HBKU Thematic Research Grant 3rd Cycle– Project Highlight

Project Title: 3G: Gaze, Guide, and Grasp: LLM-Augmented Immersive Experiences for Qatar's Heritage Sites

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Executive Summary (limit to 200 words)

The project aims to revolutionize how cultural heritage is preserved, experienced, and taught through artificial intelligence and immersive technologies. It integrates advanced **spherical photogrammetry**, **Gaussian splatting**, and **Neural Radiance Fields (NeRFs)** for high-fidelity digital reconstructions of iconic sites such as *Al Zubarah Fort*, while employing **Large Language Models (LLMs)** to deliver adaptive, multilingual, and culturally sensitive storytelling.

The 3G framework—comprising **Gaze (reconstruction)**, **Guide (AI-driven narratives)**, and **Grasp (interactive learning)**—creates dynamic digital twins of heritage spaces accessible via VR, AR, and WebXR platforms. Through these, users can visually explore, converse with intelligent virtual guides, and engage in gesture-based, scenario-driven experiences that enhance cultural understanding and education.

The project unites interdisciplinary expertise from HBKU's **College of Science and Engineering** and **College of Humanities and Social Sciences**, in collaboration with **Qatar Museums**. By advancing Qatar's leadership in **AI, progressive education, and social progress**, the 3G project will establish a sustainable model for digital heritage preservation and experiential learning—bridging tradition, technology, and innovation for future generations.

Expected Outcome (limit to 100 words)

The project will deliver a **functional prototype** of the **3G Framework (Gaze, Guide, and Grasp)**—an AI-augmented immersive platform for Qatar's cultural heritage. Outcomes include:

- A **digital twin** of a selected heritage site reconstructed using spherical photogrammetry, Gaussian splatting, and NeRFs.
- An **LLM-powered multilingual conversational guide** offering adaptive cultural narratives.
- A **gesture-based XR interface** enabling interactive exploration and learning.

Additionally, the project will produce a **feasibility study** for scaling digital heritage preservation across Qatar, **various publications** to top venues in visual computing and digital heritage, and **invention disclosures** for potential intellectual property protection.

Collaborating HBKU entities:

Submitting Home Entity: College of Science and Engineering

Participating Home Entity: College of Humanities and Social Sciences

Photos – please insert photos, schematics, graphs…etc. relevant to the project

Figure 1. **The 3G Framework (Gaze–Guide–Grasp) for LLM-Augmented Immersive Heritage Experiences**. The pipeline begins with Gaze, where spherical photogrammetry and advanced rendering techniques (e.g. Gaussian Splatting and NeRFs) enable high-resolution digital reconstruction of heritage sites. Guide introduces AI-driven, LLM-powered conversational agents that deliver culturally sensitive, multilingual narratives tailored to diverse audiences. Finally, Grasp emphasizes interactive and experiential engagement through gesture-based and object-specific interactions in XR environments, fostering immersive learning and exploration.