

Progress report

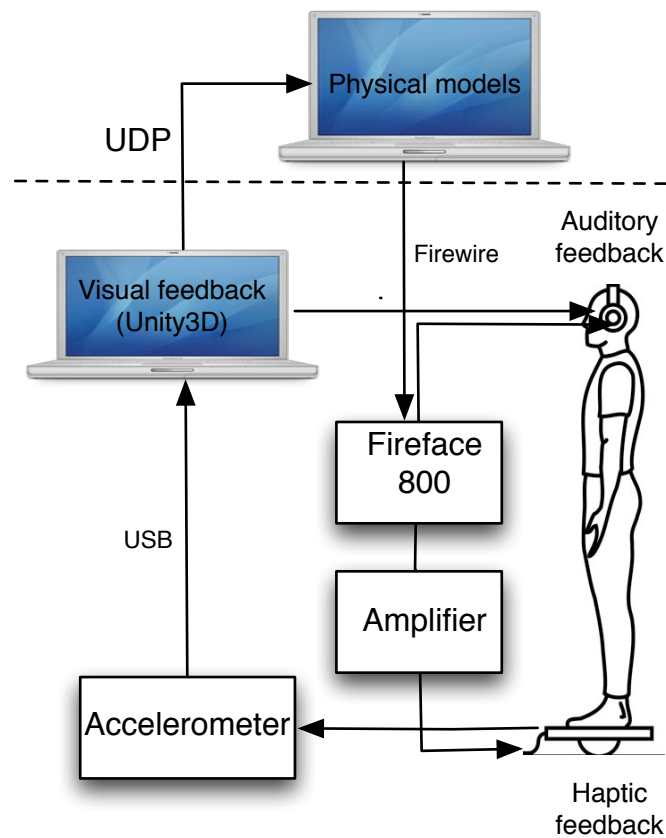
AALBORG UNIVERSITY COPENHAGEN

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Haptic wobble board

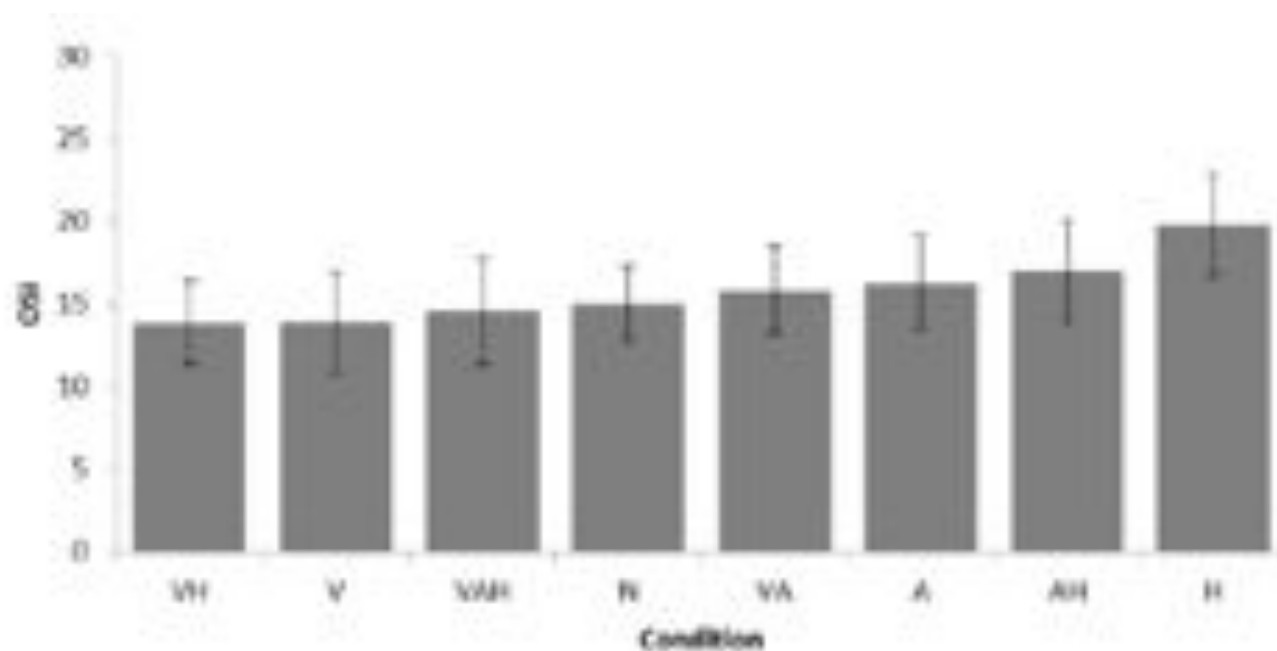


The architecture

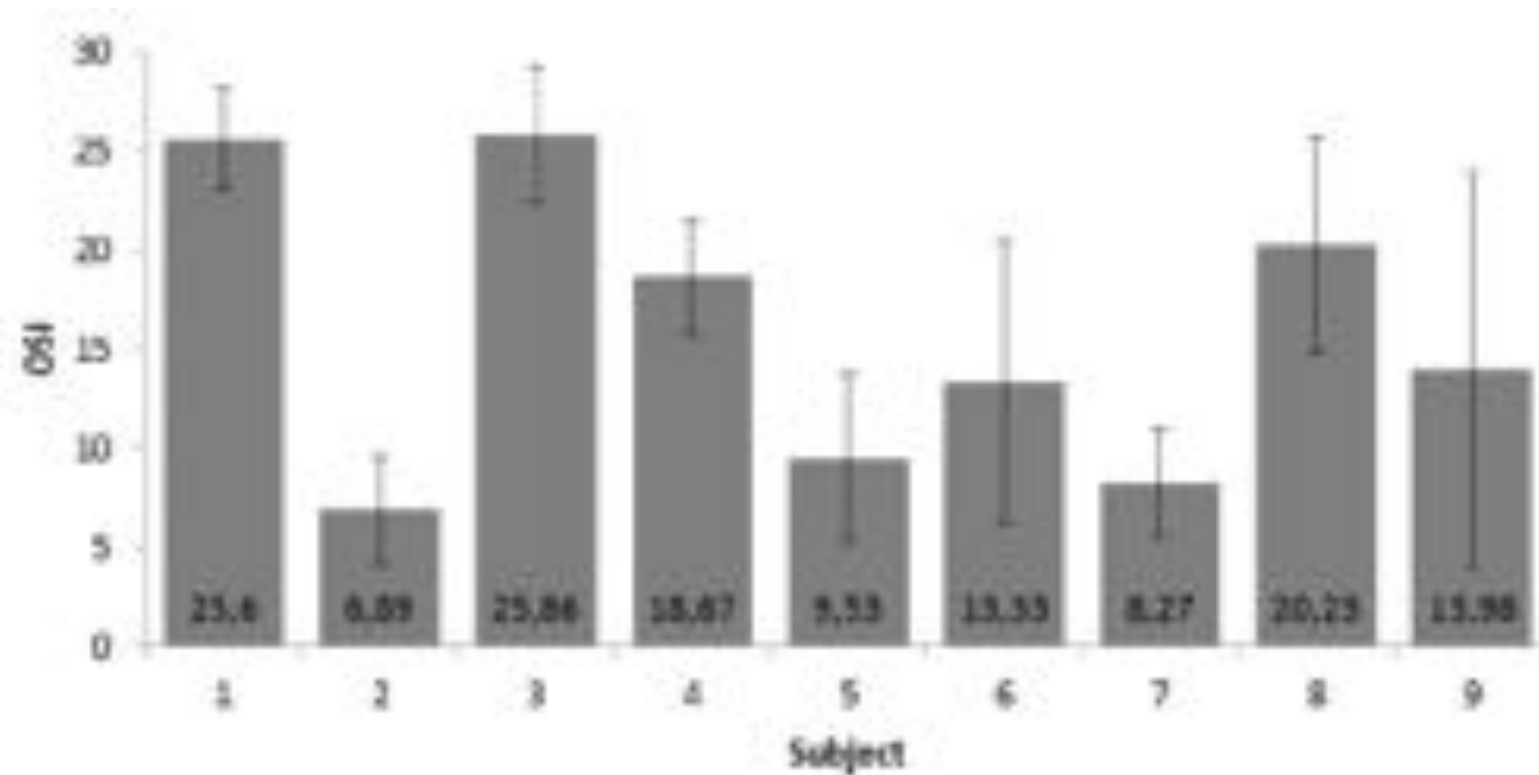


Results

$$OSI = \sqrt{\frac{\sum (0 - Y)^2 + \sum (0 - X)^2}{N}}$$



Results: subjects' stability index



Basic AH experiments

	Duration (in sec.)	Number of steps	Footsteps distance increment (in ms.)	Footsteps distance range (in ms.)	Heel-toe distance increment (in ms.)	Heel-toe distance range (in ms.)
flat_1	12	19	-	550 (fixed)	-	69 (fixed)
flat_2	16	19	-	750 (fixed)	-	69 (fixed)
bump_1_step	27	31 = 4+12+11+4	50	550 → 1150	-	69 (fixed)
bump_2_step	16	19 = 4+6+5+4	100	550 → 1150	-	69 (fixed)
hole_1_step	18	31 = 4+12+11+4	-50	750 → 150	-	69 (fixed)
hole_2_step	11	19 = 4+6+5+4	-100	750 → 150	-	69 (fixed)
bump_1_h_t	24	31 = 4+12+11+4	-	550 (fixed)	30	0 → 360 (+ 69)
