



SPHERYX | Project Presentation

A Multimodal Game Application

Simpal Kumar, Dani Rotzetter and Jan Kühni

University of Fribourg

Department of Informatics

DIVA Group



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1. INTRODUCTION

- **SPHERYX game design**
 - Ball **throwing** game (e.g. Angry Birds)
 - Interactive
 - 2D **physics** environment (sandbox)
 - Written in C++
 - Ogre 3D **rendering** engine
 - Other libraries for Wiimote, Voice recognition, Android
- **Modalities**
 - Gestures/ Voice/ Touch
 - All modalities needed to complete the game

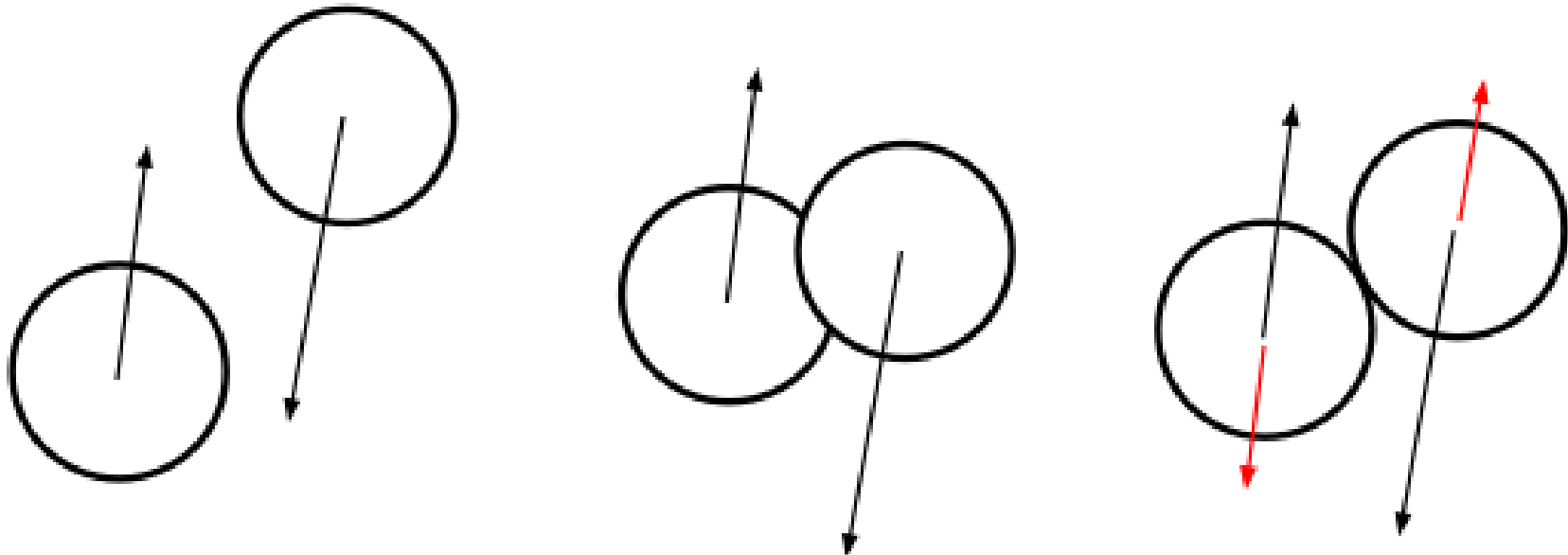
2. PHYSICS ENGINE (I)

- **Functionalities**
 - gravity & friction
 - **efficient** collision detection
 - sphere to **sphere** collisions
 - sphere to **polygon** collisions
 - **real time** pointer interaction
 - change physics parameters at **runtime**
- **Implementation example**
 - sphere to sphere collision
 - problem: **discrete** simulation (frame driven)

