Evaluation of Different Control Techniques in a Mobile Jump and Run Game

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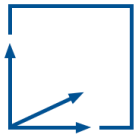


Final: Bachelor Informatik: Games Engineering

Supervisor: Prof. Dr. Gudrun Klinker

Introduction / Motivation

- A rising industry: mobile gaming [1]
  - $68.5 billion market value, 45% of total gaming industry
- The importance of control interface in the game
- No existing extensive guidelines
- Lots of space for creativity

Problem Description: Issues

- More powerful devices / More complex games
- Limited interaction methods
- Unavailable traditional interaction methods
- Existence of too many possible solutions, no guidelines

Existing Solutions / Related Work

- Gamification aspect of control techniques [2]
- Soft Keys vs. Hard Keys [3]
- Comparitive and absolute advantages of interaction methods in mobile devices [4]
- Touchscreen vs. Analog Input Methods [5]
- Touchscreen vs. External Controllers [5]
- Gestural Controls [6]

Goals of this Thesis

- Effects of different control techniques to the play experience in mobile context
- Creating a guideline for the control schemes in mobile games
- Optimal solution for the mobile jump and run genre

Critical Research Issues

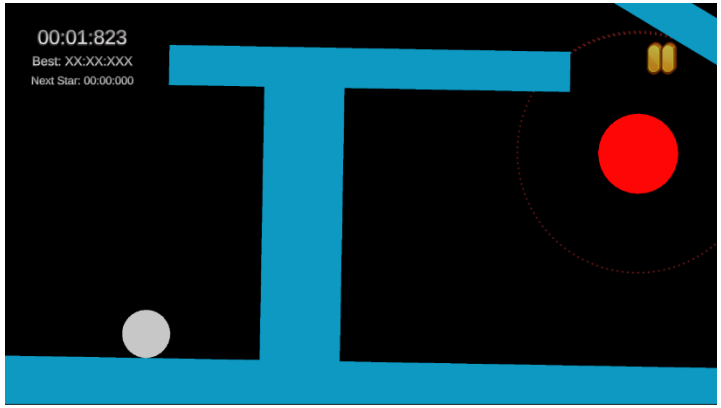
- Lack of existing solutions
- Sample of test subjects
- Usage of different testing devices for the user study
- Calibration of implemented control techniques

Proposed Work / Approach

- Three different control schemes for a single game in the jump and run genre, Space Wanderer
- Evaluation of the usability and play experience of each control scheme based on a user study
- Results comparison and conclusion

Implementation

- Space Wanderer
  - Target platform: Android [9]
  - Game Engine: Unity – Version 2019.3 [8]
- Three different control schemes
  - Gesture-based
  - Software-based
  - Virtual Gamepad



Implementation

- Mechanics
  - Rotation:

Implementation

- Mechanics
  - Scaling:

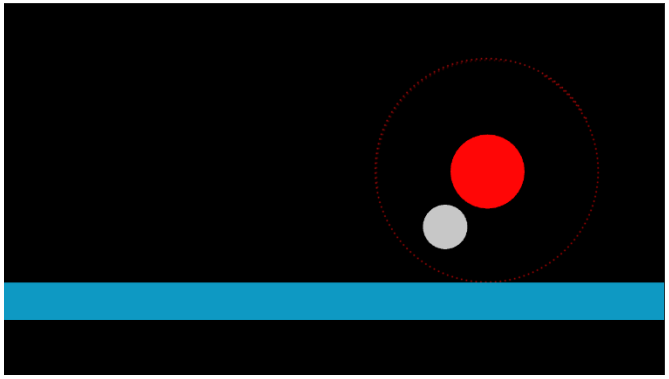
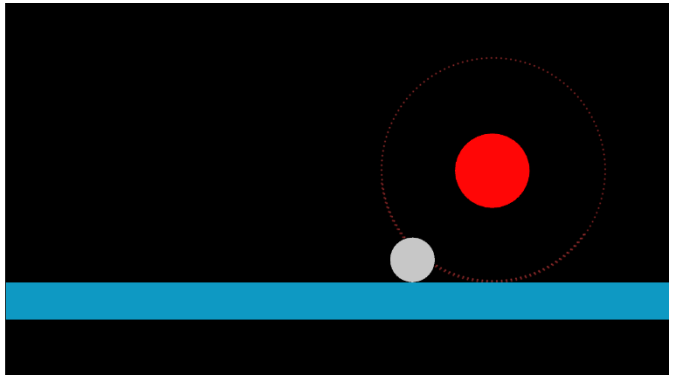
Implementation

- Mechanics
  - Swipe / Camera Movement:

Implementation

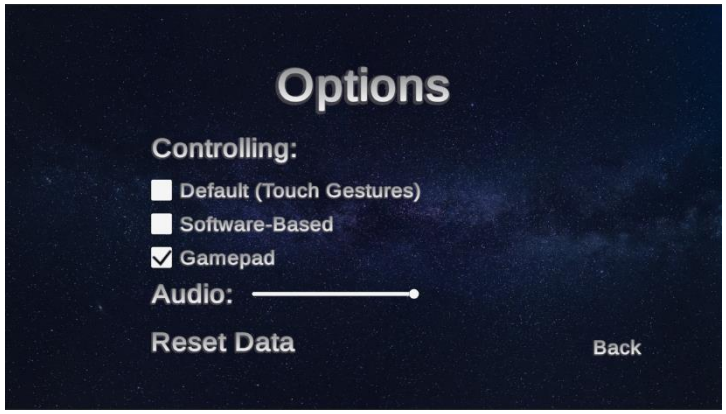
- Mechanics
  - Gravitational Force(Main/Enemy):