bump_2_h_t	14	19 = 4+6+5+4	-	550 (fixed)	60	0 → 360 (+ 69)
hole_1_h_t	24	31 = 4+12+11+4	-	550 (fixed)	-20	240 → 0 (+ 69)
hole_2_h_t	13	19 = 4+6+5+4	-	550 (fixed)	-40	240 → 0 (+ 69)
bump_1_comb	32	31 = 4+12+11+4	50	550 → 1150	30	0 → 360 (+ 69)
bump_2_comb	19	19 = 4+6+5+4	100	550 → 1150	60	0 → 360 (+ 69)
hole_1_comb	22	31 = 4+12+11+4	-50	750 → 150	-20	240 → 0 (+ 69)
hole_2_comb	15	19 = 4+6+5+4	-100	750 → 150	-40	240 → 0 (+ 69)

Audio

	Bump	Hole	Flat	Mean certainty Total	Mean certainty Correct answers	Mean certainty Wrong answers	% Correct answers
flat_1	1		14	6	6.1429	4	93.33
flat_2		1	14	5.6667	6	1	93.33
bump_1_step	13	2		5.4286	5.5385	4.5	93.33
bump_2_step	14	1		5.4667	5.5714	4	93.33
hole_1_step	1	14		4.8	4.7857	5	93.33
hole_2_step	2	13		4.9333	5	4.5	86.66
bump_1_h_1	13	1	1	5.6	5.8469	4	86.66
bump_2_h_1	12	2	1	5.1333	5.4167	4	80
hole_1_h_1		15		4.2667	4.2667		100
hole_2_h_1	3	12		4.4	4.8182	3.25	80
bump_1_comb	14	1		5.4	5.5	4	93.33
bump_2_comb	14	1		5.1333	5.3571	2	93.33