2. PHYSICS ENGINE (II)

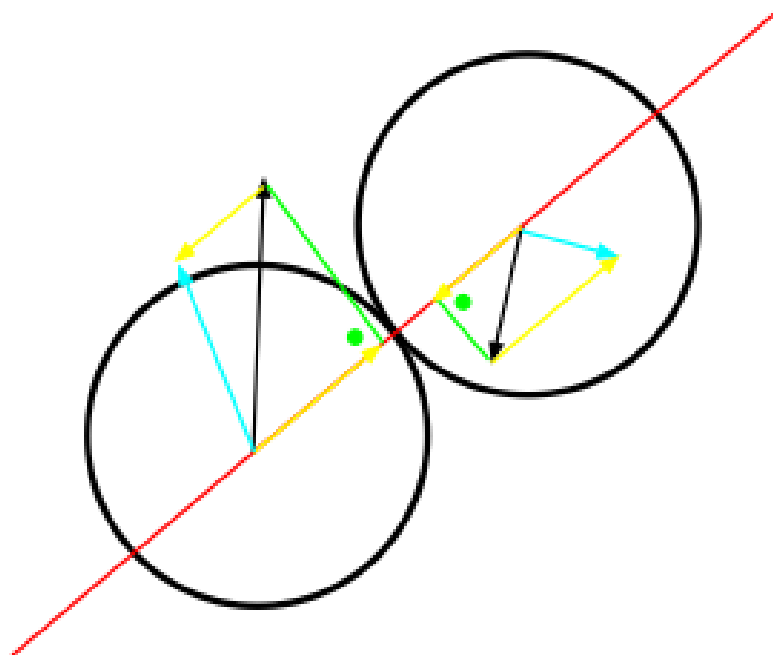
- Frame driven, **discrete** simulation

frame x \longrightarrow frame $x+1$ (collision detected) \longrightarrow frame $x+1$ corrected



2. PHYSICS ENGINE (III)

- Generic **sphere collision**



1. Find vector that **connects** center points 'c2c'
2. find force vectors by **projecting** sphere vectors onto c2c vector (using **dot product**)
3. add new **force vector** to initial sphere vector
4. Undo position warp
5. Apply friction and gravity

3. MULTIMODAL APPROACH

Input

- Fusion (Decision level)
- Haptic
 - Keyboard, mouse (pointing, grabbing)
 - Touch screen (physics)
- Motion gesture
 - Wiimote (pointing)
- Speech
 - Voice recognition (grabbing)

Output

- Fission
- Haptic
 - Vibration (errors & input conf. on Android)
- Visual
 - Screen (gameplay)
 - Display (physics info)
- Audio
 - Voice (input confirmation)
 - Sonification (conn. errors & successes)

3. A) CASE

Use of modalities

Fusion

Sequential

Parallel

Combined

(Alternate) Point
and grab

(Synergistic)
Move and release

Independent

(Exclusive)
Gravity level and
move (one after
another)

(Concurrent)
Move ball and
adjust gravity

3. B) CARE

- Complementarity
 - **Multiple modalities must be** used to reach a state
 - Point and grab (gesture & speech or gesture & click)
- Assignment
 - **Only one** modality can be used to reach given state
 - Gravity level (gesture/ touch screen)

3. B) CARE

- Redundancy
 - Multiple modalities can be used **redundantly** to reach given state
 - Grab (speech/ click)
- Equivalence
 - Multiple modalities **possible** to reach given state
 - Game state (keyboard/ speech)