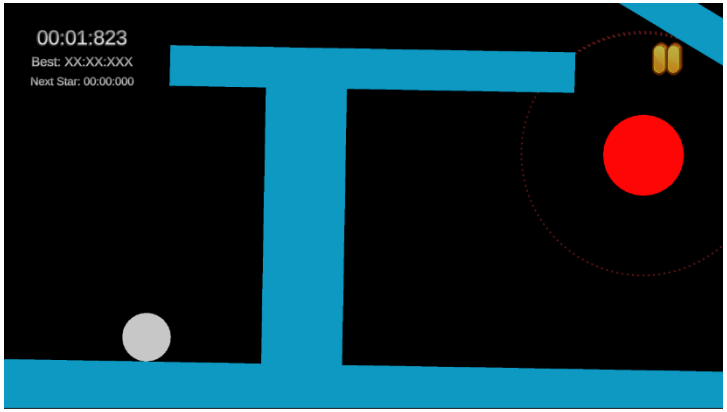


Implementation

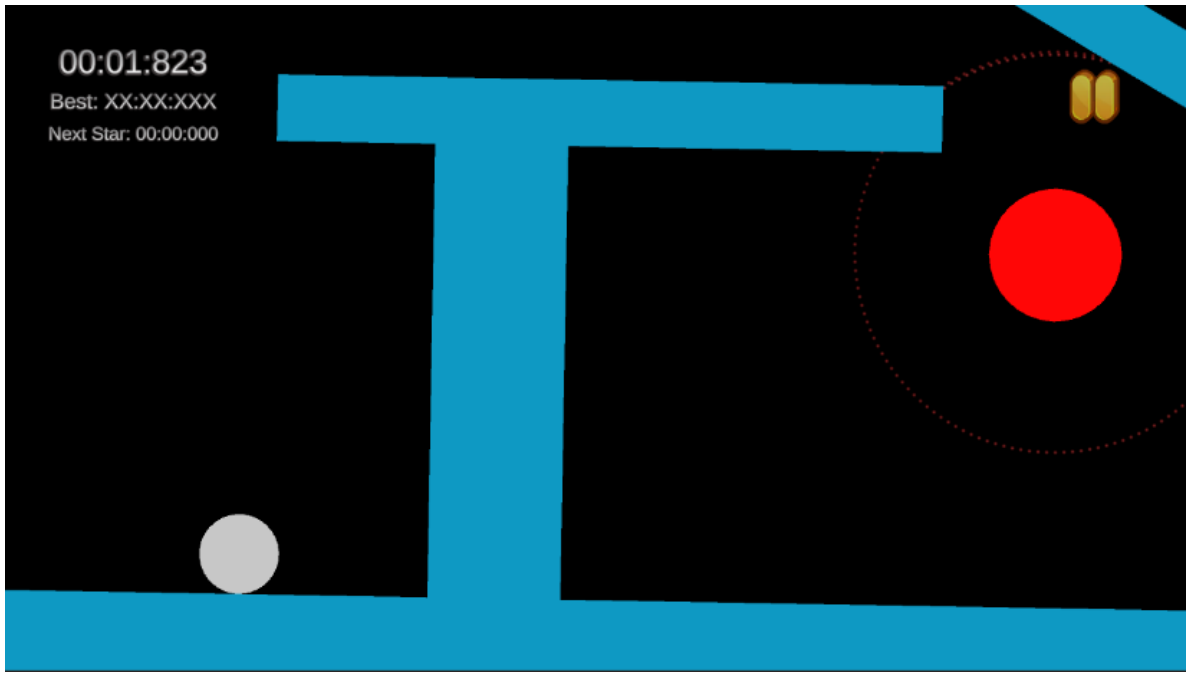
- Scenes:



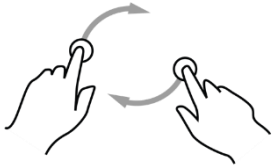


Implementation

- Control Schemes:
  - Gesture-based

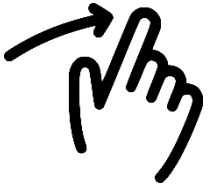


Rotation: [9]