hole_1_comb	1	14		5.1333	5.2143	4	93.33
hole_2_comb	1	14		4.9333	5	4	93.33

Audio condition for wood surface

Haptic

	Bump	Hole	Flat	Mean certainty Total	Mean certainty Correct answers	Mean certainty Wrong answers	% Correct answers	Mean Realism	Mean Quality
flat_1	2		13	5.2	5.3077	4.5	86.66	3.9231	4
flat_2	2		13	5.1333	5.3077	4	86.66	3.6154	4.1333
bump_1_step	13		2	4.8	4.7692	5	86.66	4.0769	4.0667
bump_2_step	15			5.2	5.2		100	3.9333	3.8
hole_1_step	2	11	2	4.6667	4.4	5.2	73.33	3.0909	3.6
hole_2_step	2	13		4.6667	4.6923	4.5	86.66	3.7692	3.9333
bump_1_h_t	7	5	3	3.6667	4.1429	3.25	46.66	3	3.4
bump_2_h_t	9	6		4.6667	4.7778	4	60	3.4444	3.6667
hole_1_h_t	1	8	6	3.8	4.375	3.1429	53.33	3.25	3.2
hole_2_h_t		12	3	3.8667	4.25	2.3333	80	3.75	3.2
bump_1_comb	11	4		4.2667	4.2727	4.25	73.33	3.1818	3.2
bump_2_comb	11	3	1	4.7333	5.1818	3.5	73.33	4.0909	3.7333
hole_1_comb	2	13		4.4	4.3846	4.5	86.66	3.5385	3.8
hole_2_comb	1	12	2	4.6667	5.3333	2	80	3.25	3.2

