

Exploring Orphan Legumes in Virtual Reality: An Interactive 3D Atlas for Agricultural Knowledge Dissemination

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ABSTRACT

Orphan legumes are regionally important, underutilised crops that tolerate drought and poor soils, fix atmospheric nitrogen and provide protein-rich food. Despite their potential for agricultural biodiversity and sustainable food systems, limited research, market investment and public awareness restrict their visibility. This work presents an immersive Virtual Reality (VR) environment developed within the Horizon Europe PROSPER project to support agricultural knowledge dissemination. Using Unity and Meta Quest 3, the environment connects orphan legumes with their geographical, agricultural and cultural contexts. The Interactive 3D Atlas provides the main entry point, allowing users to explore regions, discover associated orphan legumes and access contextualised information about their characteristics, growth stages, uses and regional knowledge. The VR environment is currently under development, with the Atlas structure, interaction model and initial content integration established.

Keywords: *Virtual Reality, Agriculture 4.0, Agricultural Knowledge, Immersive Learning, Digital Agriculture*

BACKGROUND AND MOTIVATION

Orphan legumes are underutilised crops with important agricultural and cultural links to specific regions. Their nutritional, agronomic and environmental characteristics make them relevant to agricultural diversification, biodiversity and sustainable food systems. However, limited research and market investment contribute to their low visibility, while knowledge about their cultivation, uses and regional relevance remains insufficiently accessible. This highlights the need for accessible and contextualised approaches to agricultural knowledge dissemination through immersive technologies [1, 2].

PROSPER VR APPROACH

The VR environment is being developed within the Horizon Europe PROSPER project using Unity and Meta Quest 3. The experience combines immersive 3D visualisation, geographical exploration and hand-based interaction, supporting an experiential approach to agricultural knowledge dissemination [3, 4]. The Interactive 3D Atlas provides the main entry point: users select a region and access the orphan legumes associated with it. The application then presents contextualised information about the selected species, including its characteristics, growth stages, uses and regional knowledge. The VR environment combines immersive 3D visualisation, geographical exploration and hand-based interaction, with the Interactive 3D Atlas providing the main entry point to the experience (Figure 1).



Figure 1: PROSPER VR environment and Interactive 3D Atlas.

INTERACTIVE 3D ATLAS

The Interactive 3D Atlas is the main interface for exploring orphan legumes and their geographical and cultural context [5, 6]. The interaction follows a simple sequence illustrated in Figure 2:

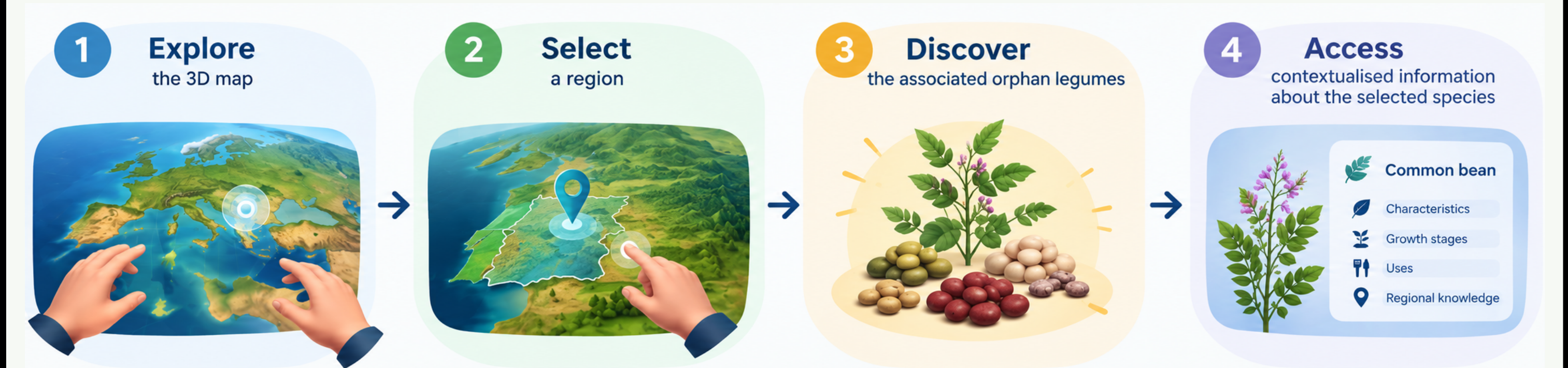


Figure 2: VR Interaction sequence.

This structure links geographical location with agricultural and cultural knowledge. The development also includes the preparation of 3D plant models for integration into the VR environment, as illustrated in Figure 3.



Figure 3: 3D model of an orphan legume prepared for integration into the VR environment.

CURRENT DEVELOPMENT

The current development phase has established the core structure of the VR application in Unity for Meta Quest 3. The Interactive 3D Atlas includes a 3D geographical map, region selection and an interaction model based on hand tracking. The application is being extended with 3D models and contextual information for selected orphan legumes, including their characteristics, growth stages, uses and regional knowledge. Content integration and further interaction development are ongoing.

CONCLUSION

PROSPER explores immersive VR as an approach to agricultural knowledge dissemination by connecting orphan legumes with their geographical and cultural contexts. The established Atlas structure provides the basis for integrating agricultural content and further developing the VR environment.

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