The 1st Symposium Of Digital Transformation in Continuing Education

Realtime 3D Game-Based Assessments

Design, Challenges and Benefits

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July 30th 2018
Ramallah - Palestine

Outline

- Advantages of game-based assessments
- Content design for realtime 3D learning environments
- Challenges
- Production and distribution
- Acceptance and adoption
- Scoring and validity concerns
- Suggested model
- Results and conclusions

Game-Based Assessments

- Can replace written assessments in measuring complex skills
  - Think of problem solving, innovation and creativity, leadership
- Adopt psychometric models such as Evidence-Centered Design
- Usually presented as 2D games with simple mechanics
- White-box vs. black box models

SimCity Pollution Challenge

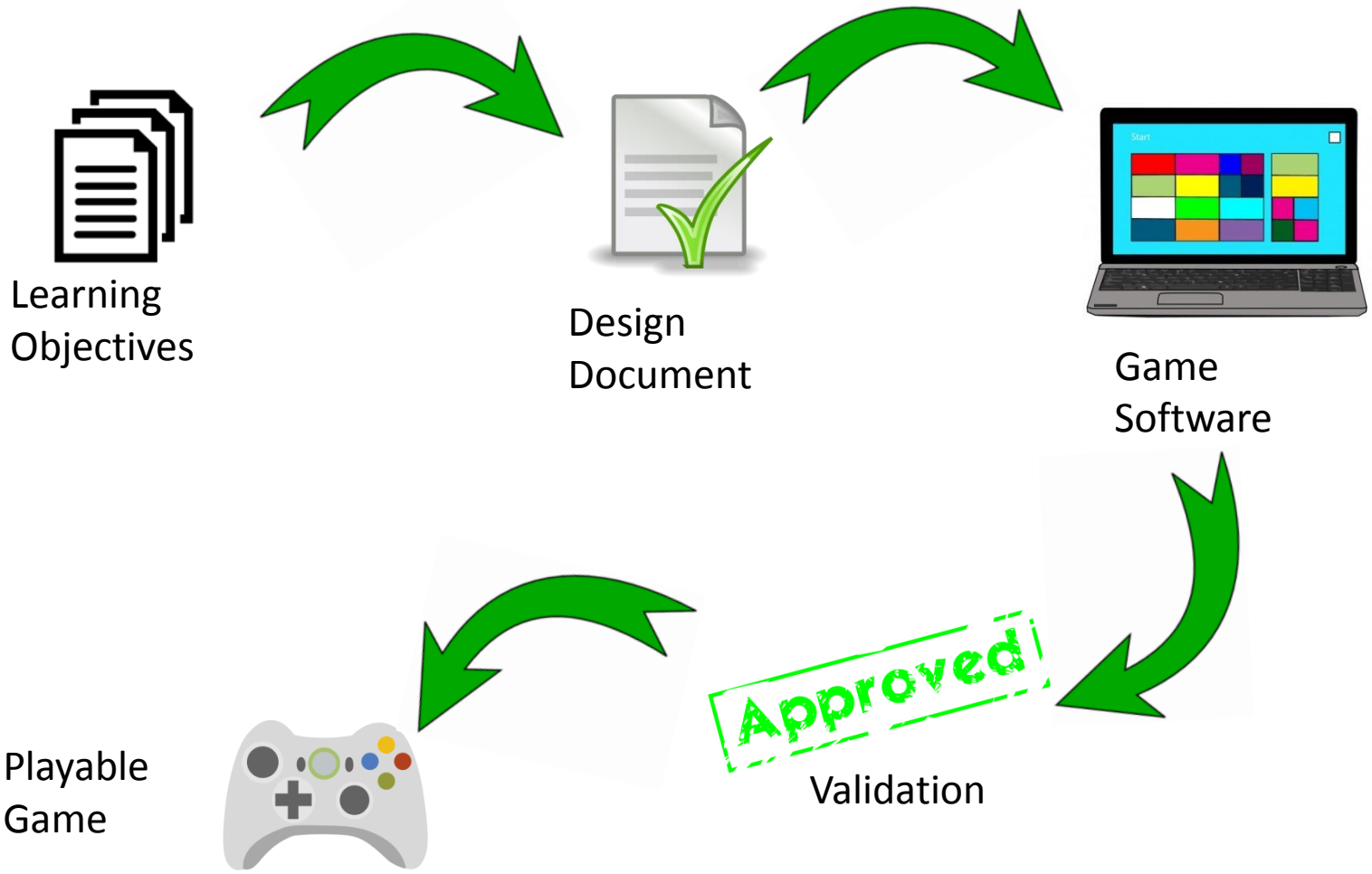
GBA Application Areas

- Formative assessments – common
- Summative assessments – less common
- High-stakes assessments – very limited

Content Design

- Content of GBA is not only textual
  - Graphics (2D and 3D)
  - Audio
  - Levels and environments
  - Roles and mechanics
- Special tools are needed to design content (too technical)

Content Design Process



Content Design

- Multiple stakeholders involved
- Many layers between learning objectives and final product
- Time consuming
  - A game needs to be developed
- Realtime 3D games = more complexity to the process

Realtime 3D Game Content

- 3D models and animations
- Avatars and AI controlled characters
- 3D environment with details (textures, lighting, etc…)
- Sound effects
- Goals and objectives
- Heads-Up Display and player feedback
- Mature player control scheme

(all must serve learning objectives)