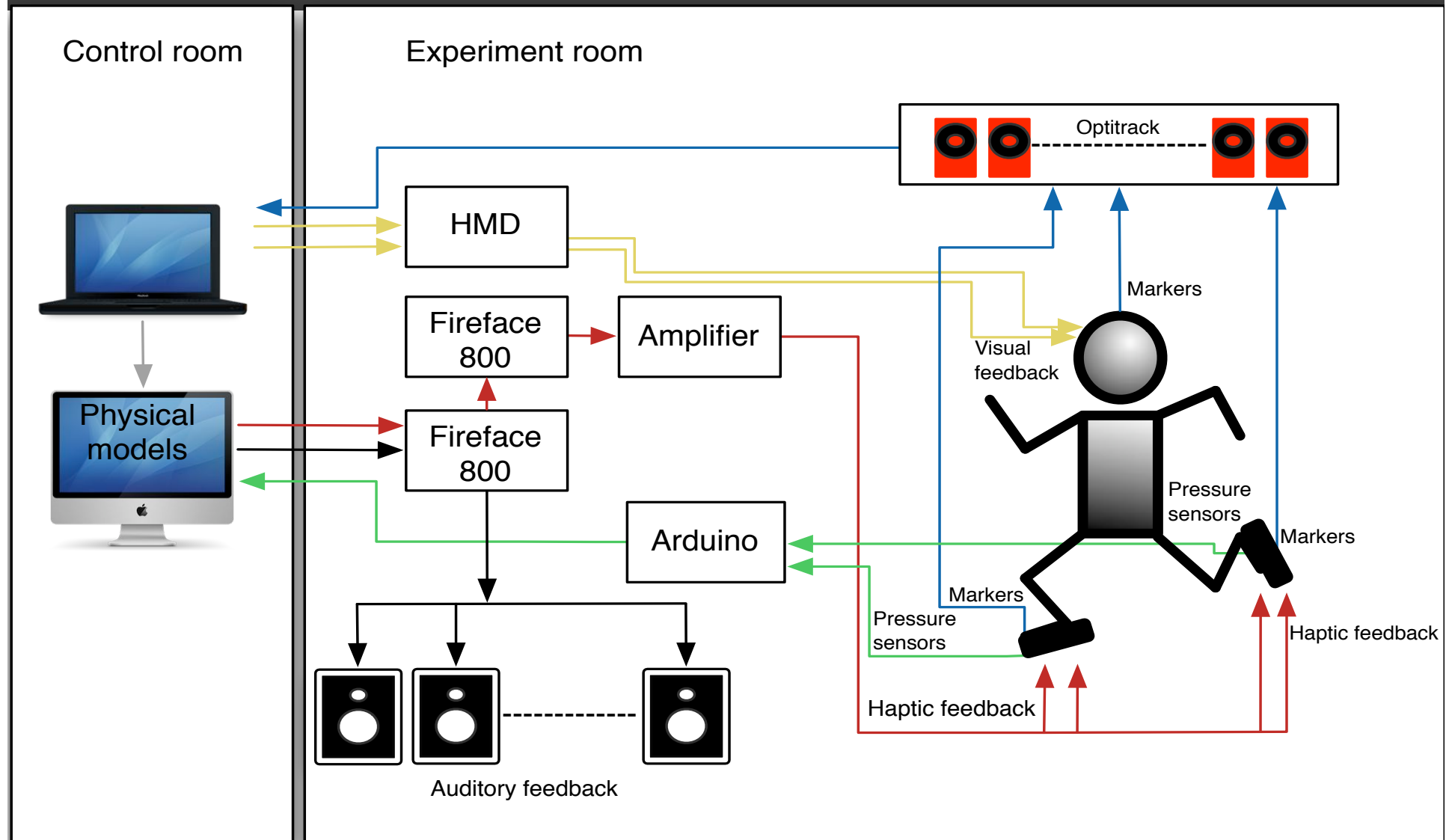
Haptic condition for wood surface

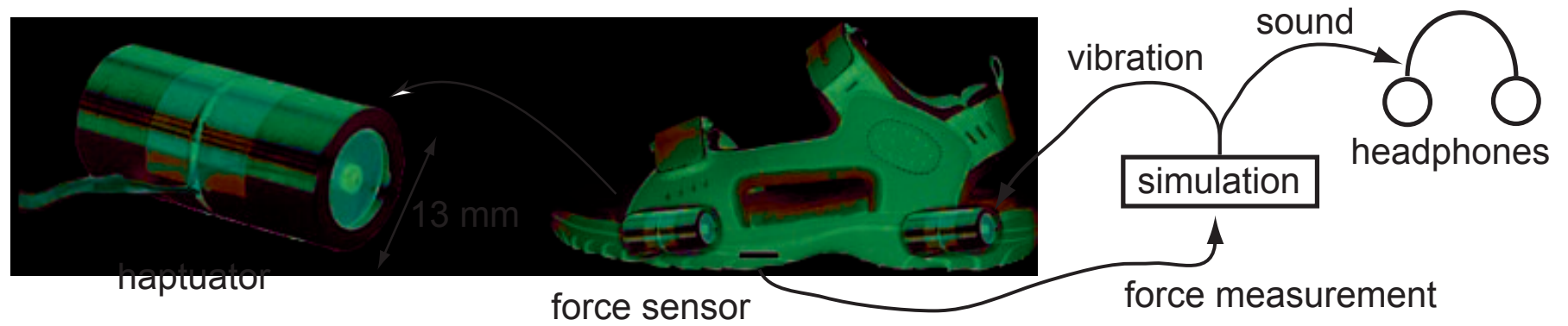
AH

	Bump	Hole	Flat	Mean certainty Total	Mean certainty Correct answers	Mean certainty Wrong answers	% Correct answers	Mean Realism	Mean Quality
flat_A			15	6	6	-	100	3.7333	3.6
flat_AH		1	14	6.0667	6.4286	1	93.33	4.9286	4.4667
bump_step_A	11	2	2	4.7333	5.1818	3.5	73.33	3.2727	3.6667
bump_step_AH	12	2	1	5.2667	5.5833	4	80	3.9167	4.6
hole_step_A	1	14		5.6667	5.7143	5	93.33	3.6429	4
hole_step_AH	2	12	1	5.1333	5.6667	3	80	4.75	4.4667
bump_h_t_A	13	2		4.9333	5.3846	2	86.66	3.6154	3.33
bump_h_t_AH	13	2		4.6667	5.2308	1	86.66	4.3846	4.0667
hole_h_t_A	2	6	7	3.7333	4.5	3.2222	40	2.8571	3
hole_h_t_AH	2	11	2	4.0667	4.1818	3.75	73.33	3.6364	4.4
bump_comb_A	12	3		4.2	4.8333	1.6667	80	3.25	3.6667
bump_comb_AH	14	1		5.0667	5.2857	2	93.33	4.2143	4.3333
hole_comb_A	1	12	2	4.9333	5.25	3.6667	80	3.5	3.8
hole_comb_AH	2	13		5.3333	5.5385	4	86.66	4.3846	4.6