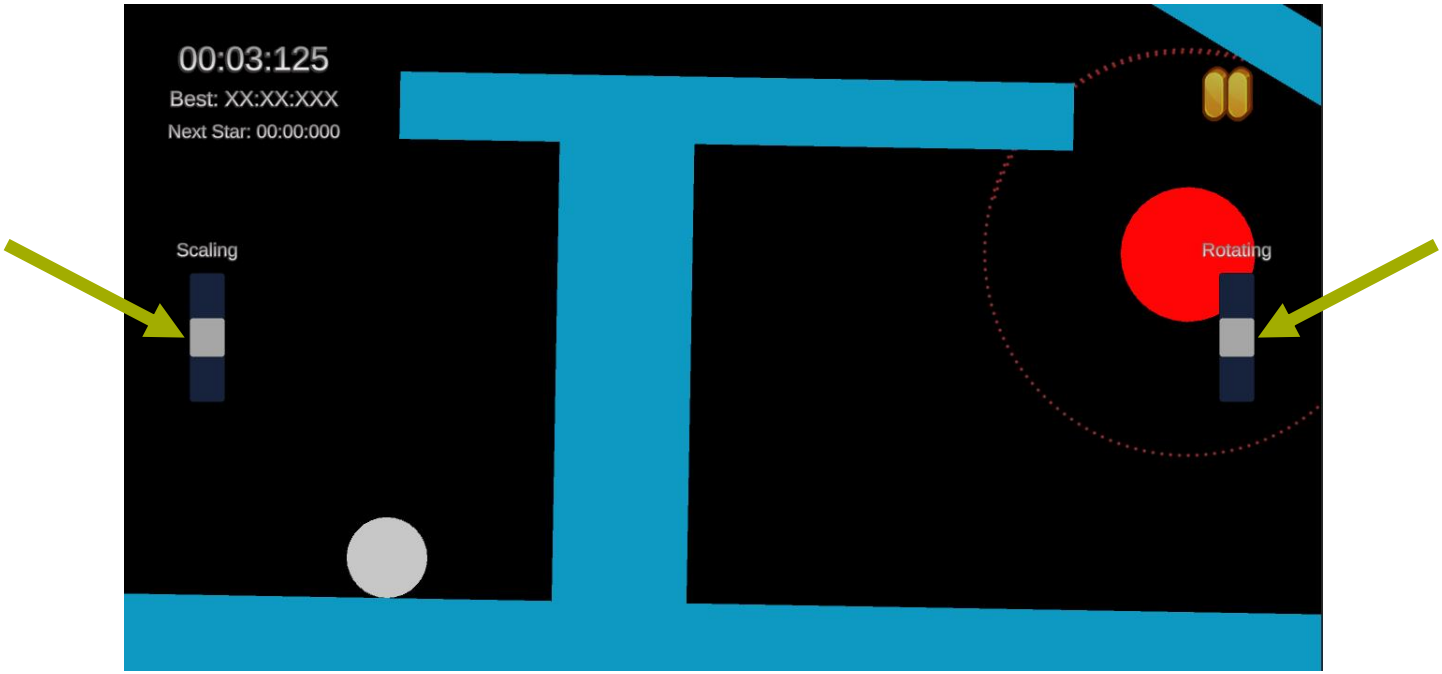
Scaling: [10]

Swipe: [11]

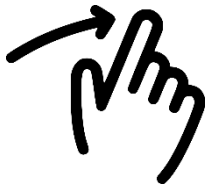


Implementation

- Control Schemes:
  - Software-based

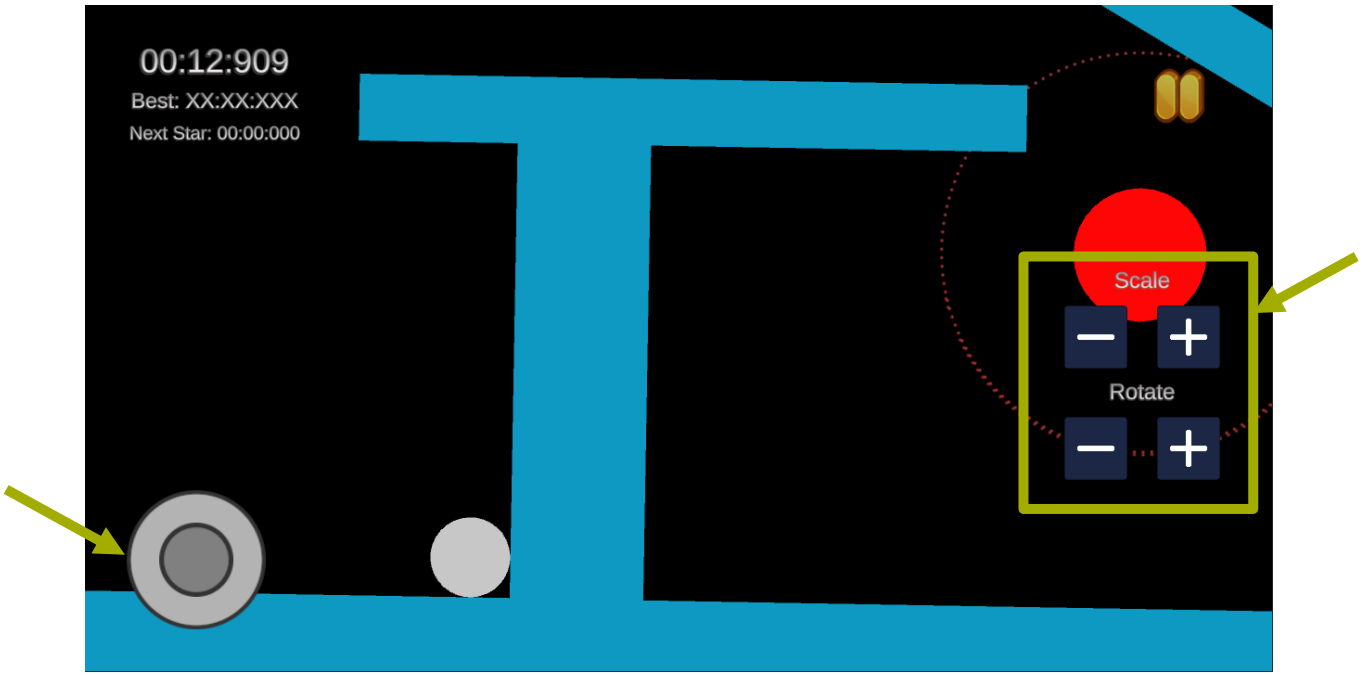


Swipe: [11]



