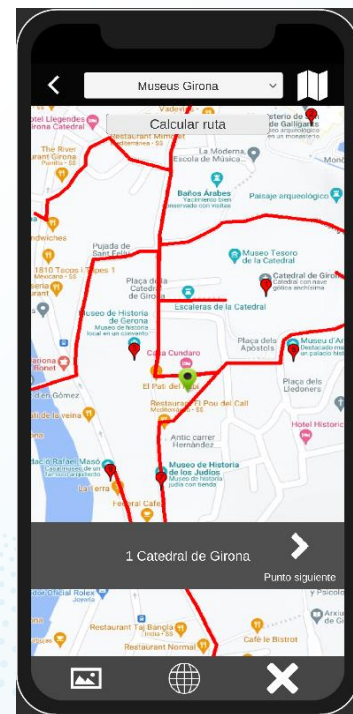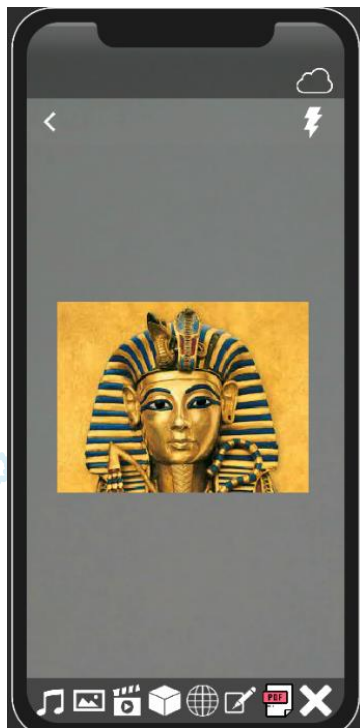
Implementation of Motiv-ARCHE v 1.0

- **Web and mobile application**
- **Implemented services**
- **AR activation**
- **Tools of motivation and acceptance**

Tools of motivation and acceptance

Motivation

- **Instructional Materials Motivation Survey (IMMS)**
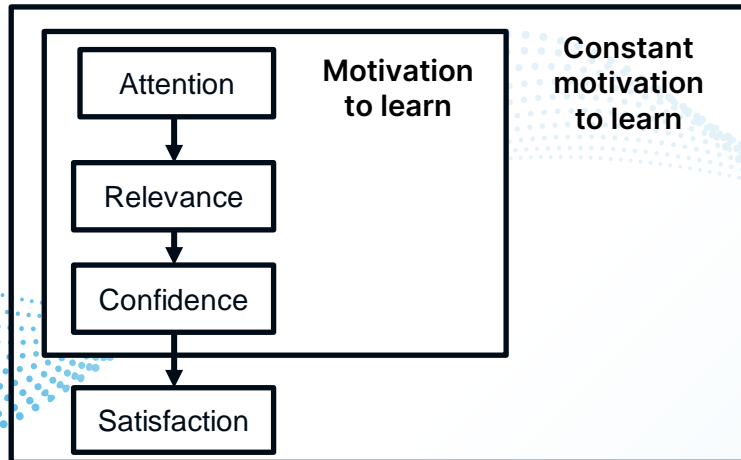
Taken and adapted from [65]

Acceptance

- **Technology Acceptance Model (TAM)**
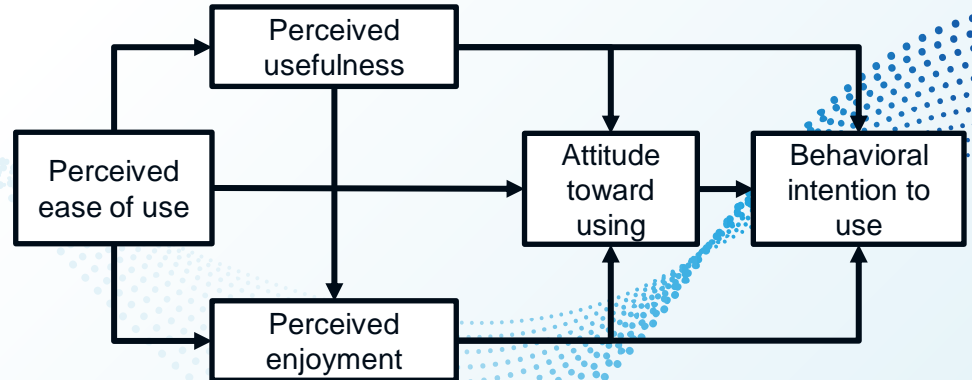
Taken and adapted from [66]

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Project progress

- **Contributions**
- **Development progress of Motiv-ARCHE**
- **Video Motiv-ARCHE**

Video Motiv-ARCHE

Augmented reality by image recognition

https://os5.mycloud.com/action/share/f7effb31-8b92-419c-ac8a-2155dcc6db31

Augmented reality by geographical position

https://os5.mycloud.com/action/share/04443c1f-58e0-4fe1-ab17-463fe8f83898

Future work

Future work

- **Implementation of adaptive services**
- **System tests**
- **Application review**

Implementation of adaptive services
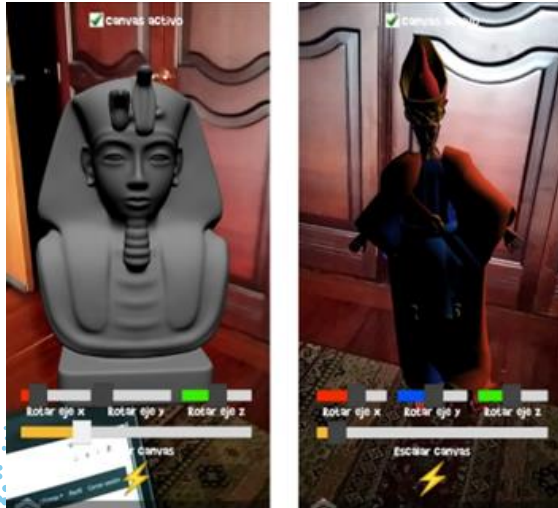
Adaptation of content considering the user

Adaptation of route by user's interest

Future work

- **Implementation of adaptive services**
- **System tests**
- **Application review**

System tests

- **Acceptance test**
- **Adaptation test**
- **Usability test**
- **System test**

Future work

- **Implementation of adaptive services**
- **System tests**
- **Application review**

Application review- Spain

Museu Medieval La Curia – Pressó de Castelló d'Empúries

Museu de la Pesca de Palamós

Amics de Riba-Roja d'Ebre els Forn d'oli de Ginebre

Application review- Colombia

Museo Colonial

Museo Iglesia Santa Clara

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[2]   UNESCO, "TIC, educación y desarrollo social en América Latina y el Caribe," *Organ. las Nac. Unidas para la Educ. la Cienc. y la Cult.*, 2017.

[3]   V. Cesário, A. Coelho, and V. Nisi, "Design Patterns to Enhance Teens' Museum Experiences," pp. 1–5, 2018, doi: 10.14236/ewic/hci2018.160.

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[7]   R. Van Krevelen and R. Poelman, "A Survey of Augmented Reality Technologies, Applications and Limitations," *Int. J. Virtual Real.*, vol. 9, no. 1, 2010, [Online]. Available: https://www.researchgate.net/publication/279867852%0AA

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Thank you