AI-Controller Objects

Player Perspective and HUD

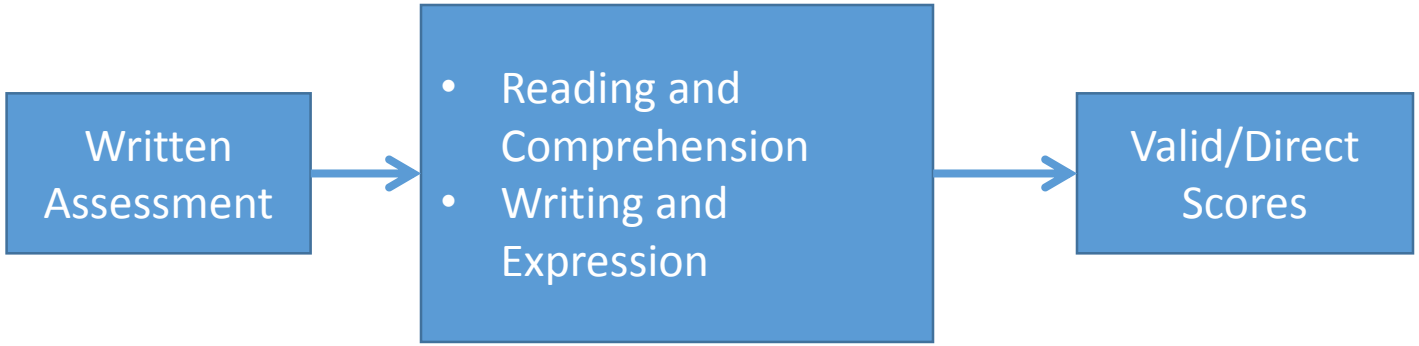
Challenges:
Production and Distribution

- Game development, in general, is expensive
- Stakeholder speak different languages and look from different perspectives
- Publishing on multiple platforms adds more production costs
- Final production needs to be validated by domain experts

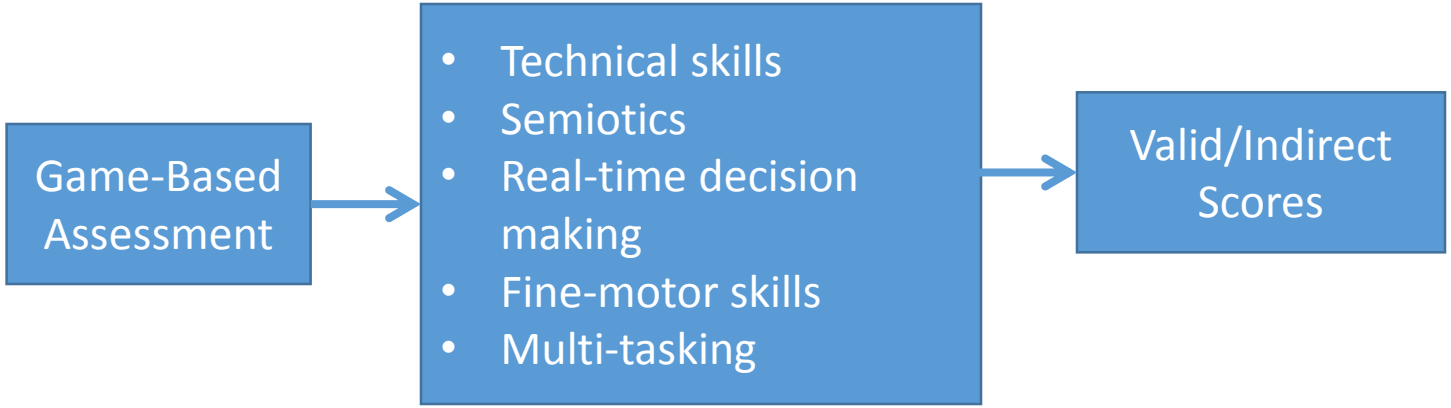
Challenges:
Acceptance and Adoption

- Most teachers are technophobic
- Schools lack appropriate technical infrastructure
- Scoring in-game actions and points is not always straightforward
- Validity concerns

Assessment Validity



Assessment Validity



GBA Scoring

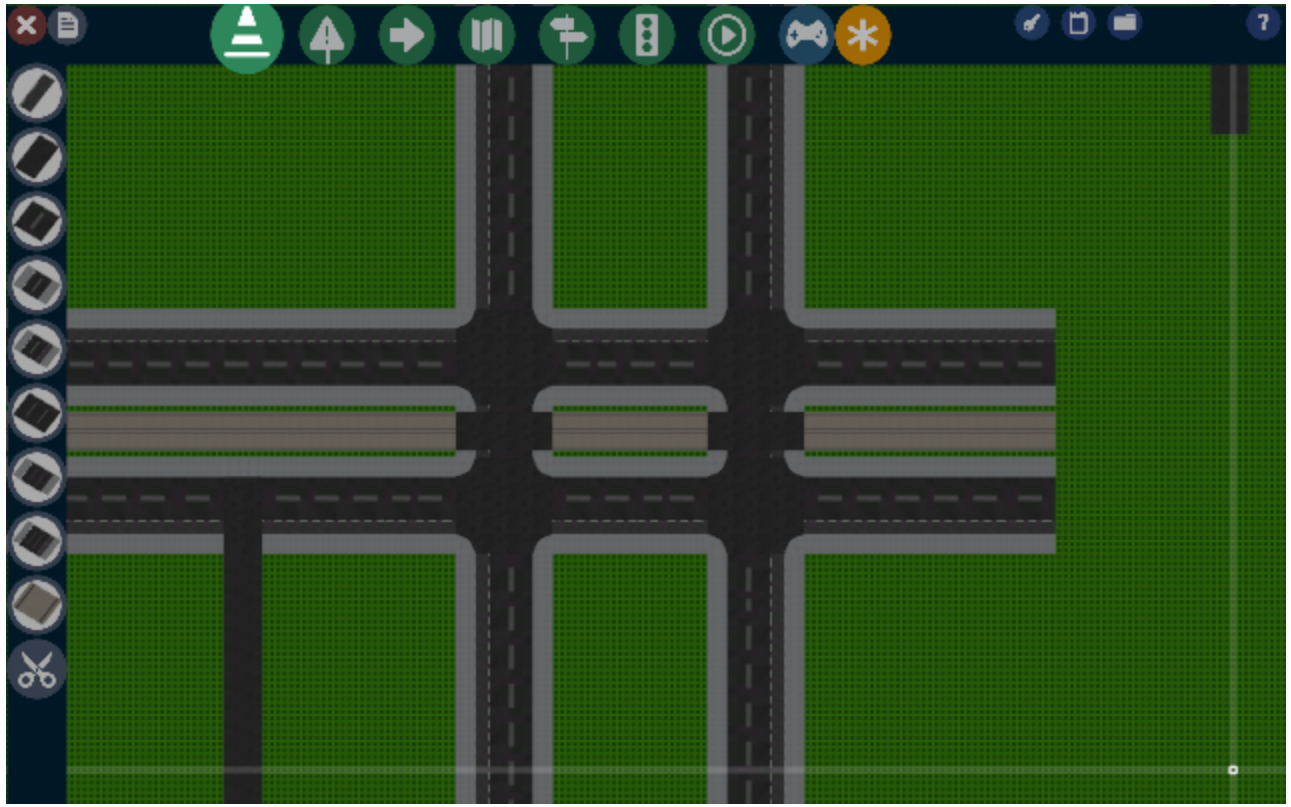
- In-game actions may not directly indicate possession of knowledge/skill in question
- Black-box scores are brief, but easier to interpret – answering the *WHAT* question
- White-box scores are detailed, but harder to interpret – answering the *WHY* question
- Psychometric frameworks like *Evidence-Centered Design* are employed