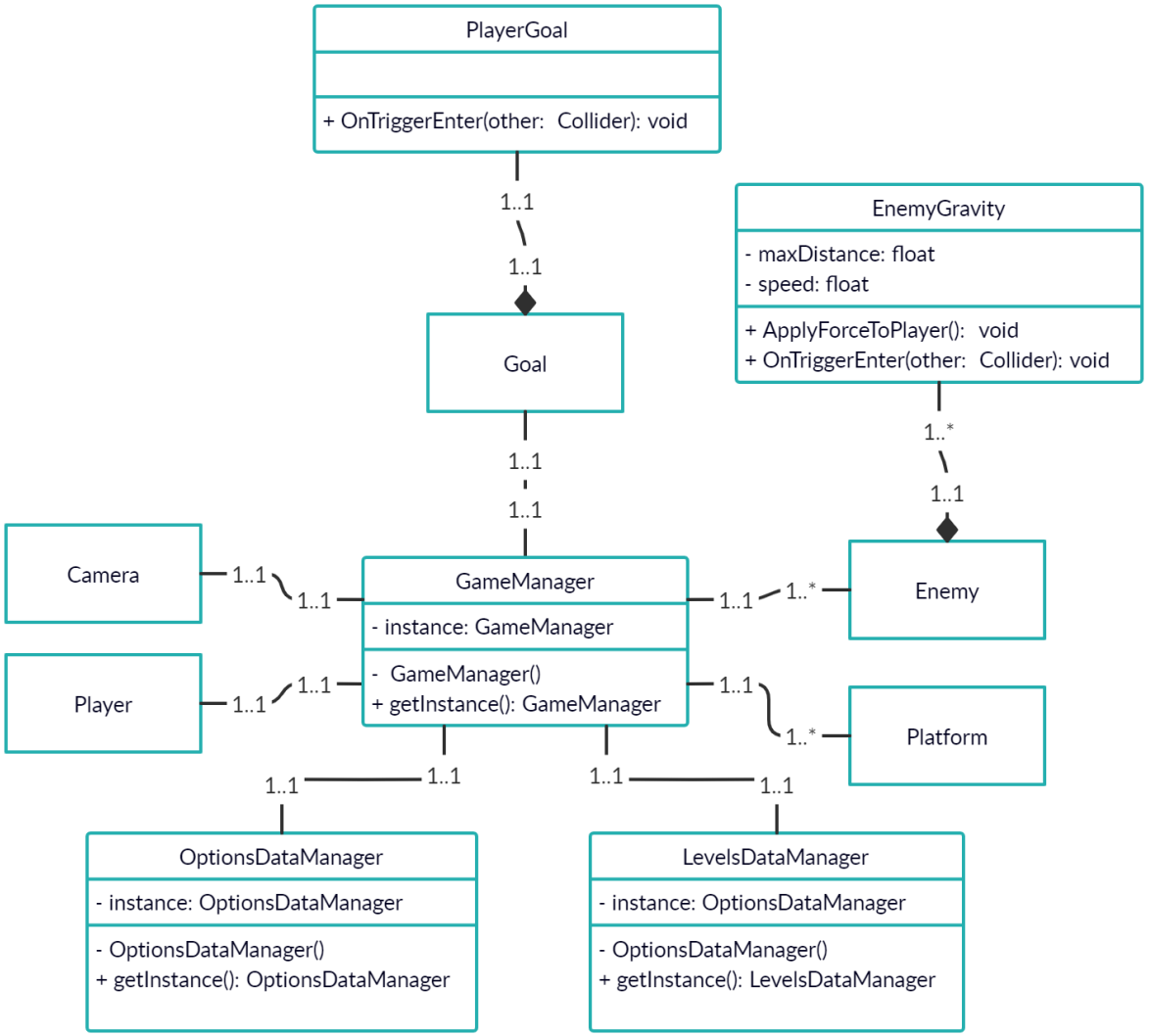
Implementation

- Control Schemes:
  - Virtual Gamepad



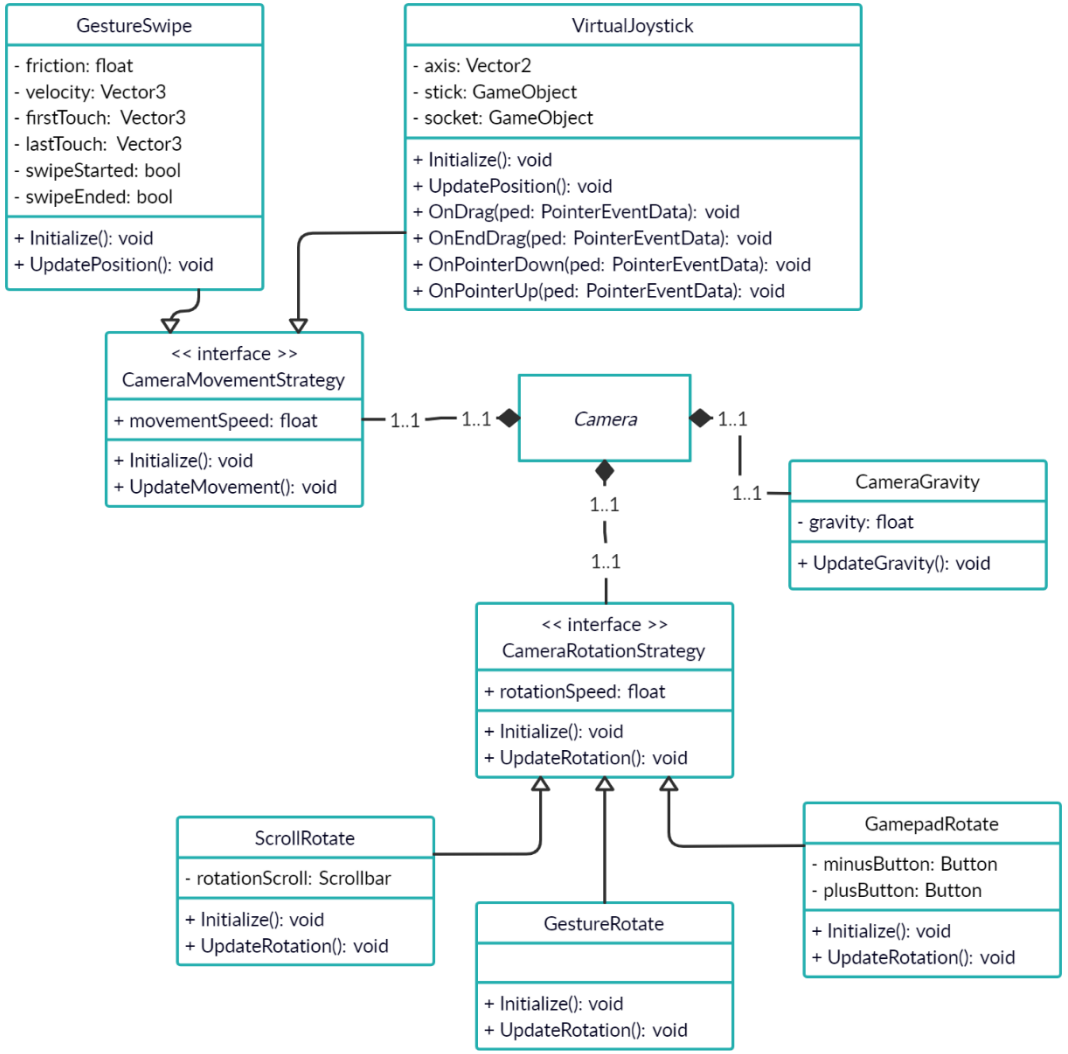
Implementation

- General UML Class Diagram of the Game