4. TECHNOLOGIES

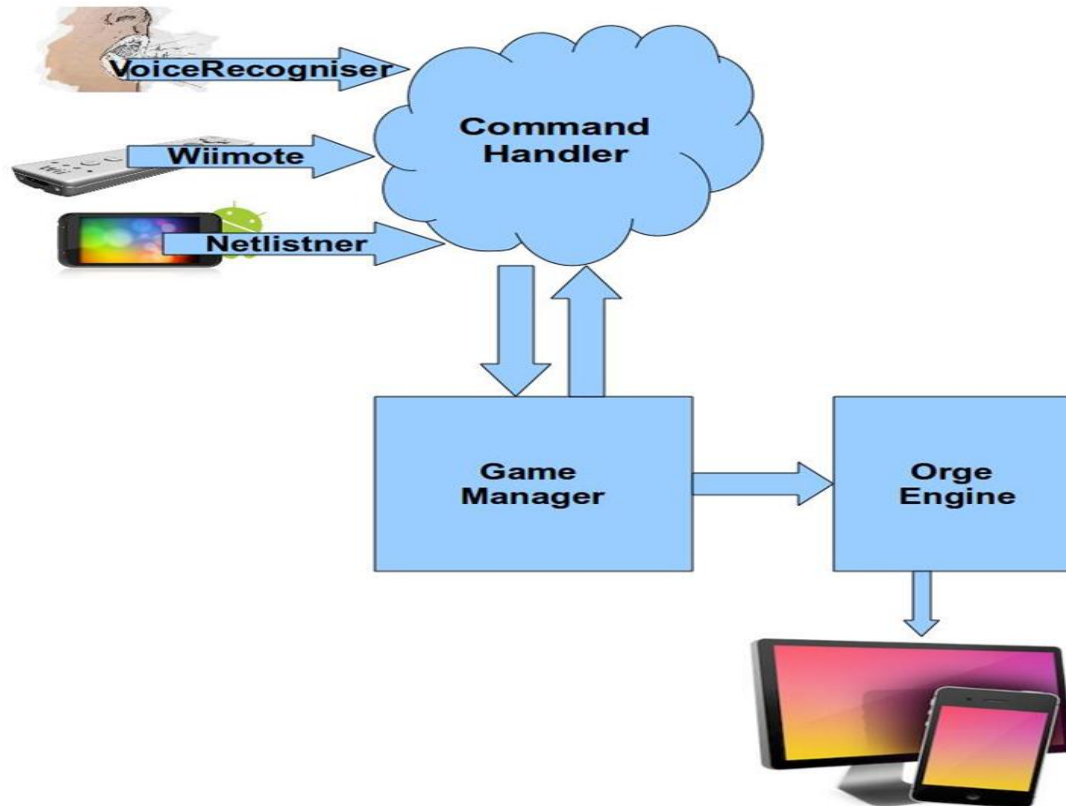
- **IDE**

- Microsoft **Visual Studio 2010**
- Focus on **.NET**
- Works well for **unmanaged C++**