GBA Challenges Approached

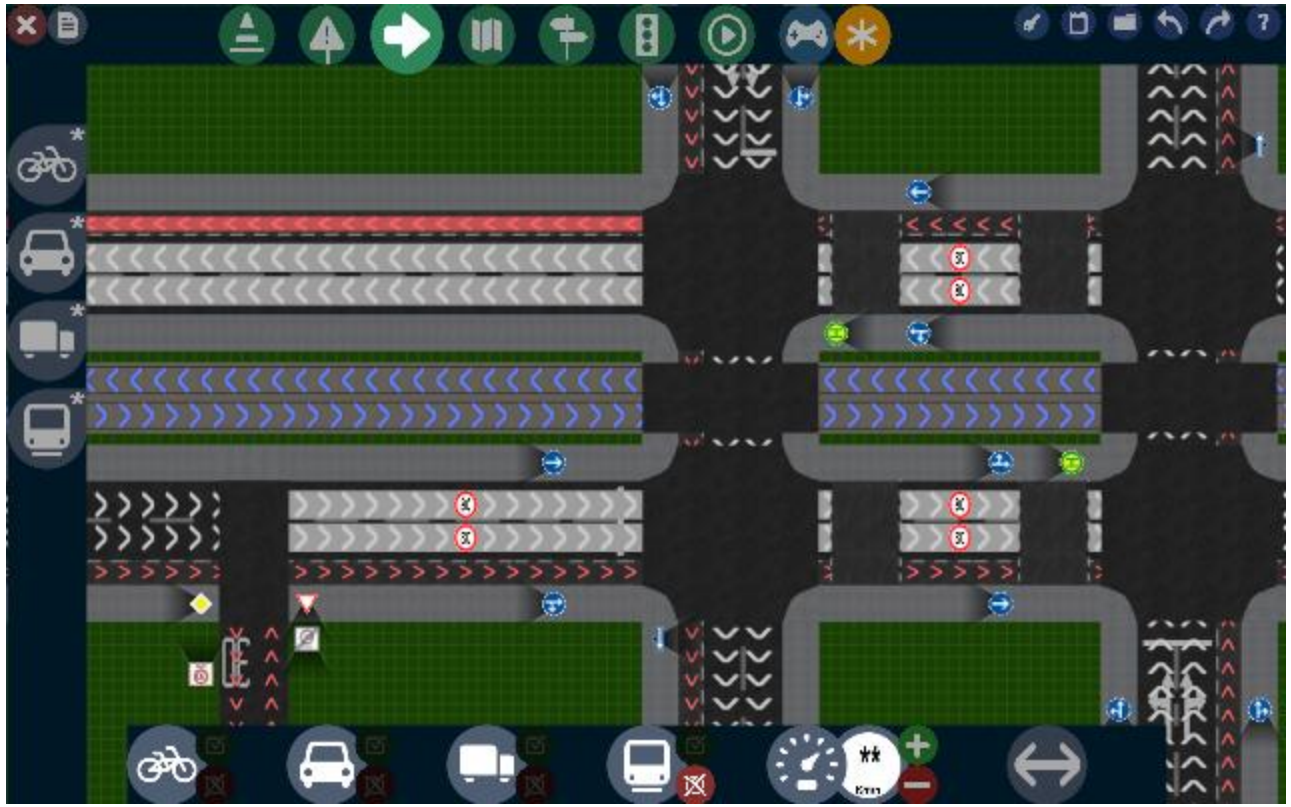
- Content design
- Development, deployment and adoption
- Scoring and score validation