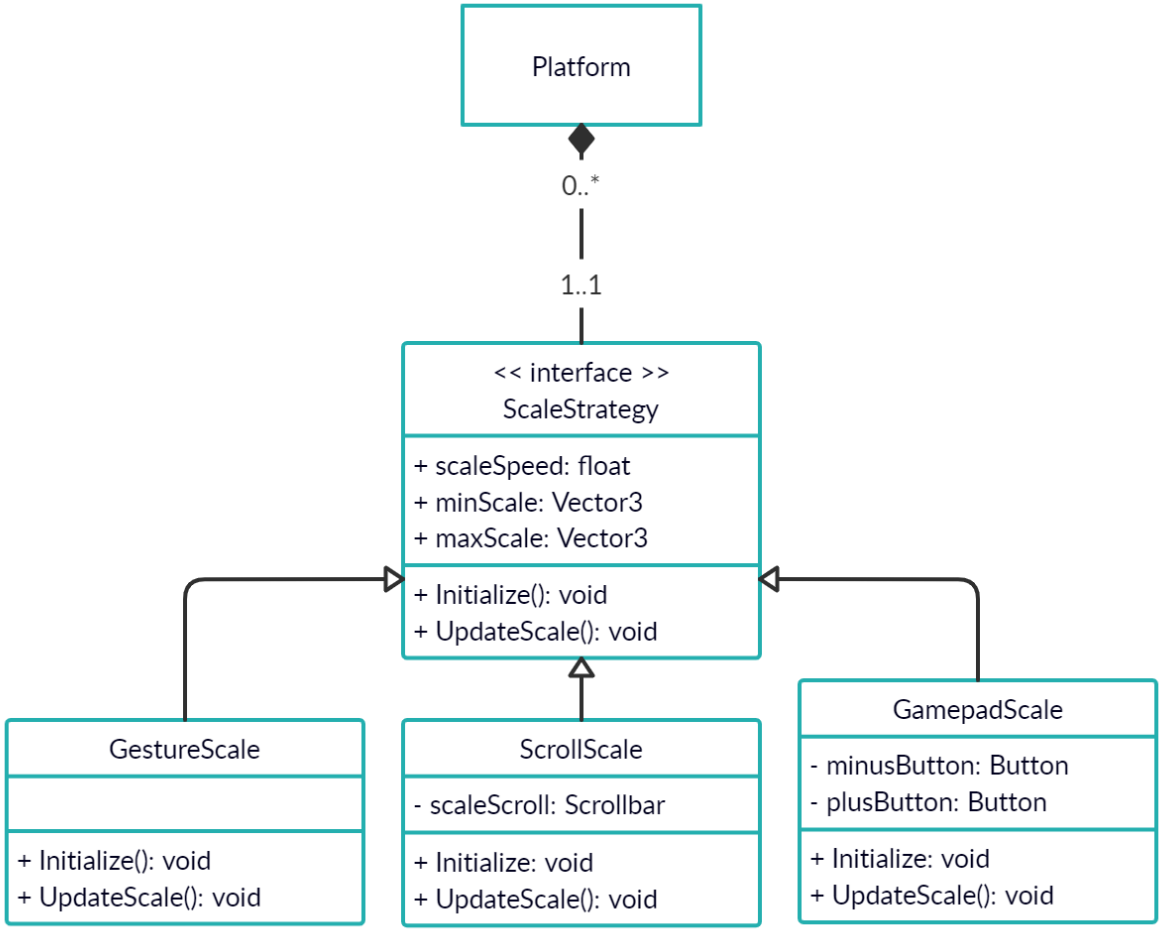
Implementation

- UML Class Diagram for Camera Movement and Rotation



Implementation

- UML Class Diagram for Platform Scaling



Evaluation (User Studies, Test Runs)