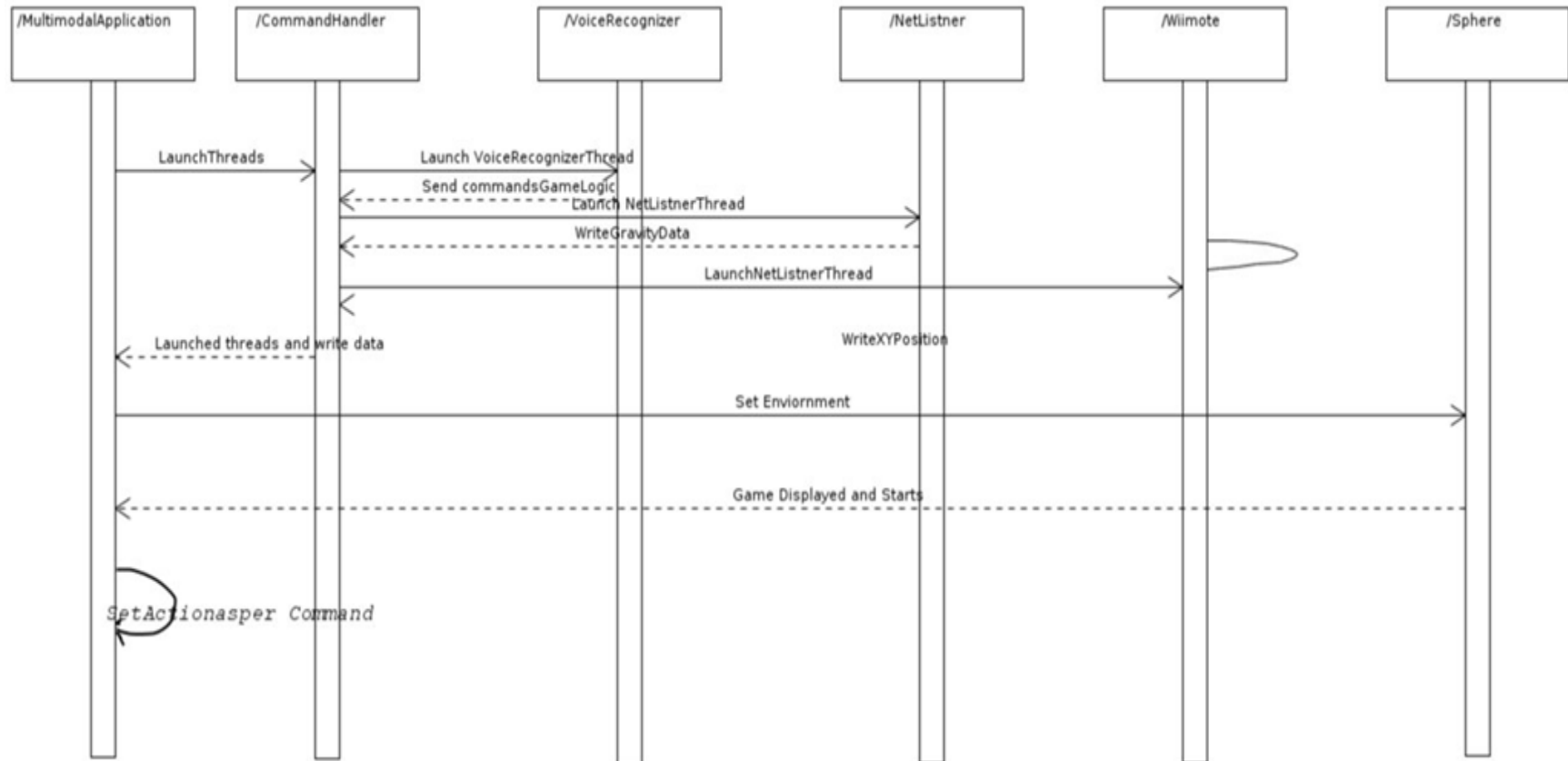
- **Rendering Engine**

- OGRE, 3D Graphics Rendering Engine (Object Oriented)
- Not a classic 'game engine' (mechanics/physics)
- Open Source (MIT-Licence since v1.7)
- Multi Platform
- DirectX/ OpenGL
- Learning concepts takes time (scene nodes, meshes, raytraces e.g.)
- Good documentation/ helpful community

5. A) Game Architecture



5. B) Sequence Diagram



6. User Evaluation Experiment Setup



Users	8, within-group setup (all users test all variable combinations). Three users start with traditional controls, three users start with multimodal control. The first two experiments are executed without modifying physics.
Test phase	Each user has five test tries in the first level of the game, for both versions (traditional and multimodal).
Physics experiment	The user is only allowed to modify the physics before each attempt.
Independent variables	Using multimodal vs traditional controls (keyboard, mouse), Modifying physics variables vs not
Dependent variables	Time needed to hit target ten times

6. Interview

Users	Age	Gender	Easier	More fun	Phyics variable	Modalities used in good combination	Comment/Remarks
1	26	Male	Traditional	Multimodal	was too difficult	Voice regonition should have learning phase	First wii game played and it was best wii game played ever
2	25	Female	Traditional	Multimodal	its an enrichment	yes used in good way	in traditional approach ball could be grabbed in air, not need to wait for ball to stop
3	31	Male	Traditional	Multimodal	cool way to modify skill level	yes used in good way	
4	24	Male	Traditional for level2, MM for level 1	Multimodal	it was fun to use gravity	yes used in good way	Would enjoy second round asap, it was fun!
5	54	Male	Traditional	Traditional	stress to use other device	Voice regonition was imprecise	Fun to play
6	23	Female	Traditional	Multimodal	Gravity is fun to Manipulate	Wii mote hard to control	
7	32	Male	Traditional	Traditional	It enriches the application		It was fun to play. Specially Gravity/Bounce factors.
8	45	Female	Traditional	Traditional	It enriches the application	yes	It was fun

