Heuristics about Arcade Game Design in a Comfortable Rhythm

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XR-Driven Digital Transformation of Design, Training, and Education

Research and Working Experiences

07/2019 -- Present, Research Project on Glaucoma Detection using Color Fundus Images
Role: Team Member **Supervisor:** Postdoc Zhicheng Zhang, Stanford University

- Used Convolutional Neural Networks (CNN) and Grey Level Co-occurence Matrices (GLCM) to extract features, based on python cv2, skimage libraries
- Made evaluation of 3 machine learning algorithms in terms of image classification accuracy by sklearn

09/2019 -- 06/2020, Research Project on Mobile Health, Measuring Anxiety Level in Social Interactions
Role: Team Member **Supervisor:** Prof. Mehdi Boukhechba, University of Virginia

- Collected data from Shimmer (ECG and GSR sensors), extracted time-series features from multimodal sensors to detect social anxiety level with Jupyter Notebook, Python 3
- Made comparison of machine learning algorithms to predict social anxiety interaction scale (SIAS) score change, such as Linear Regression, Support Vector Machine Regression, K-Nearest Neighbor, Gaussian Naive-Bayes, based on a system of loss functions, using python sklearn and keras libraries

09/2019 -- 12/2019, Research Project on The Analysis and Improvement of Keppler Medical Device and Material Co. Ltd. Production System
Role: Team Member **Supervisor:** Prof. Cindy Chang, University of Virginia

- Applied of Production System Engineering Toolbox to do different manufacturing system analysis, like identification of bottleneck places and improvable places of this system
- Used Google Colab based on Python 3 to do opportunity window analysis to reallocate the workers

01/2019 -- 05/2019, Research Report for the Heuristics of Arcade Game Design

- Searched all the literatures by myself, and did survey online
- Discovered the real art of designing arcade games in a comfortable rhythm, including a decent user interface, along with the reasonable difficulty and proper hints along with the game.

03/2018 -- 07/2018, Hefei New Oriental English School
Role: Internship Student

- Used Excel to grade mock exams online, including SAT, ACT, TOEFL, AP and GRE; served as teaching assistants in English classes with size of 9 or smaller; wrote feedback for students.
- Enhanced my English reading, listening and oral communication skills.

10/2016, Project of Video Technology and Cloud Computing, Chinese Academy of Sciences

- Completed the software for video dialogue forms all by myself, perfected various of expressions and voice communication function with teammates smoothly, created a decent user interface
- Independently wrote all the codes related to .json, learned to refer to the literature online for coding. completed the Python GUI programming and designed a GUI based chatting client, debugged all by myself.
- Did the investigation report about TS, PS, and PES with other members and presented the final report by myself

Topics Working On

The current institution I am employed in: Zhejiang Lab

The current project I am working on:

1. The Deep Learning of EEG signals for epilepsy seizure detection (current working group)

2. The 3D game design about “Chronicles of the Earth”

3. Continuing on my contribution 28004 “Social Anxiety Disorder based on Mobile Sensing” and contribution 28005 “Identification of glaucoma using deep learning”

Background and Related Work

The basic rules:
A proper rhythm to instruct players to feel the creative ideas of the game, how to pursue their goals ->
the higher level user experience will be produced

The design of arcade games:
- Big machine in public places, for players with a wide range of ages
- Purpose of making revenue

- E. M. Rayboum [1]:

8 key elements supporting communication medium for face-to-face interaction

- D. Pinelle et. al. [2]:

10 heuristics principles helping players to learn, control and understand the game

- M. J. Dondlinger [3]:

Quality of games depends on 3 aspects:
- the narrative context containing feedback information
- the system of goals and rules
- interactivity and multisensory cues

- M. Szwoch [4]:

The affect-aware video games, the balance between increment of difficulty level of games for high-level players and protection for new players from frustration