- Two questionnaires:
  - System Usability Scale (SUS) [12]
  - Player Experience Inventory (PXI) [13]
- 25 university students, 84% male, 16% female, aged between 20-24
- Most preferred platform: PC, followed by mobile devices
- 0-5 hours of playing per a week in average
- Most liked genres: Action(56%), Strategy(%48), Platform(%36)

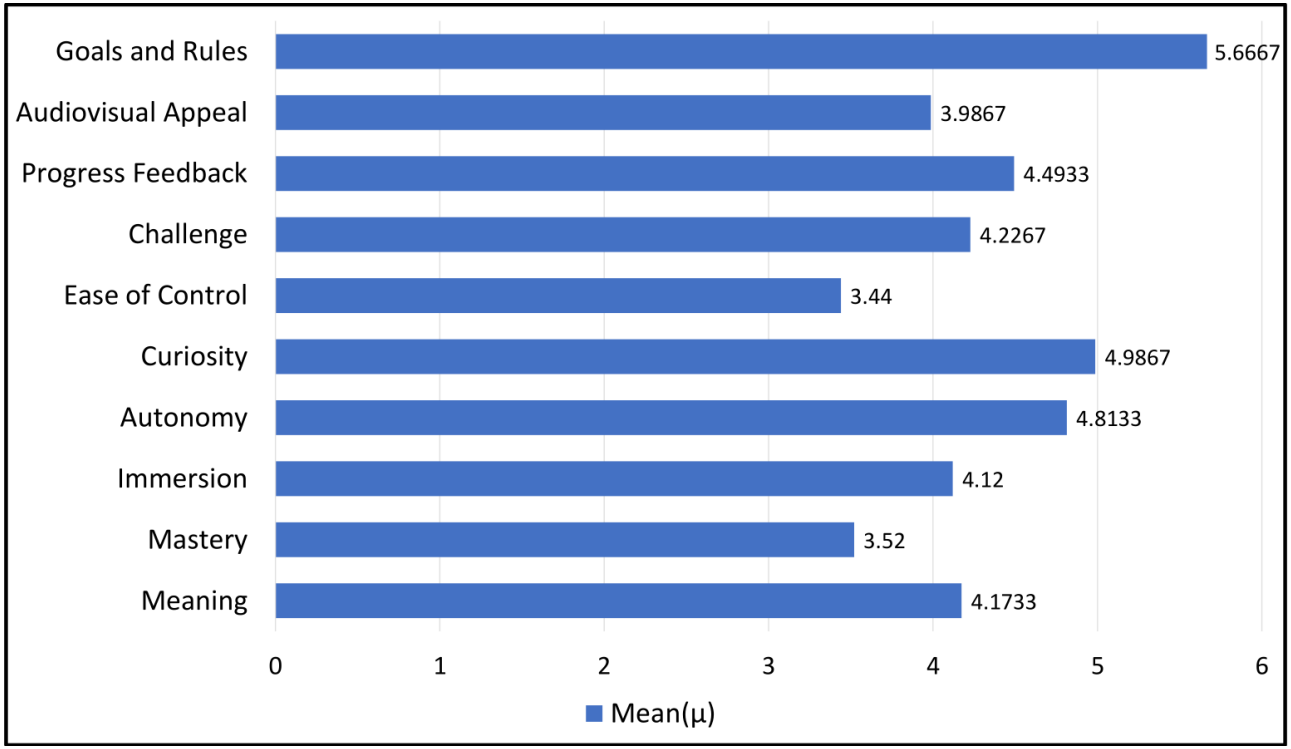
Evaluation (User Studies, Test Runs)

- SUS - Gesture-based Control Scheme:

Statement	Mean(μ)	Median	Mode	Deviation(σ)	Min	Max
I think that I would like to use this system frequently.	2.48	3	3	1.3578	0	4
I found the system unnecessarily complex.	1.6	1	1	1.3229	0	4
I thought the system was easy to use.	2.04	2	1	1.4283	0	4
I think that I would need the support of a technical person to be able to use this system.	0.84	0	0	1.3128	0	4
I found the various functions in this system were well integrated.	3.36	4	4	0.8103	2	4
I thought there was too much inconsistency in this system.	0.84	1	0	1.106	0	4
I would imagine that most people would learn to use this system very quickly.	2.4	3	3	1.2583	0	4
I found the system very cumbersome to use.	1.68	1	0	1.547	0	4
I felt very confident using the system.	2.16	2	1	1.3748	0	4
I needed to learn a lot of things before I could get going with this system.	1.16	1	0	1.3128	0	4
Mean(μ) Total Score: 65.8						

Evaluation (User Studies, Test Runs)

- PXI - Gesture-based Control Scheme:



