VR-DiabEdu: An Immersive Diabetes Education and Glucose Monitoring Instruction System

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***Abstract*—This paper presents VR-DiabEdu, an immersive virtual reality system built in Unity 3D for diabetes patient education. Users explore a city environment, navigate a hospital with a waiting area, reception desk, and doctor's consultation room, and complete four interactive learning modes in a dedicated training room. Two Convai-powered AI characters handle natural-language conversation about blood glucose, diet, symptoms, and treatment. The system demonstrates how VR can turn passive health education into an active, decision-driven experience [7], [8].**

***Index Terms*—Virtual Reality, Unity 3D, Diabetes Education, Conversational AI, Glycemic Index, Healthcare Simulation**

I. Introduction

Diabetes management depends on everyday decisions about food, exercise, and lifestyle [9]. Traditional educational tools-pamphlets, videos, and lectures,are passive and rarely allow learners to practise those decisions. Virtual reality addresses this by placing the learner inside the decision context rather than describing it from the outside [5].

VR-DiabEdu is a Unity 3D system that combines a coherent hospital environment, Convai-powered conversational AI characters, and four activity-based learning modes. The learner can walk into a hospital, talk with a virtual doctor, build a meal under a glycemic-index (GI) target, and classify foods by GI category, all within a single VR experience [8].

II. System Overview

The system is structured around a first-person hospital flow. An outdoor city with a park establishes context; inside, the user passes through a waiting area, reception desk, doctor's room, and training room. Navigation uses WASD + mouse-look with a "Press E" contextual interaction prompt. Two Convai NPCs handle open-ended dialogue; four Unity C# modules handle the activity modes [1], [2].

III. Environment Design

A. Outdoor Environment: City and Park

The outdoor area includes a city block and park with looping walk/exercise animations on avatars, reinforcing the role of physical activity [3]. Soft daylight lighting contrasts with the warmer hospital interior.

B. Hospital Interior

The hospital interior (Fig. 1) models a realistic patient path-sofa seating, decorative art, a teal reception counter, and a door to the doctor's suite. The training room uses a brighter and futuristic style to signal its role as the learning hub.

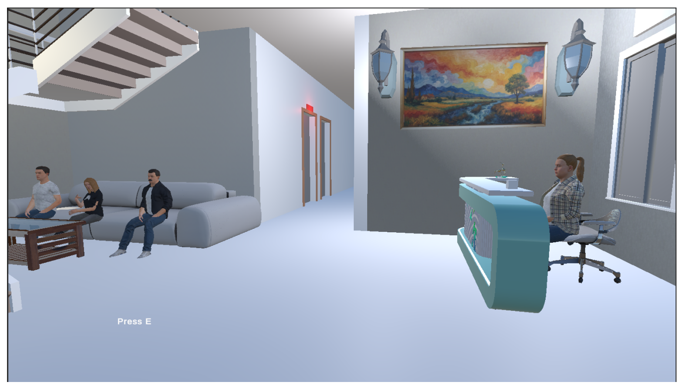

Fig. 1. Hospital lobby: waiting area with seated NPCs and reception desk. The "Press E" prompt is visible bottom-left.

Fig. 2. Reception desk. Pressing E opens a navigation menu directing the user to the Doctor Room or Training Room.

IV. AI-Based Conversational Interaction

Two characters use Convai with role-scoped knowledge bases [2]. The receptionist handles orientation and room navigation (Fig. 2). Dr. Smith (Fig. 3) handles diabetes education:

the user can type freely *or* click topic buttons—*What is Diabetes*, *Blood Sugar*, *Diet*, *Symptoms*, *Treatment*—which inject pre-written prompts into the Convai pipeline. Responses are delivered via text-to-speech with yellow on-screen captions for accessibility [7].

Fig. 3. Dr. Smith consultation. Topic buttons (right) and free-text input (bottom) both route through Convai. Yellow captions accompany the spoken response.

V. Learning Modes in the Training Room

The training room menu (Fig. 5) exposes four modes [5].

A. Quiz Mode

Presents a row of food items (apple, fries, salad, cupcake, bread, soft drink) and three buttons: *Low*, *Medium*, *High*. Correct GI classifications increment the on-screen score [4].

Fig. 4. Quiz Mode: Select the food item and get score based on GI.

B. Learn Mode

Places the user in a virtual classroom (Fig. 7) with seated NPC students and a standing instructor. Lesson controls (Back, Start, Pause, Stop, Next) and an *Ask Question* button are exposed on the right.

C. Meal Planner

Gives the user a target GI (under 55) and a row of food cards (Fig. 6). The user fills three meal slots; pressing *Check My Meal* evaluates the average GI and reports whether the meal is within the limit [4], [6].