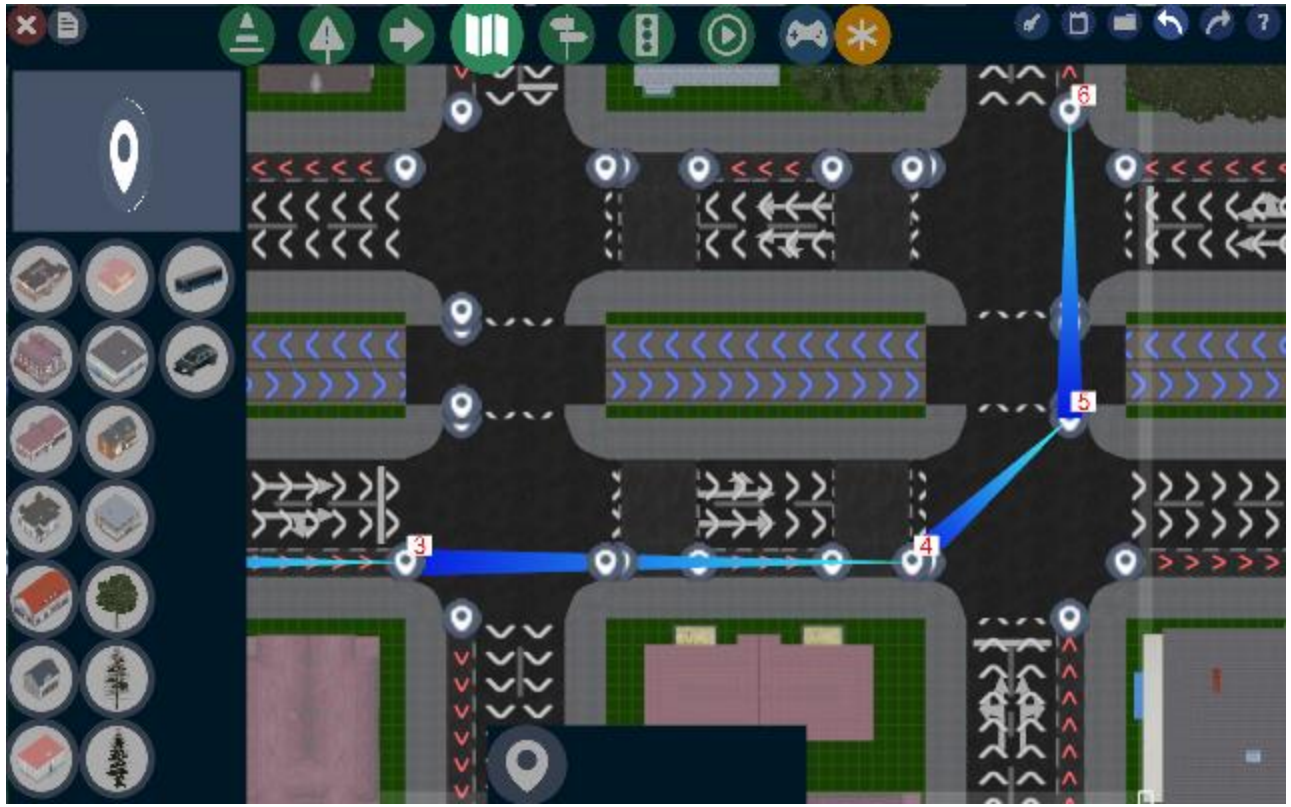
Level Editors

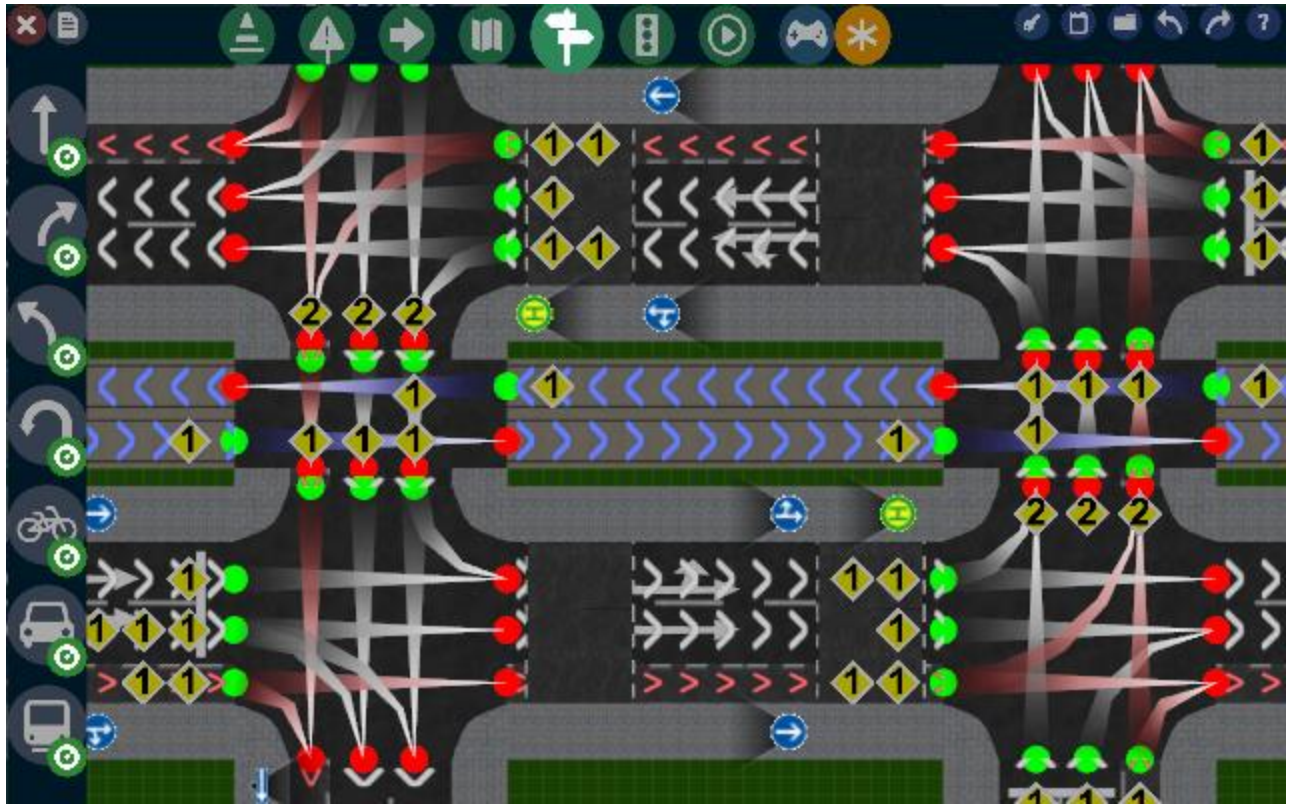
- Do not require programming/design skills
- Allow domain experts to express learning objectives directly as in-game content
- Enable users to immediately test and modify the content before forwarding assessment to students