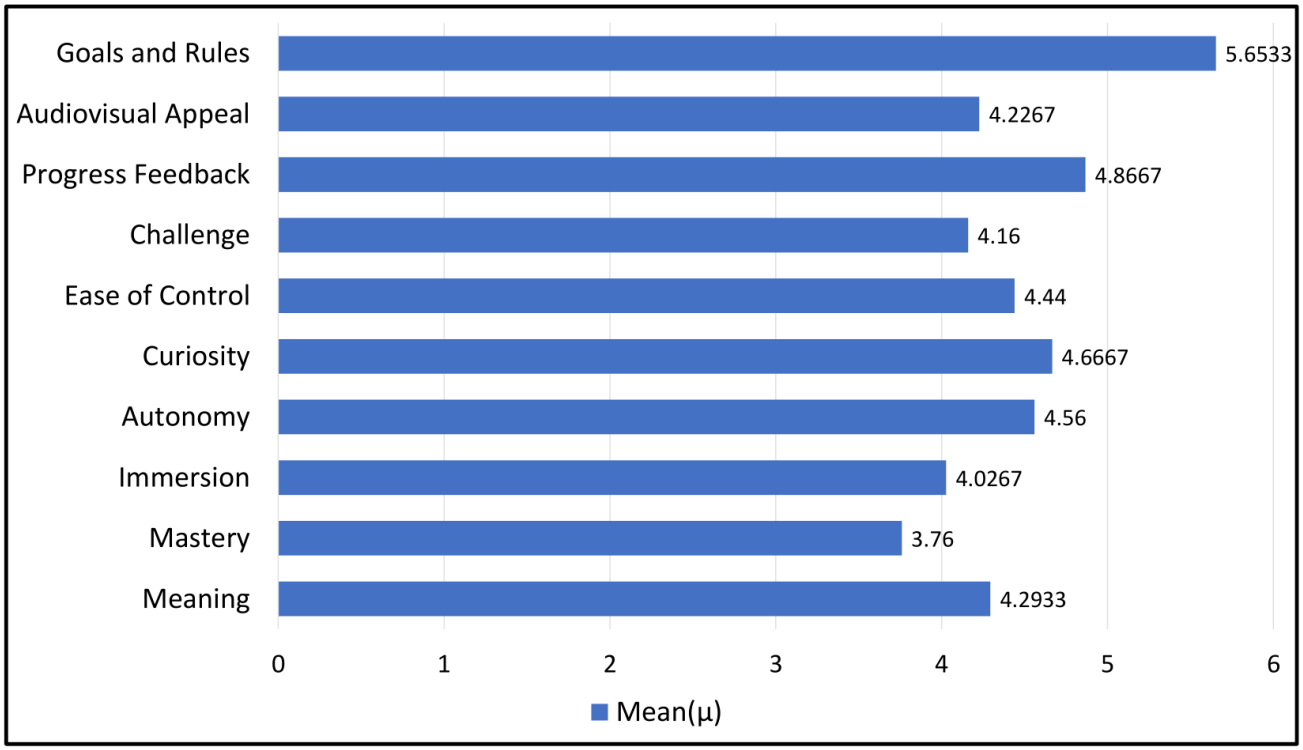
Evaluation (User Studies, Test Runs)

- SUS – Software-based Control Scheme:

Statement	Mean(μ)	Median	Mode	Deviation(σ)	Min	Max
I think that I would like to use this system frequently.	2	2	1	1.4434	0	4
I found the system unnecessarily complex.	1.92	2	0	1.579	0	4
I thought the system was easy to use.	2.2	2	1	1.291	0	4
I think that I would need the support of a technical person to be able to use this system.	1.2	0	0	1.5811	0	4
I found the various functions in this system were well integrated.	2.8	4	4	1.5546	0	4
I thought there was too much inconsistency in this system.	1.12	1	0	1.3638	0	4
I would imagine that most people would learn to use this system very quickly.	2.6	3	4	1.2247	0	4
I found the system very cumbersome to use.	2.28	3	3	1.4583	0	4
I felt very confident using the system.	2.28	2	2	1.3392	0	4
I needed to learn a lot of things before I could get going with this system.	1.48	1	0	1.5578	0	4
Mean(μ) Total Score: 59.7						

Evaluation (User Studies, Test Runs)

- PXI – Software-based Control Scheme:



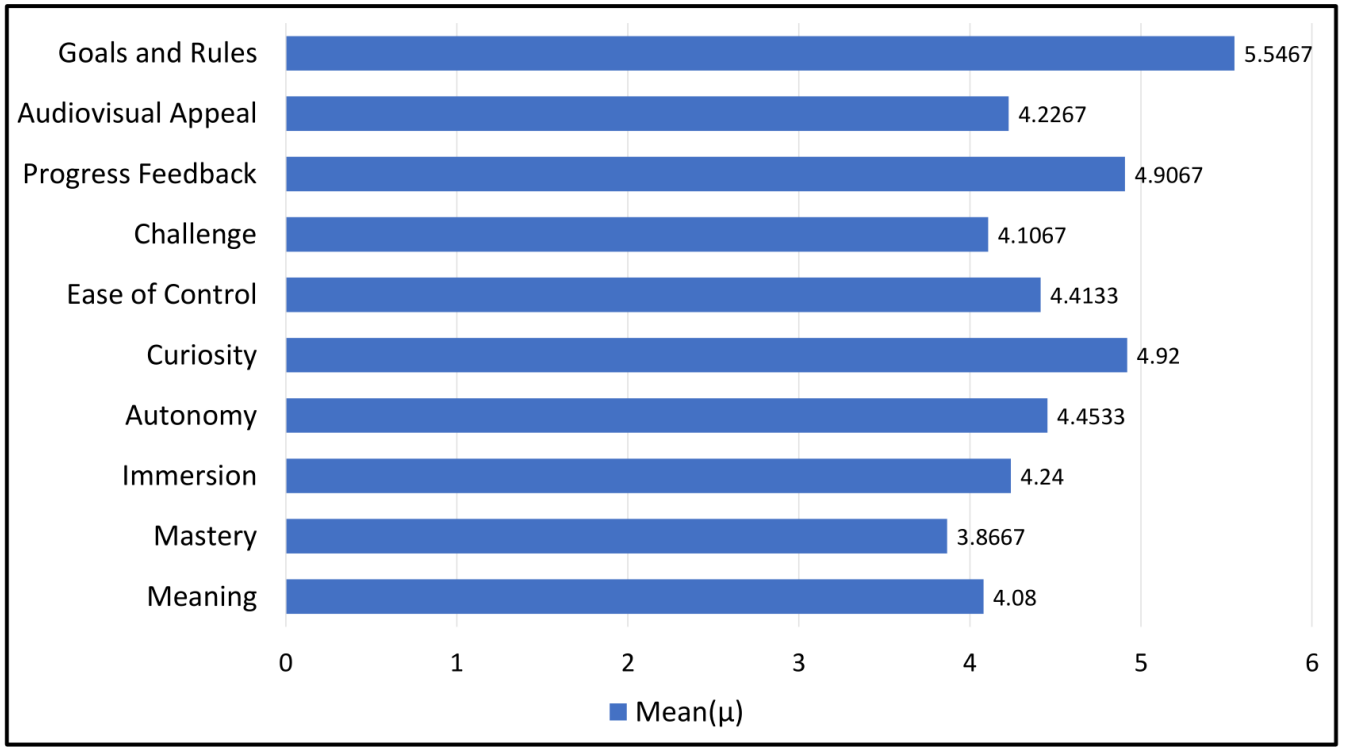
Evaluation (User Studies, Test Runs)