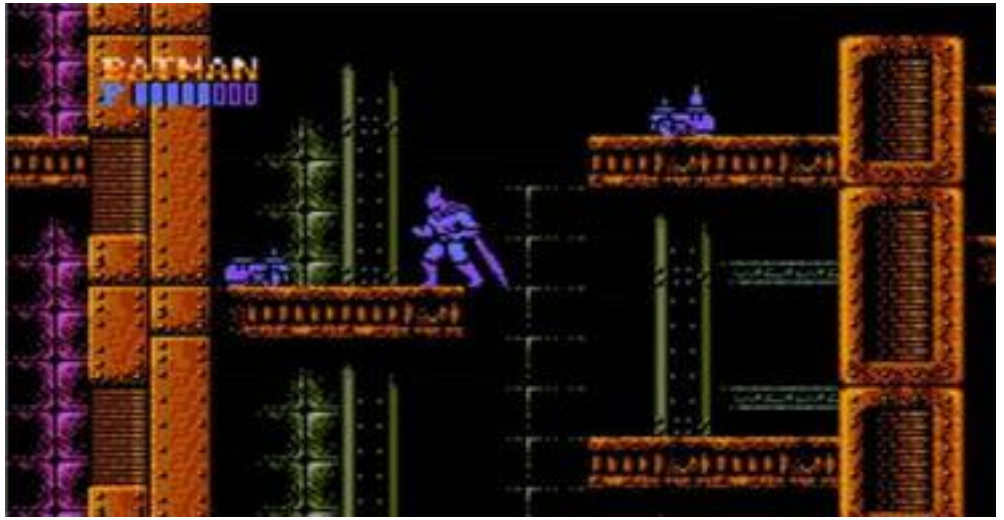
Our Methods

- Our perspective: mainly based on Chinese Bulletin Board System (BBS), [2] and [4]
- Our work mainly discusses:
  - ➢Difficulty optimization in some aspects
  - ➢Creation of decent user interface
  - ➢Timely hints to teach players how to play

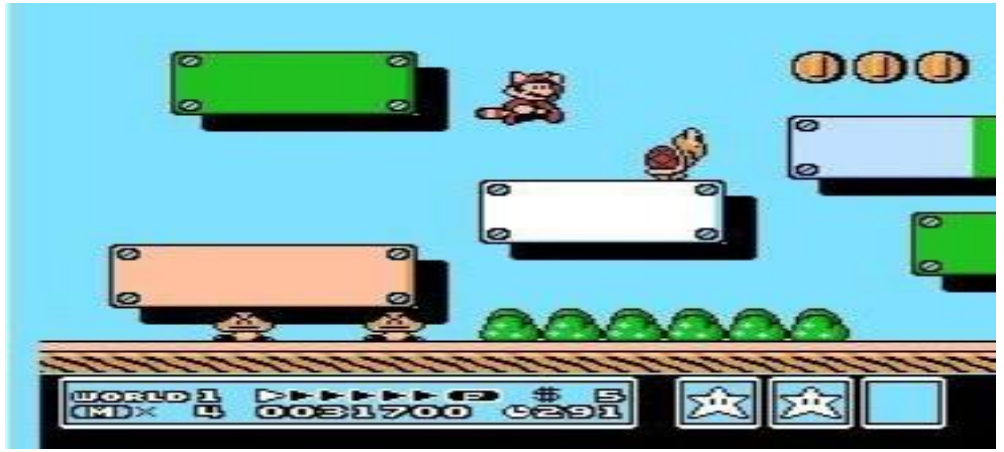
The Factors Influencing the Difficulty

Making a smooth game:
Do not impede players playing in a way they want!

(-) Batman:
The Batman needs to bend his knees for certain frames before jumping, a subtle delay
Push “jump” but not expected behavior, sometimes
“False slips”: bad operating system, making them blame on themselves