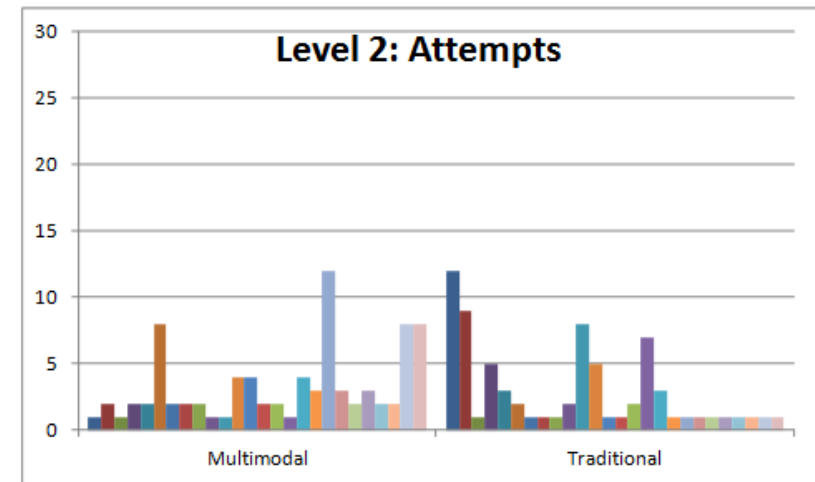
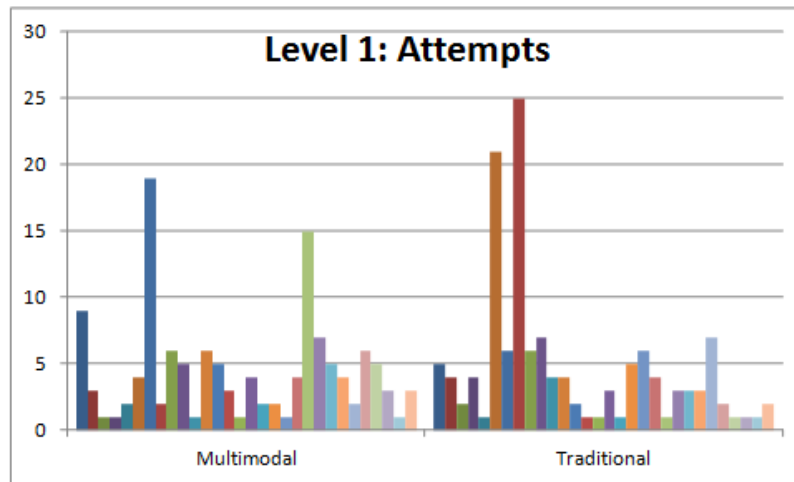
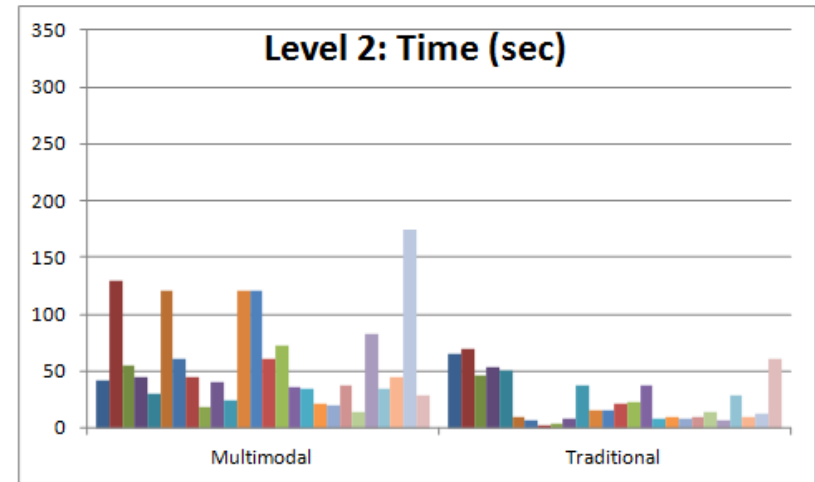
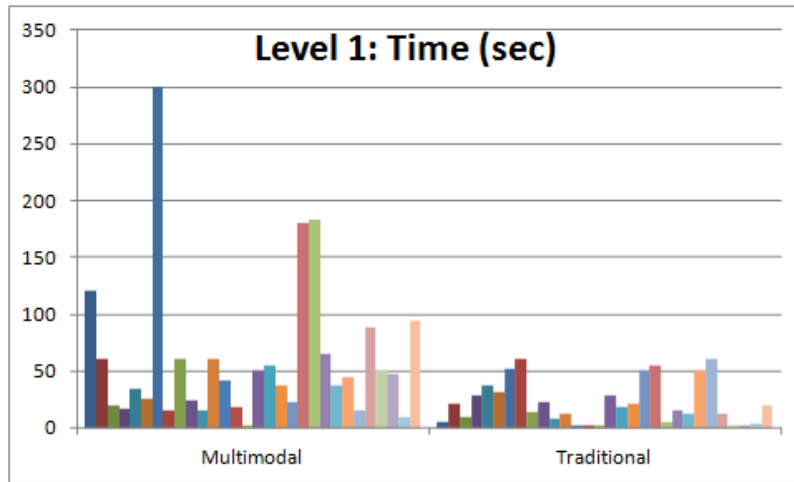
6. Observations