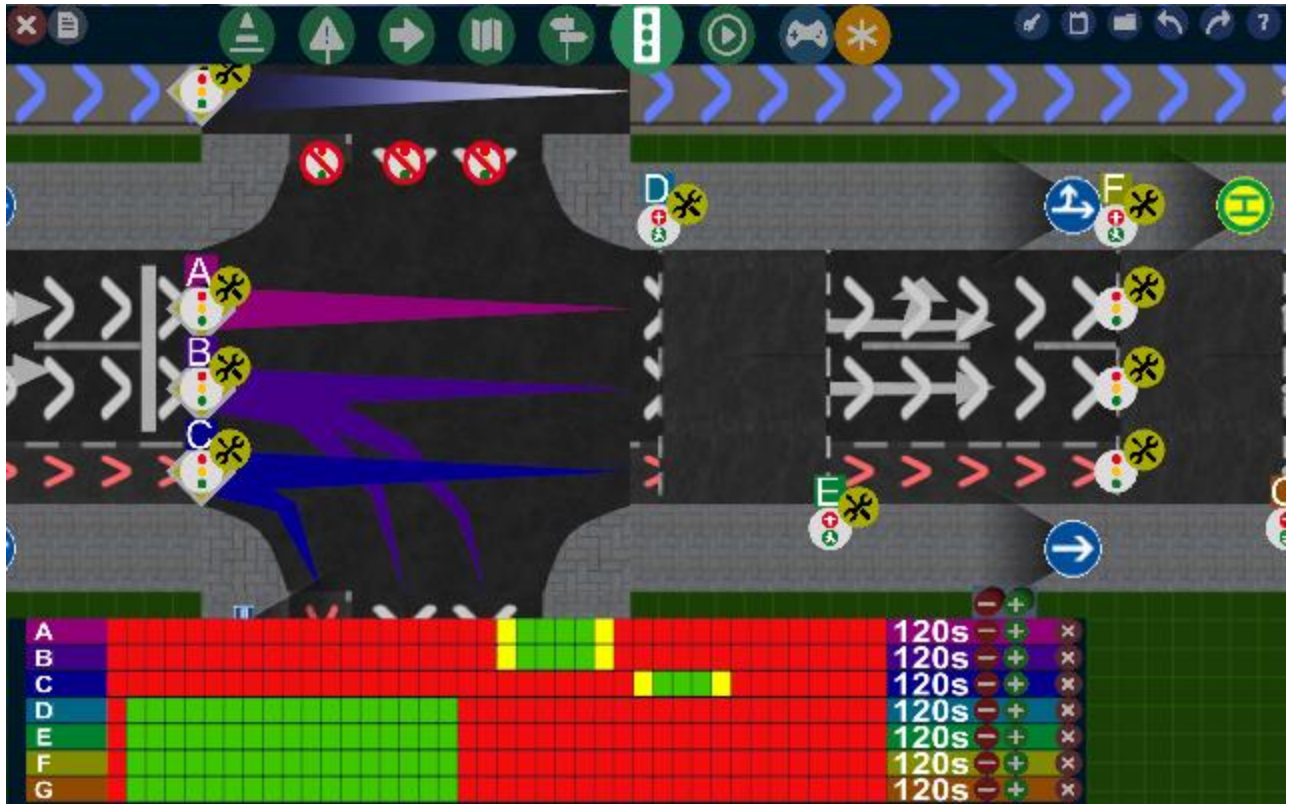


30
ZONE
STOP




6
5
3
4



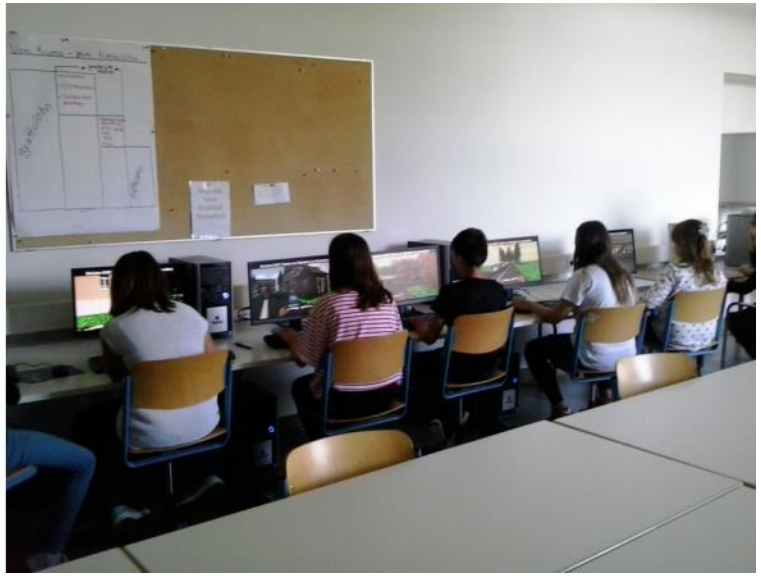

A
B
C
D
E
F
A 120s
B 120s
C 120s
D 120s
E 120s
F 120s
G 120s

FPS: 18
80
(80)
85
(85)

Drücken Sie ESC Taste um Spielen zu beenden oder F1 zur Hilfe
INDIA BRASSERIE

Mobile Deployment

- 8 months working with schools and PCs ➔ 200+ players
- 6 months on Google Play ➔ 1000+ players



Fahrradwelt 3D

Yasser Jaffal

USK ab 0 Jahren

INSTALLIEREN

Die App ist möglicherweise nicht für dein Gerät optimiert

500 Downloads

4,4 ★★★★★ 15

Familienfreundlich

Lernspiele

Ähnlich

Ein 3D Spiel, mit dem Kinder ihre Radfahrkenntnisse prüfen können.

WEITERLESEN

Installs by user

939

Lifetime

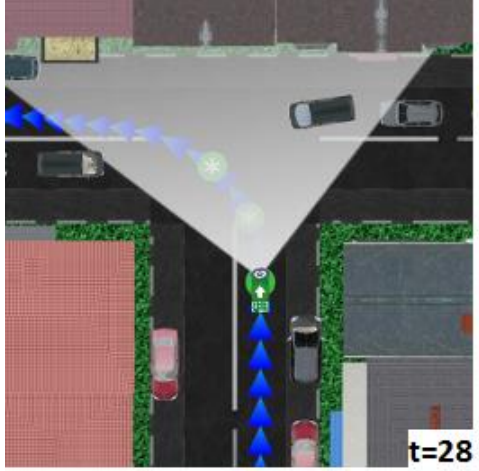
Installs by user

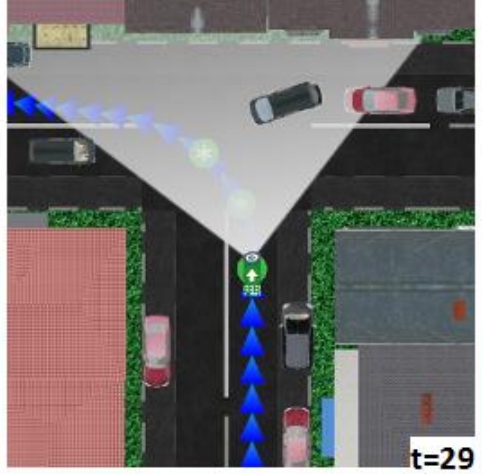
Top countries

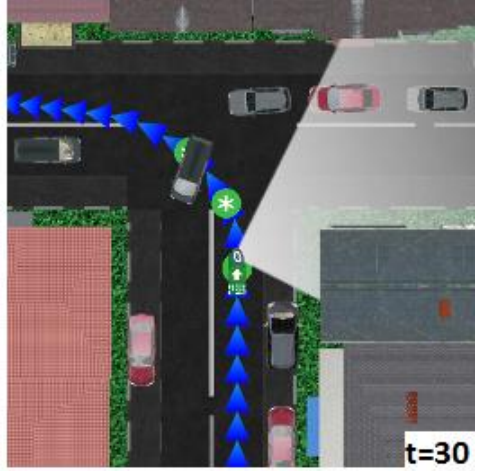
Germany	779
Austria	41.0
Israel	21.0
Turkey	10.0
Switzerland	8.00

