

Unsupervised User Observation in the App Store: Experiences with the Sensor-based Evaluation of a Mobile Pedestrian Navigation Application



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Motivation

- Nowadays situated observation techniques are not very *scalable* and *obtrusive*
- Makes it hard to extend user studies to more than N people
- Results have limited generalizability



Idea

- There are many smartphones out there...
- All of them have several sensors...
- Many of them have access to some market...

- Why not bring the study to them?
 - Own mobile device
 - Real setting
 - Real use



Ingredients

- Development environment
- Market account/developer license
- Application
- Study component on the device
- Server component in the lab
- Analysis tools



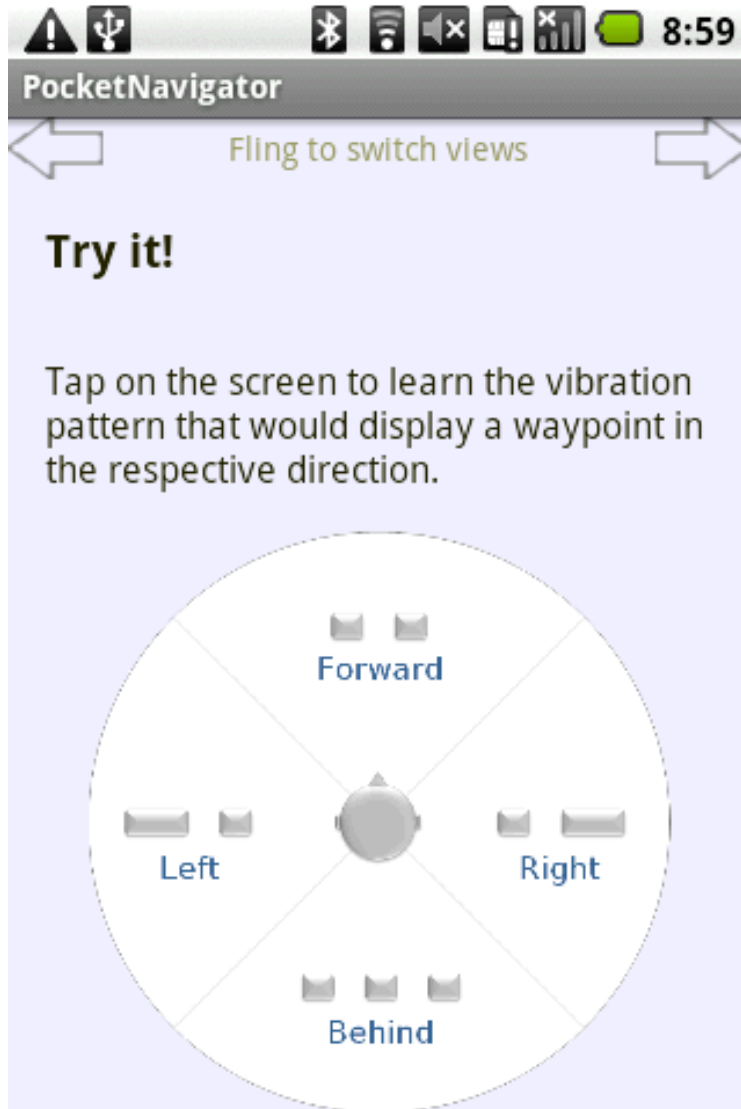
Application: PocketNavigator (I/M)



- Map
- User Location
- Routing
- Compass
- Geocoding
- ...