D. Speed Round

A timed variant of Quiz Mode. The user classifies successive food items before a countdown expires, converting recognition into real-world recall [8].

Fig. 5. Training Room menu: Quiz Mode, Learn Mode, Speed Round, and Meal Planner.

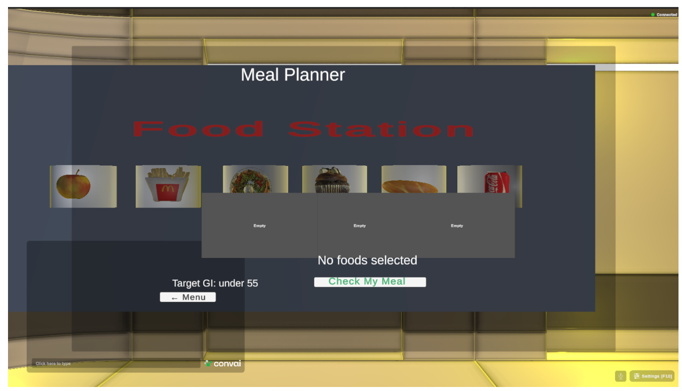

Fig. 6. Meal Planner. The user composes a three-item meal under a target GI; *Check My Meal* provides instant feedback.

Fig. 7. Learn Mode: virtual classroom with NPC students, an instructor, playback controls, and a free-text Ask Question button.

VI. Implementation Details

A. Engine, Tools, and Languages

The project is built in Unity 3D with C# scripts for all gameplay logic [1]. Convai is integrated through its Unity SDK, which exposes a `ConvaiNPC` component hosting the per-character knowledge base, voice, and microphone settings. Visual assets— buildings, furniture, NPC avatars, and props—are sourced from Unity Asset Store packages.

B. Player Controller and Interaction

The player uses a `CharacterController` with mouse-look split between body yaw and camera pitch (clamped to $\pm 90°$). A forward raycast from the camera detects interactable objects and toggles the "Press E" prompt. Furniture and props are placed on a dedicated layer; the Layer Collision Matrix disables collisions between that layer and the player, so the player walks through tables and chairs but is still blocked by walls and doors.

C. UI and Scene Transitions

The UI is built with Unity's Canvas system. Topic buttons inject pre-written prompts directly into Convai. Each major area is a Unity scene or demarcated sub-area; transitions are triggered by interactable doors and the reception menu.

VII. Functionality Criteria Coverage

Table I maps the ten required functionality criteria to their realization in VR-DiabEdu [7], [8].

TABLE I
TEN FUNCTIONALITY CRITERIA — VR-DIABEDU COVERAGE

#	Criterion	Realization
1	Vision	First-person camera; city, park, hospital, training room; UI overlays for menus and captions.
2	Sound	Convai TTS voice for receptionist and Dr. Smith; ambient Unity AudioSource sounds.
3	Animation	Park avatar walk/exercise loops; NPC idle and seated animations; door open/close.
4	Interactivity	Press-E system throughout; mode buttons; food selection in all training modes.
5	Char. Behaviors	Receptionist routes to rooms; Dr. Smith answers topic buttons or free-text.
6	Sensors / Triggers	NPC proximity trigger colliders; raycast interaction; mode entry/exit triggers.
7	Player	CharacterController, WASD + mouse look; layer-matrix walk-through props.
8	AI	Two Convai NPCs with scoped knowledge bases; Ask-Question hook in Learn Mode.
9	UI Elements	Mode menu; topic buttons; score display; meal slots; lesson controls; captions; Convai input field.
10	Hardware	Keyboard/mouse PC build; Unity XR-ready structure; Convai mic for voice input.

VIII. Why Virtual Reality and Project Novelty

Diabetes self-management is a behavioural problem more than an information problem [6], [9]. VR is the right medium because it places the learner inside a decision context—building a meal, asking a doctor a question, classifying a food—and delivers immediate feedback [8]. A leaflet cannot tell the user whether their plate exceeds a target GI; VR-DiabEdu can.

The novelty lies in combining conversational AI with four activity modes inside a single coherent hospital narrative, and in using the glycemic index as the unifying concept reinforced across definition (Learn), recognition (Quiz), planning (Meal Planner), and time-pressured recall (Speed Round) [5].

IX. Conclusion

VR-DiabEdu shows that core diabetes self-management concepts can be packaged as an immersive, first-person VR experience that is more engaging than passive media [5], [7]. The combination of a hospital spatial narrative, Convai-powered dialogue, and four GI-focused activity modes covers all ten required functionality criteria and serves as a working prototype for VR-based patient education.

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