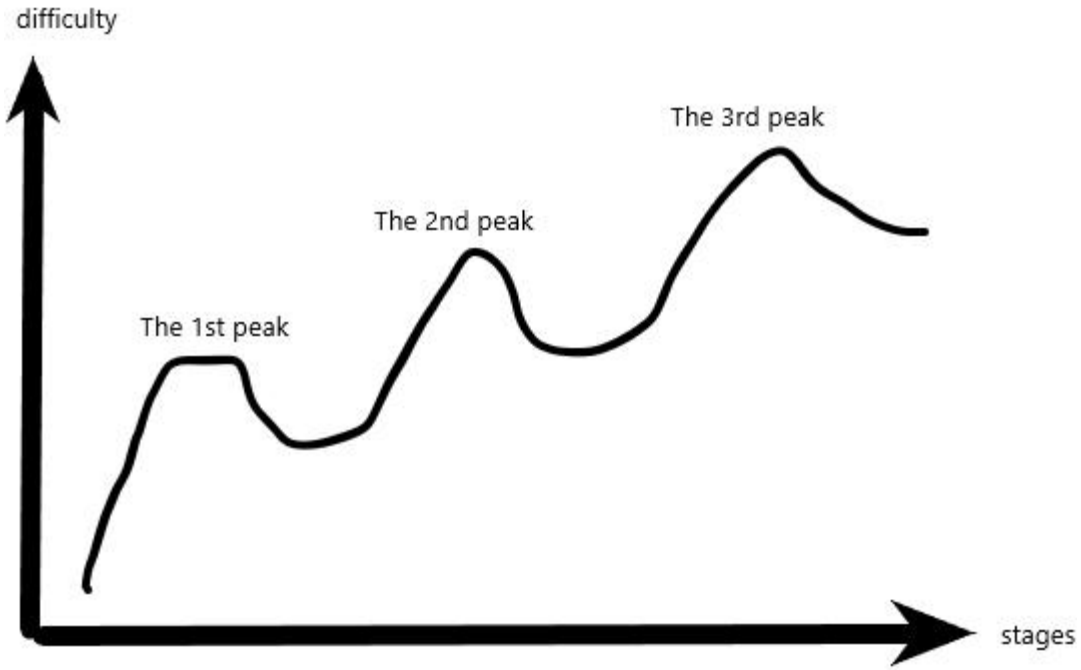


(+) Super Mario III:
Just a simple jump, no violations of our expectation



Principle 7: Provide controls that are easy to manage, and that have an appropriate level of sensitivity and responsiveness

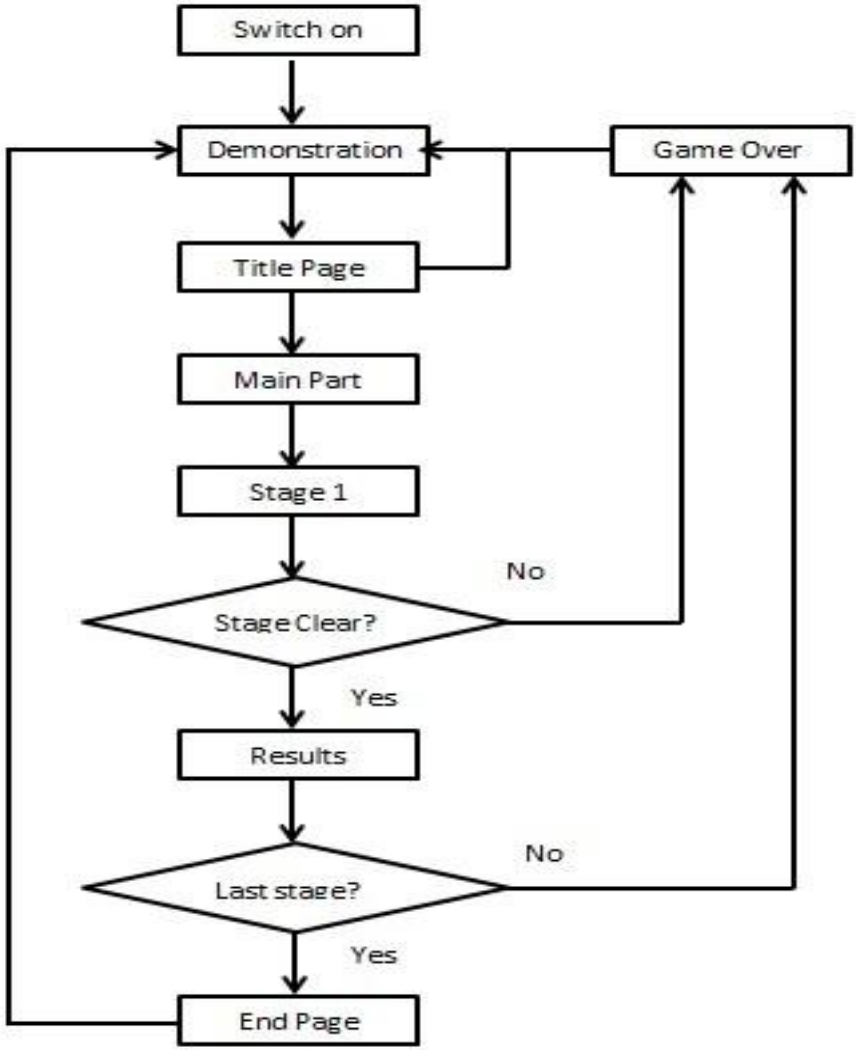
The Factors Influencing the Difficulty



Multi-peaks Model:
Alternation of “tense” and “relaxed” states
According to [1], intermittent increase of level of challenge, with the increase of players’ skill level
Focusing on single task
Willing to insert coins

