Design and implementation of virtual agents that can provide support during online learning and self-studying

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Motivation and Requirement

• **Online learning** and **self-study**

• **Advantage:** Able to satisfy daily study routine at home.

• **Disadvantage:** Unable to provide attractive learning environment such as teachers' support and active interpersonal atmosphere.

Maintain student’s learning state of self studying and online-learning, and to help students develop their self-regulated learning skills.
Project flow chart

1. Pre-Research: Discovery Research, to gather user’s requirements
2. Questionnaire
3. Implementation: Avatar and animation Blender
4. System Integration: Unity3D
5. User’s feedback: Evaluative Research, Survey and Remote Meeting
6. Analysis and summary

Diagram:
- Discovery Research
- Design: Participatory Design
- Implementation
- Integration: Unity3D
- Evaluative Research
Solution

- Design and implement several virtual agents based on **Unity3d** through participatory design (PD) approach.

Problems

- Fatigue
- Distraction
- Lack of Motivation
- Lack of Concentration
- Miss DDL
- Low Efficiency

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Diagram:

- **Discovery Research**
- **Design**
- **Implementation**
- **Integration**
- **Evaluative Research**
Virtual Agents

• **Definition**: Autonomous software agent that can interact with the environment and the user.

• **Significance**: A well-designed believable avatar can influence people's decision making in real life through the manner of human-computer interaction.

• **Design of virtual agents:**
  ① Based on the “personality”
  ② Verbal behaviours: dialogues or chatter bots
  ③ Non-Verbal behaviours: Facial expressions, Gestures and Gaze
Background Introduction

- ‘Participation’ within HCI practices can refer to consultation and user testing or to studies of self-organized groups where the researcher is the participant–observer.

1. Brain storm
2. Story board
3. Context mapping
4. “tool to think with”
3D Game Engine and Modelling

- **Game Engines** supports the design of computer games or interactive real-time graphics applications.

- **3D Modelling** is to build models through virtual 3D space, using 3D modeling software.

- **Unity3D 2020.3.3 and blender**
Participatory Design Process

- **Design team:** 6 college students majored in a variety of subjects. Including: Telecommunications, Psychology, Economics, Multimedia technology, and Software Engineering.

- **Meeting Schedule:** A total of eight participatory design events, between 10/30/2021 and 3/30/2022.

- **Meeting Platform:** online meeting, TenCent Meeting.
# Participatory Design Result

## Remediation Needs:

- Ask the user to take a break
- Ask the user to do another task
- Ask the user to exercise
- Ask the user to change their posture
- Ask the user to start working
- Ask the user to change their workplace
- Remind the user of distractions
- Remind the user to focus on
- Remind the user of their learning goals
- Remind the user to put down their phones
- Chat with the user
- Encourage the user, show empathy
- Be happy for the user

## Avatar Character:

### Supervisor, Companion and Friend.

- **A “supervisor”** assume the role of a “manager”, it has stricter verbal and non-verbal behaviour.

- **A “companion”** is a character that remains silent most of the time, it shows support and empathy while needed.

- **A “friend”** is more like a vivacious character between companion and supervisor.
Participatory Design Result

- Avatar behavior design:

<table>
<thead>
<tr>
<th>Avatar</th>
<th>Non-verbal behavior</th>
<th>Verbal behavior 1</th>
<th>Verbal behavior 2</th>
<th>Verbal behavior 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ask user to take a break</td>
<td>Neutral 😊</td>
<td>(User Name), Stretch your body!</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Ask the user to do another task</td>
<td>Neutral 😊</td>
<td>(User Name), Try something else</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Ask the user to exercise</td>
<td>Neutral 😊</td>
<td>(User Name), You should get some exercise</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ask the user to change their posture</td>
<td>Neutral 😊</td>
<td>(User Name), Please posture can also lead to poor productivity. Try another way.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Ask the user to start working</td>
<td>Neutral 😊</td>
<td>(User Name), You've been hanging around too long. Let's work!</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Ask the user to change their workplace</td>
<td>Neutral 😊</td>
<td>(User Name), Maybe you can be more productive working somewhere else. I recommend your preferred work place!</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Remind the user of distractions</td>
<td>Neutral 😊</td>
<td>(User Name), Something is distracting you</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Remind the user of the need for breaks</td>
<td>Neutral 😊</td>
<td>(User Name), Maybe you should take a break</td>
<td></td>
</tr>
</tbody>
</table>

Forty-two different behaviors for the three characters.
Implementation of Avatars and their animation

Design sketches → Distorting → Low poly mesh with Smooth Colouring → Unreasonable pose

Coloursing (UV) → Skelton (FK) → Skelton (IK) → Animation
System Integration
Screenshots
User Study

- **Questionnaire**
  Feedbacks from 21 students

Believability of Avatar

- Satisfied
- Could be better

Distraction Caused by Avatar

- Satisfied
- Could be Better

Features that help user understand the messages

- Facial Expression
- Gesture
- Verbal Behaviour
- Character

Discovery Research  Design  Implementation  Integration  Evaluative Research
User Study

• First-hand feedbacks, from 3 participants

Distant Usability Testing

<table>
<thead>
<tr>
<th>Tasks</th>
<th>User1</th>
<th>User2</th>
<th>User3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start the software</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Adjust the size of the avatar</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Adjust the avatar’s position on screen</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Rotate the avatar</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Arouse the function panel</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Setting focus alarm clock</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Record learning Goal</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Change Avatar</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Leave a note</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Audio instruction</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Understand avatar behaviour (Verbal and Non-verbal) correctly</td>
<td>10/10</td>
<td>9/10</td>
<td>10/10</td>
</tr>
</tbody>
</table>
User Study

• First-hand feedbacks, from 3 participants

<table>
<thead>
<tr>
<th>Learning State</th>
<th>User 1</th>
<th>User 2</th>
<th>User 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning efficiency</td>
<td>Increased</td>
<td>Slightly increased</td>
<td>Almost Unchanged</td>
</tr>
<tr>
<td>Fatigue</td>
<td>Slightly decreased</td>
<td>Slightly decreased</td>
<td>Almost Unchanged</td>
</tr>
<tr>
<td>Learning Motivation</td>
<td>Increased</td>
<td>Increased</td>
<td>Increased</td>
</tr>
<tr>
<td>Distractions</td>
<td>Almost Unchanged</td>
<td>Almost Unchanged</td>
<td>Almost Unchanged</td>
</tr>
<tr>
<td>Concentration</td>
<td>Increased</td>
<td>Almost Unchanged</td>
<td>Increased</td>
</tr>
</tbody>
</table>

Self reported learning states

Discovery Research

Design

Implementation

Integration

Evaluative Research

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Conclusion: Guidelines for the design of supportive agent

- **Design method**: participatory design shows strong practicability.

- **Aspects to be Considered**:
  - Discovery Research
    - Target user
    - User’s Requirements
  - Evaluation Research
    - Believability
    - Character: Gentle
    - Verbal Behavior: Simple and clear
    - Non-Verbal Behavior
      - Audio
      - Chat Box
      - Gaze
      - Gesture
      - Facial expression
    - Randomness of gaze (idle) animation
    - Full body animation
    - Arms and hands

Thank You