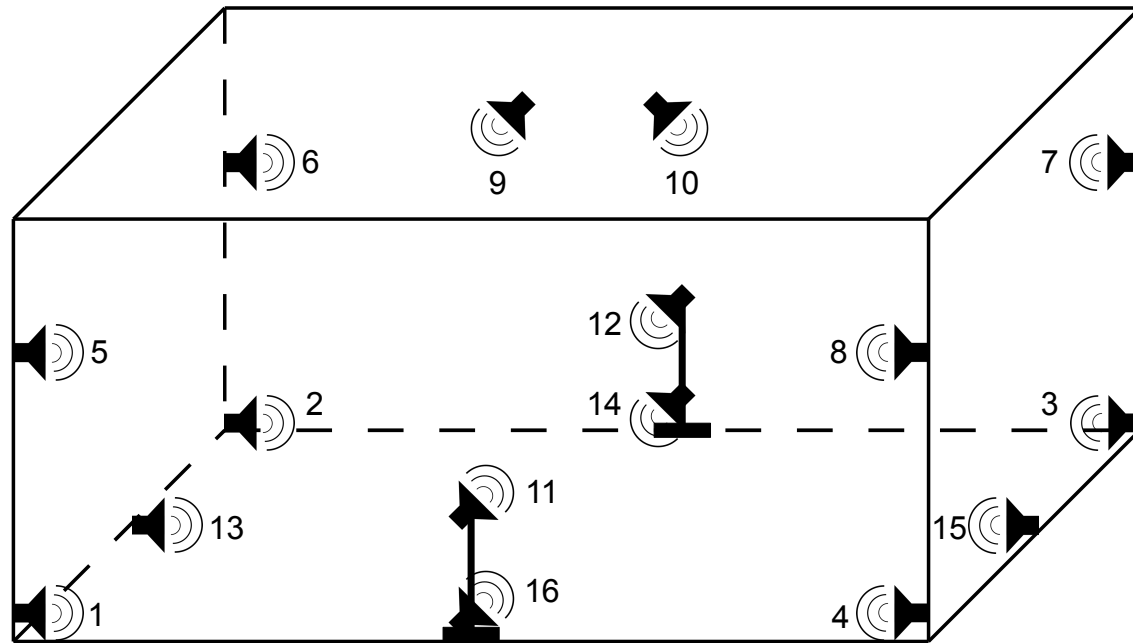
Audio-haptic condition for wood surface

Multimodal architecture

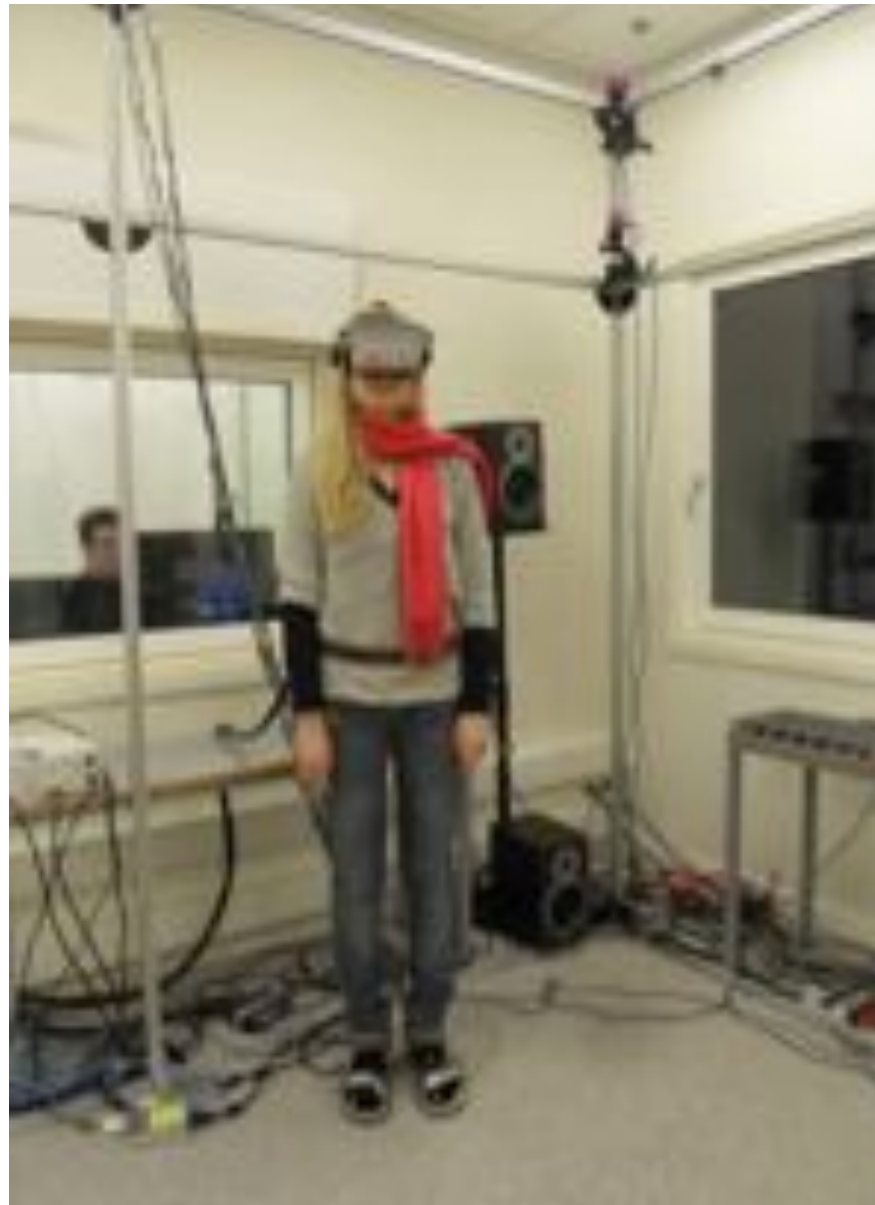




Haptic feedback