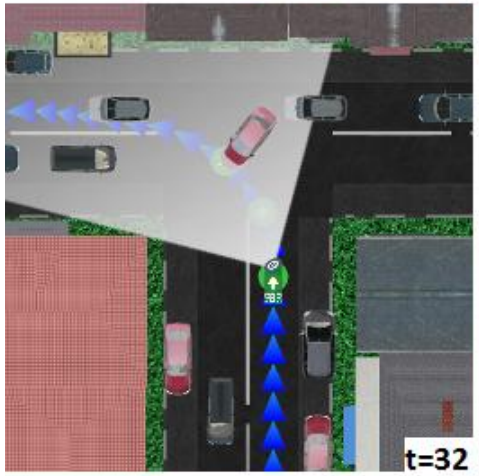
Scoring

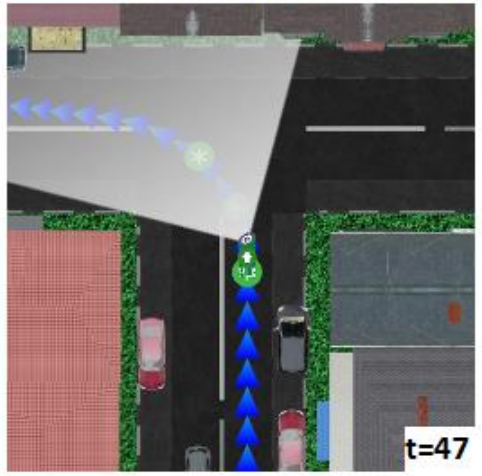
- Spatio-temporal game analytics were useful
- Manual vs. automated scoring (using expert systems)