Users	asstance required	Time to start game	commands repeated (Yes/No)	which commands repeated	precision error with wii
1	yes, hints given to modify gravity	straightforward	Yes	5 times 'grab' and 2 times 'set'	pretty precise
2	yes, hints about how to throw ball	straightforward	yes	2-3 times reset and take	problem in pointing some times
3	hints to use modalities	straightforward	yes	1-2 times repeat and put	not much
4	yes, hints for gravity initially	straightforward	yes	1-2 times initially grab ,take,put then worked fine	not much error
5	yes, indication to set graviy	was easily learned	yes	3-4 times repeated "take"	problems with precise pointing
6	Yes, hints about how to move wiimote	quickly Learned	yes	grab	some errors while throwing
7	Yes, how to use gravity	quickly Learned	yes		
8	Yes, about using wiimote, gravity	took few minutes	yes	take, grab 5-6 times	problems in pointing

6. Results of Game Play

Users	Average Time Taken				Average Attempts			
	Level 1 Traditional	Level 1 Multimodal	Level 2 Traditional	Level 2 Multimodal	Level 1 Traditional	Level 1 Multimodal	Level 2 Traditional	Level 2 Multimodal
1	20.6	50.4	6.4	60.4	3.2	3.2	1.4	1.6
2	36	85.2	23	120	13	7.2	3.4	8
3	5.2	27.6	14.4	37.4	2.4	3.2	2.6	1.6
4	34.6	69.2	14.4	81.6	3.8	2.6	1	2.6
5	28.6	69	47	25.6	3.4	6.6	3.6	4.8
6	8.2	33	58.2	73	1.4	5.2	3.6	4.6
7	57		50		6		2	

6. Comparison



6. EVALUATION I

- .Usability Test was successful**
- .75%+ Users found MMI fun**
- .Gravity/Bounce parameters enriches application**
- .7 out of 8 users found modalities used in good combination**
- .Game play was well appreciated and funny**
- .Irrespective of average time taken to hit target user preferred to play using multimodal modalities**

6. Evaluation II

- (+) Fun with Multimodal
- (+) Easier with Traditional
- (+) Gravity with touch modalities is excellent
- (+) Modalities used in combination were found good
- (+) After 1-2 repetitions voice recognition works good

- (-) Wii was difficult sometimes to point
- (-) Voice recognition problematic with high pitch



7. VIDEO

- Finally some **action!**



Questions ?