Example:
Warriors of Fate (1992)
Stages 2, 6 and 8 are peaks

How to Create a Good User Interface

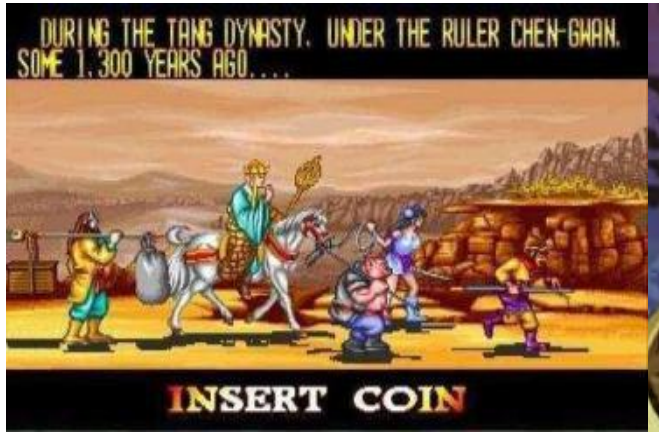


The general framework of the process for arcade games

(with some problems)

How to Create a Good User Interface

Part 1: Demonstration and title
INSERT COIN flashing
animations added to let players know about the story
15~30s optimal, then title
Disappear after inserting coin(s)
Principle 5: All the games need to allow users to skip non-playable and frequently repeated contents



Part 2: During the game
Principle 8: Provide users with information on game status

- Clear and quick way with least mental workload
- The remaining vitality of players and enemies, the time limitation, etc.

(-) Captain Commando (1991):
White-sky blue-lake blue-light blue-green-yellow green
Degrading mechanism, distract the players or misleading effects

(+) Oriental Legend Special (1998):
Green = remaining vitality
Red = vitality loss (bleeding status, injury)

How to Create a Good User Interface

Results:
Bring an unforgettable feeling of satisfaction -> ambition of getting higher scores in the next stage, motivation produced
15 ~ 30 seconds
After the last stage: the ending stories longer, stark applause for tough work of players
60 seconds, not to long, for other players waiting to play

Giving Timely Hints: Teach Players to Play

Explicit Hints:
Demonstration part before the game/end demonstration parts
In implicit places, more coins and longer time to master skills before discovery, ensure the profits
Principle 9: Provide instructions, training and help

Implicit Hints:
Example: The Punisher
The motion patterns of enemies, or something following a regular pattern
"You have your strategies, I have my strategies to respond to yours"
Guardroid: 3 high jumps + fiery rays, 1 high jump + fiery rays with less than 1/3 vitality
Principle 3: Provide predictable and reasonable behavior for computer controlled units

Limitations and Future Work

- Main problem:
- Somewhat subjective, without much objective data support, might with some flaws (the obstacles to propose the basic methodology)
- The visual and sound effects

- Future work:
- A similar case study of producing a comfortable environment for eXtend Reality (XR)
- Highly immersive virtual environments

References

[1] E. M. Raybourn, “Computer Game Design: New Directions for In- tercultural Simulation Game Designers”, Developments In Business Simulation and Experiential Learning, Volume 24, pp. 144-145, 1997.

[2] D. Pinelle, N. Wong and T. Stach, “Heuristic Evaluation for Games: Usability Principles for Video Game Design, CHI 2008 Proceedings”, pp. 1453-1462, Game Zone, April 5-10, 2008.

[3] M. J. Dondlinger, “Educational Video Game Design: A Review of the Literature”, Journal of Applied Educational Technology, Vol. 4, No. 1, pp. 21-27, Spring/Summer 2017.

[4] M. Szwoch, Design Elements of Affect Aware Video Games, Gdansk University of Technology, ul. Narutowicza 11/12, 80-233.

Thank you!

Any questions?