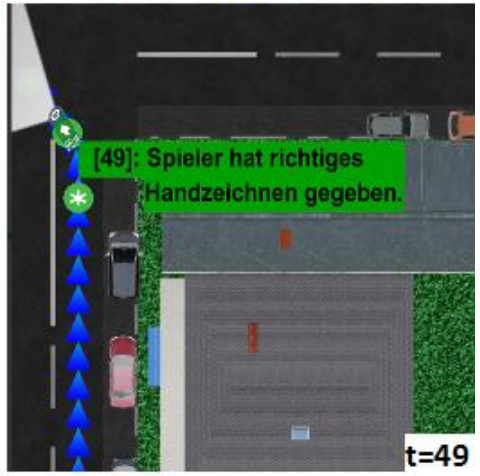






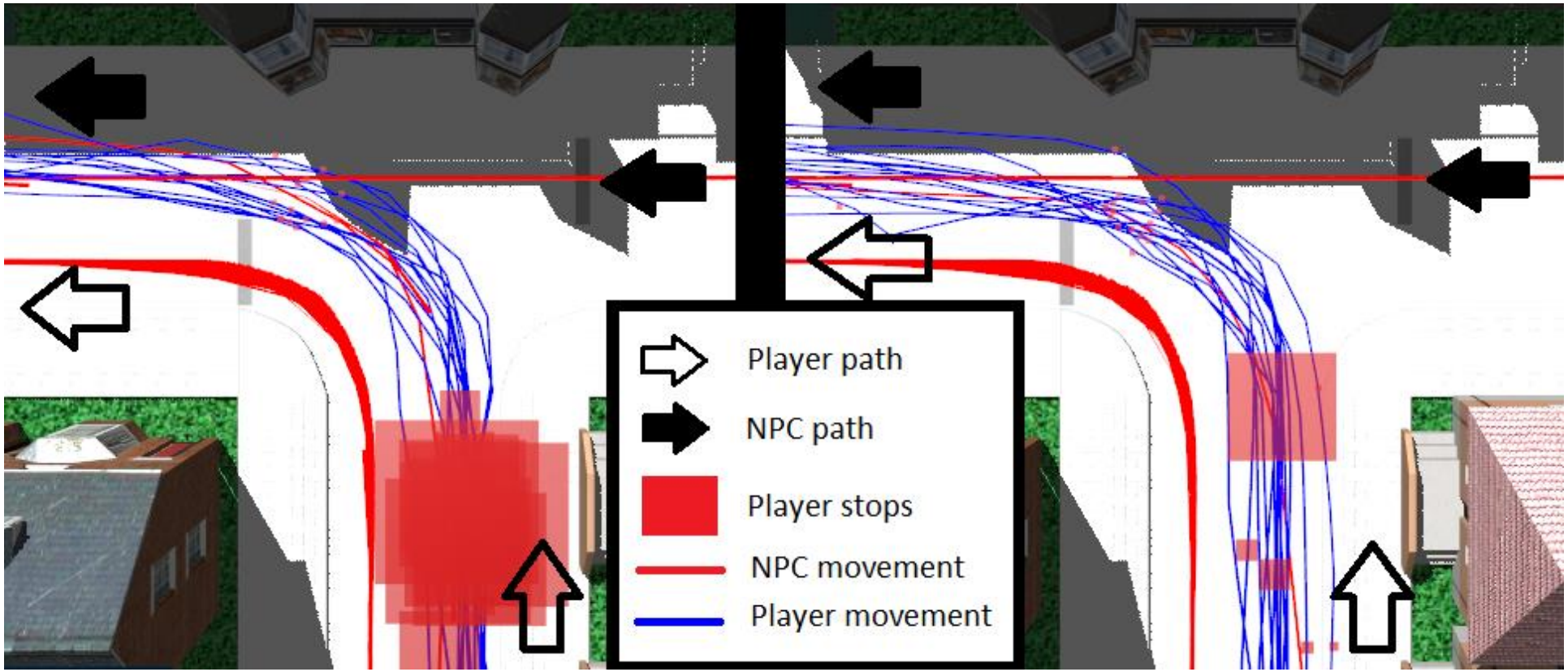


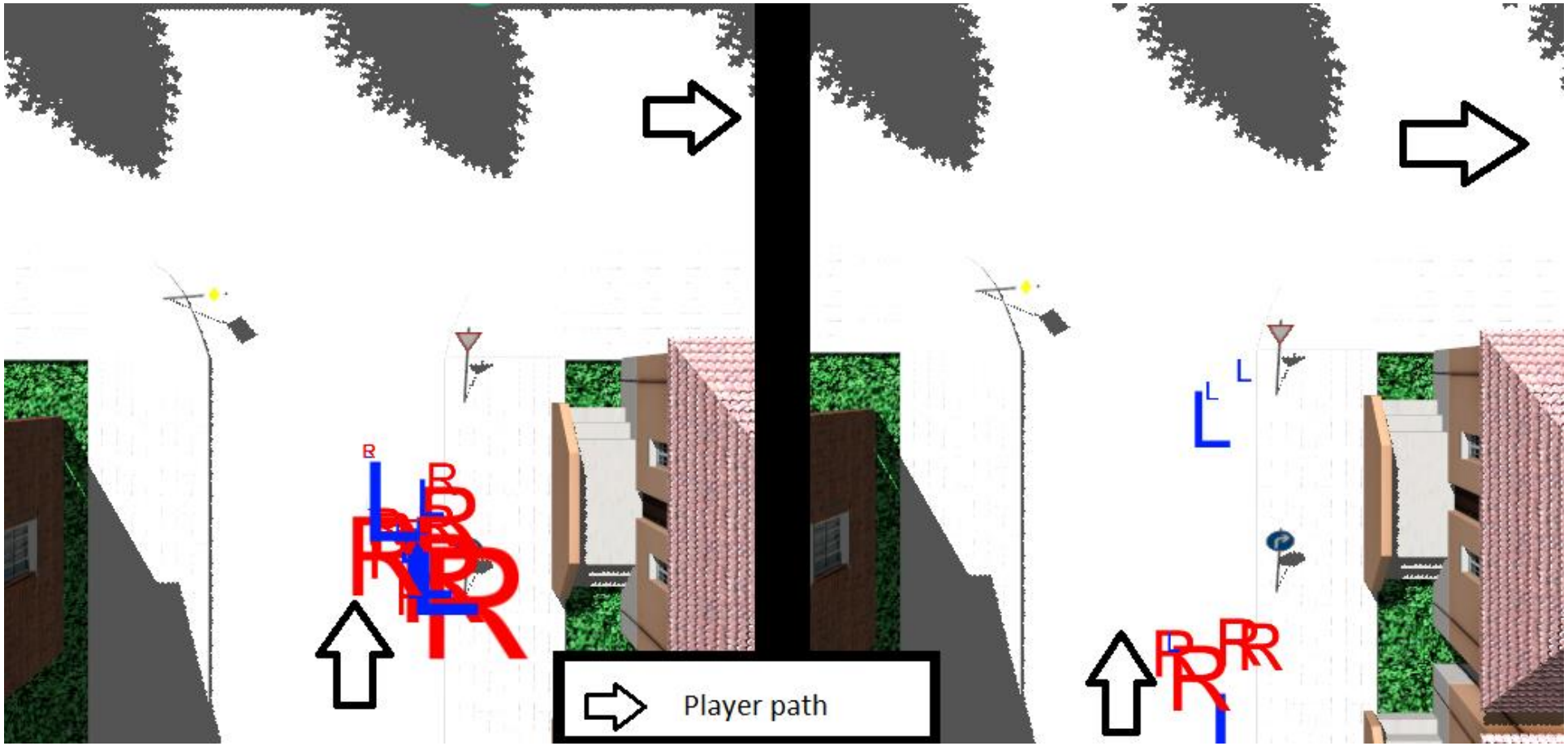


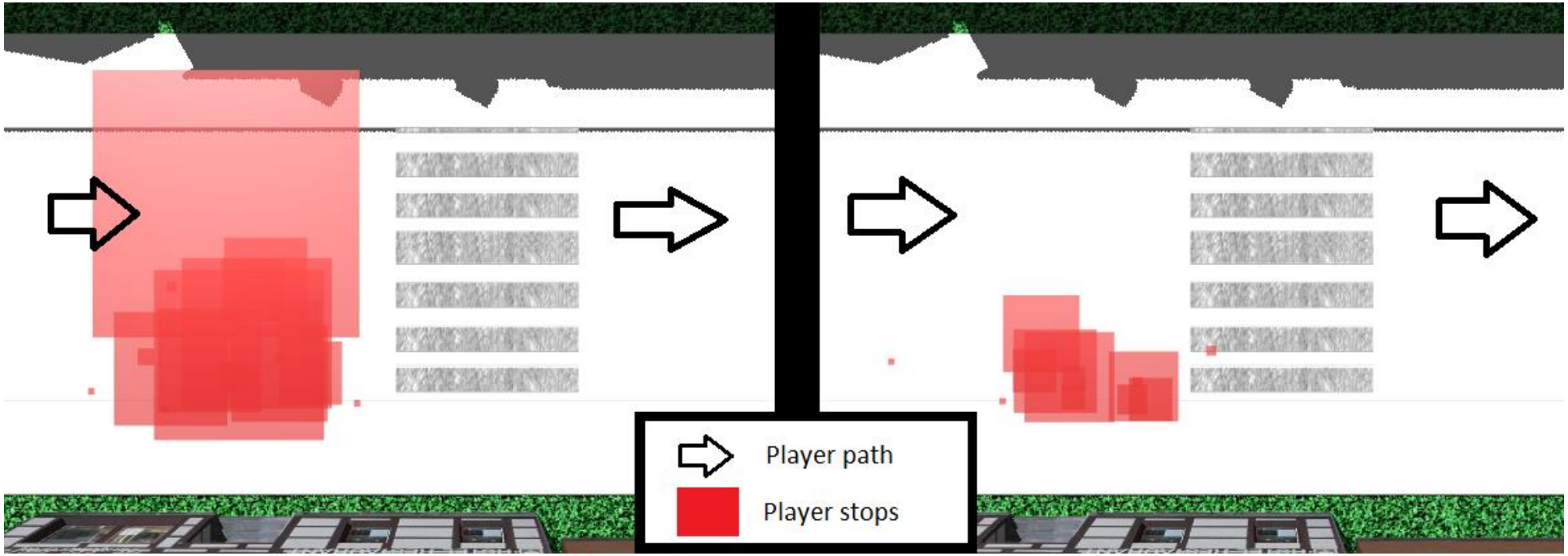


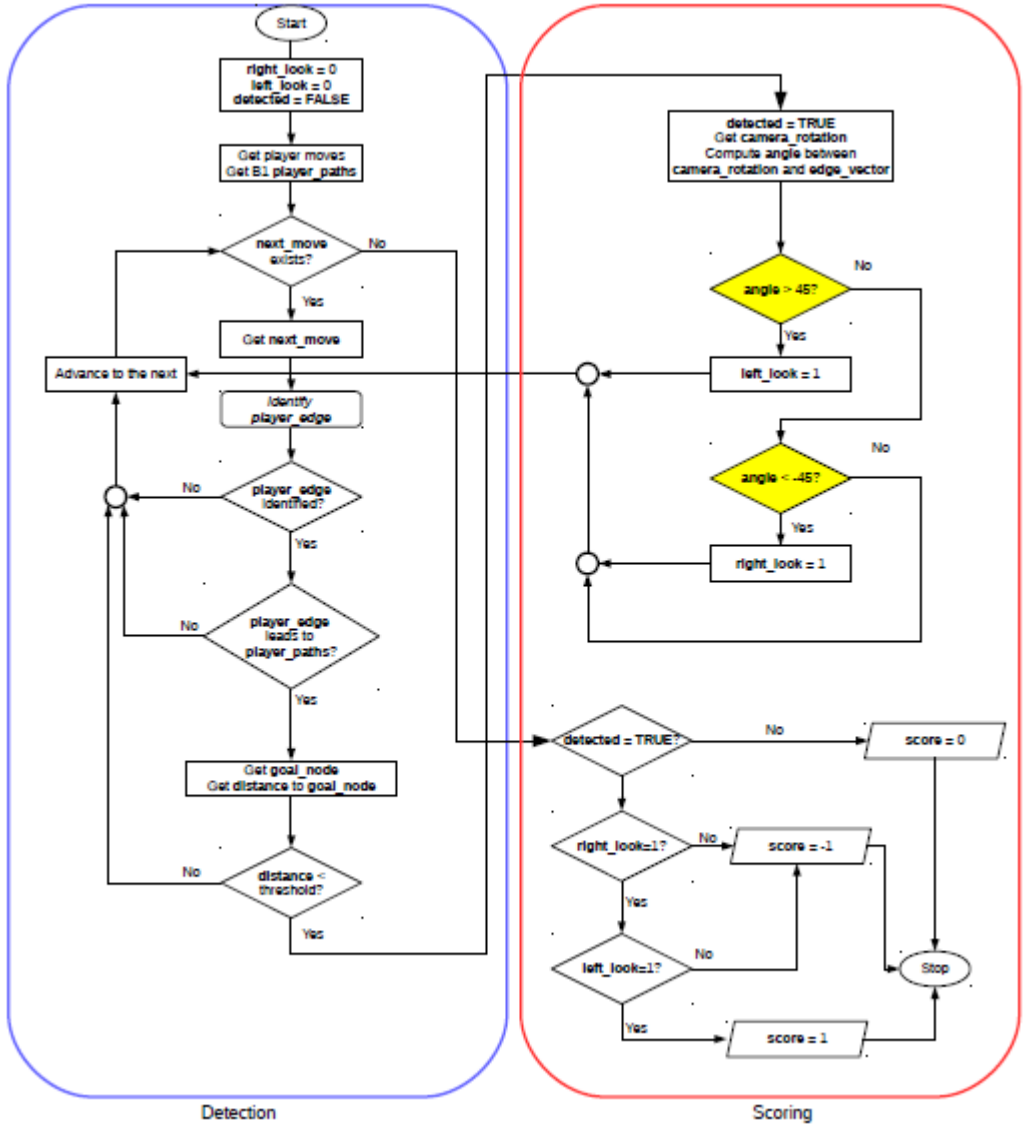
[28] Player reduced speed while approaching crossing (K1=1)
[29] Player stopped before crossing entrance (D2=-1)
[30] Player looked right (B1=1)
[32] Player looked left (B1=1)
[47] Player entered after right-incoming traffic (C1=1, L2=1)
[49] Player gave left hand signal (M1=1)
[55] Player exited the crossing

No incoming traffic from the opposite side (C3=0)


Player path
NPC path
Player stops
NPC movement
Player movement


Player path


Player path
Player stops


Start
right_look = 0
left_look = 0
detected = FALSE
Get player moves
Get B1 player_paths
next_move exists?
No
Yes
Get next_move
Advance to the next
Identify player_edge
player_edge identified?
No
Yes
player_edge leads to player_paths?
No
Yes
Get goal_node
Get distance to goal_node
distance < threshold?
No
Yes
detected = TRUE
Get camera_rotation
Compute angle between camera_rotation and edge_vector
angle > 45?
No
Yes
left_look = 1
angle < -45?
No
Yes
right_look = 1
detected = TRUE?
No
score = 0
right_look=1?
No
score = -1
Yes
left_look=1?
No
Yes
score = 1
Stop
Detection
Scoring

Meine Auswertung			