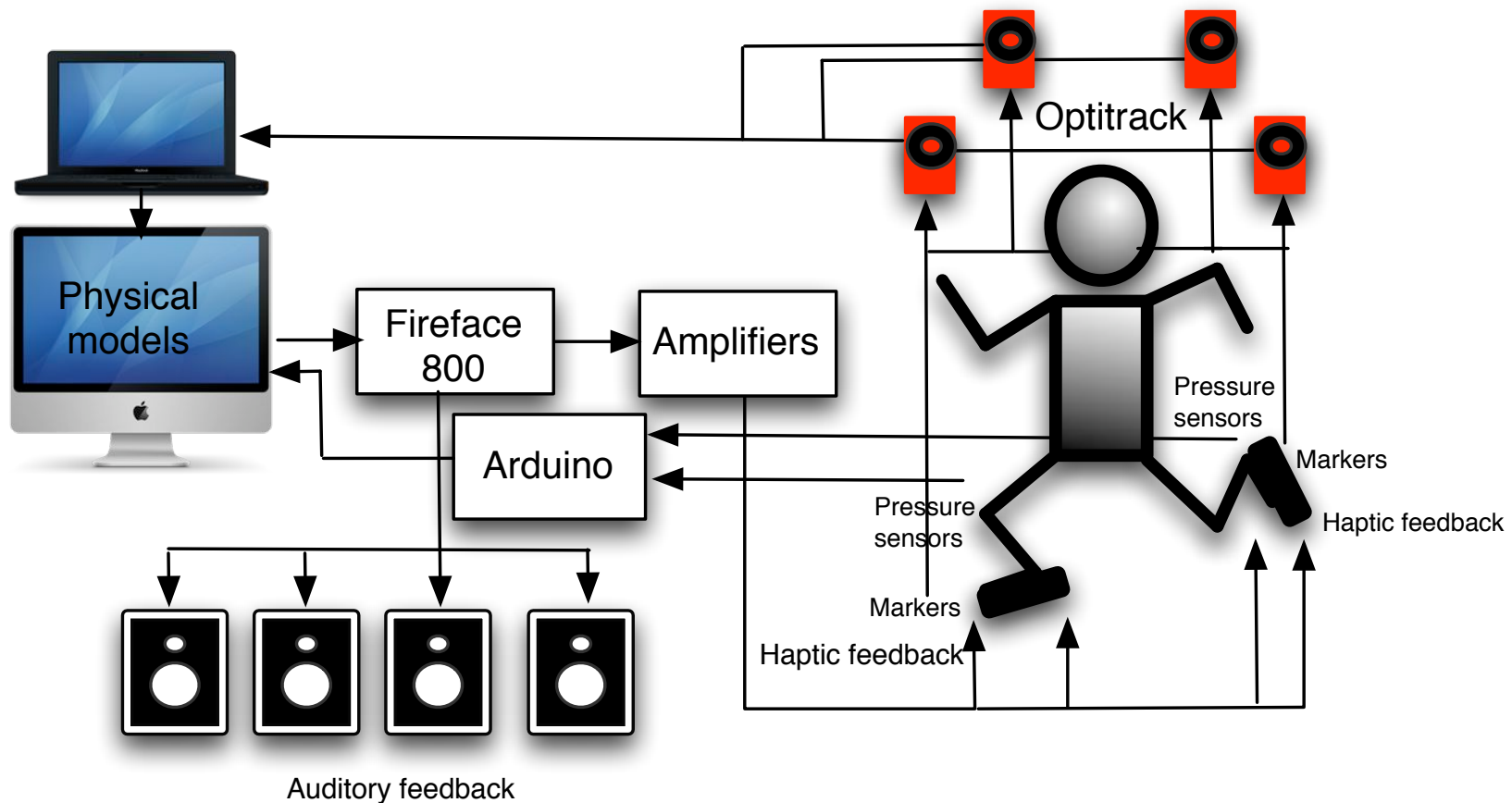


Auditory feedback



Visual feedback

Case 1: walking on a plank



Case 2: Grand Canyon



Objects



Future work