- SUS – Virtual Gamepad Control Scheme:

Statement	Mean(μ)	Median	Mode	Deviation(σ)	Min	Max
I think that I would like to use this system frequently.	1.92	1	1	1.579	0	4
I found the system unnecessarily complex.	2.08	2	0	1.5524	0	4
I thought the system was easy to use.	1.96	2	1	1.4572	0	4
I think that I would need the support of a technical person to be able to use this system.	0.88	0	0	1.3329	0	4
I found the various functions in this system were well integrated.	2.88	3	4	1.2689	0	4
I thought there was too much inconsistency in this system.	1.16	1	0	1.4341	0	4
I would imagine that most people would learn to use this system very quickly.	2.48	2	4	1.4922	0	4
I found the system very cumbersome to use.	2.32	3	4	1.5737	0	4
I felt very confident using the system.	2.36	2	1	1.2543	0	4
I needed to learn a lot of things before I could get going with this system.	1.32	1	0	1.4059	0	4
Mean(μ) Total Score: 61.7						

Evaluation (User Studies, Test Runs)

- PXI – Virtual Gamepad Control Scheme:



Discussion

- Contradiction between SUS and PXI?
- Problem with gesture-based control
- Gestural control or software-based (direct) control?
- Difference between software-based control scheme and virtual gamepad control scheme

Suggested Future Work

- Different participant groups (age, social background)
- Application of other interaction methods
- Fine-grained implementations of control schemes
- Other game evaluation questionnaires

Conclusion

- Trade-off between:

  Sense of Mastery / Required Time To Learn

  vs.

  General Usability

- Gestural controls: more complex, but also the most usable
- Direct control interfaces (virtual gamepad and software-based control schemes): easy to learn, but lacks the practicality

List of References

1. Kommandotech. Mobile Killed the PC Star: Mobile Gaming Statistics for 2020. https://kommandotech.com/statistics/mobile-gaming-statistics/, last accessed on 20.08.2020. Dec. 2019
2. Y.-k. Chou. Actionable Gamification. 1st. O'Reilly Media, Inc., 2019. Chap. 3. ISBN: 9781839211706.
3. C. Kimberly, T. Y. Lim, C. W. Khong, and C. Y. Wong. "Usability and Player Experience of Input Device for Mobile Gaming." In: International Journal of Mobile Human Computer Interaction 8 (July 2016), pp. 52–69. DOI: 10.4018/IJMHCI.2016070104.
4. T. Shittu, L. Abdullah, and P. Sulaiman. "A Review on Interaction Techniques on Mobile Phones." In: International Journal of Information Systems and Engineering 5 (Nov. 2017), pp. 72–79. DOI: 10.24924/ijise/2017.04/v5.iss2/72.79.

List of References

5. S.-D. Seo and S. Hanf. “A Comparison Study of the Smartphone Gaming Control.” In: Journal of Usability Studies archive 14 (2019), p. 201.
6. M. Lacey. Usability Matters: Practical UX for Developers and Other Accidental Designers. Manning Publications, 2018. Chap. 5. ISBN: 9781617293 931
7. Google. Android Open Source Project. https://source.android.com/, last accessed on 06.10.2020.
8. Unity Technologies. Unity Platform. https://unity.com/products/unity-platform, last accessed on 27.08.2020.
9. Nextpng. Rotation Gesture Logo. https://www.nextpng.com/en/transparent-png-crqir, license: non-commercial use, last accessed on 06.10.2020.

List of References

10. Nextpng. Zoom Gesture Logo. https://www.nextpng.com/en/transparent-png-kbxve, license: non-commercial use, last accessed on 06.10.2020.
11. Nextpng. Swipe Gesture Logo. https://www.nextpng.com/en/transparent-png-rnmmd, license: non-commercial use, last accessed on 06.10.2020.
12. J. Brooke. “SUS - A quick and dirty usability scale.” In: Usability evaluation in industry. London: Taylor and Francis, 1996, pp. 189-194. ISBN: 9780748404605.
13. V. V. Abeele, K. Spiel, L. Nacke, D. Johnson, and K. Gerling. “Development and validation of the player experience inventory: A scale to measure player experiences at the level of functional and psychosocial consequences.” In: International Journal of Human-Computer Studies 135 (2020), p. 102370. ISSN: 1071-5819. DOI: https://doi.org/10.1016/j.ijhcs.2019.102370.