2017-04-28	C2	✓	✗B1 ✓C2 ✗K1 Ungeeignet Stop: **5**
2017-04-28	L1	✓	✓E1 ✓L1 Unfälle (Fußgänger): **1**
2017-04-28	C2	✓	✓B1 ✓C2 ✗K1

Validation with Multiple-Choice Questions

- Before playing a traffic situation, players were asked theoretical question about it
- Validation is performed by computing agreement between theoretical and practical results
- Kohen's Kappa measure was used

ICH
Bevor du durch diese Krezung färst, welche Seiten musst du anschauen?
Ich muss nicht anschauen
Nur Links
Nur Rechts
Links und Rechts
Keine Ahnung

	Theoretical Correct	Theoretical Incorrect	Total
Practical Correct	45	9	54
Practical Incorrect	43	22	65
Total	88	31	119

TABLE 5.21: Confusion matrix for L4. *accuracy=0.56*, *precision=0.83*, *recall=0.51*, κ*=0.53*

Conclusions

- Developing real-time 3D GBAs is a complex task
- Editors can help generating and validating 3D game content in short time
- Interested domain experts are hard to find (unless paid)
- Mobile games are dominant, and target group has smartphones more than PCs

Conclusions

- Expert systems are good candidate when scoring complex in-game behavior
- Game analytics tools are good at collecting and storing evidences in real-time 3D environments
- Enhancing UX helps achieving scores with higher validity

Thanks for Attending

- Any questions?