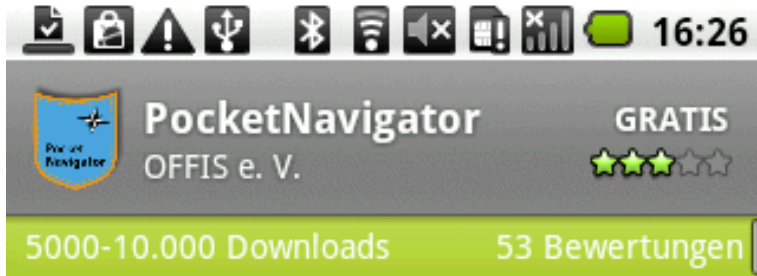
Application: PocketNavigator (IMI)



- Tactile Feedback
 - Research interest
 - Unobtrusively guides user to next waypoint



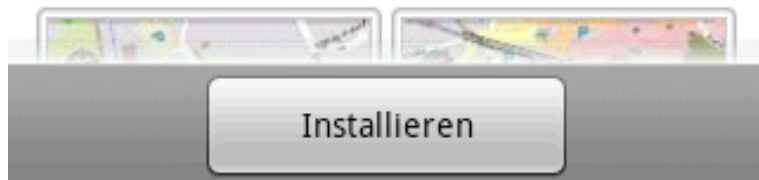
Challenge 1: Recruiting (MI)



The PocketNavigator is a very easy to understand OpenStreetMap-based navigation system for pedestrians. Coming straight out of the research lab, its killer-feature is that it guides you by vibration patterns.

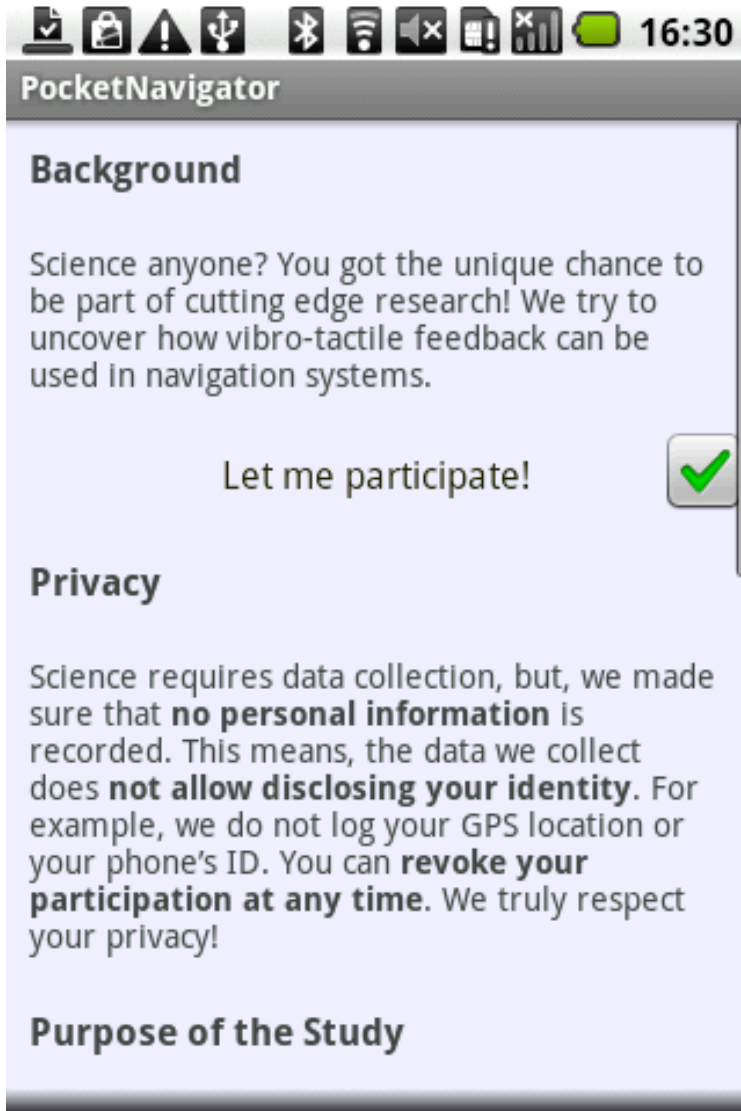
You'll never get lost again while you can leave the device in the pocket.

Version 2.6 0,90 MB



- *Attract* participants
 - Nice Icon
 - Description
 - Screenshots
- Provide advertised functionality
- Robust and reliable

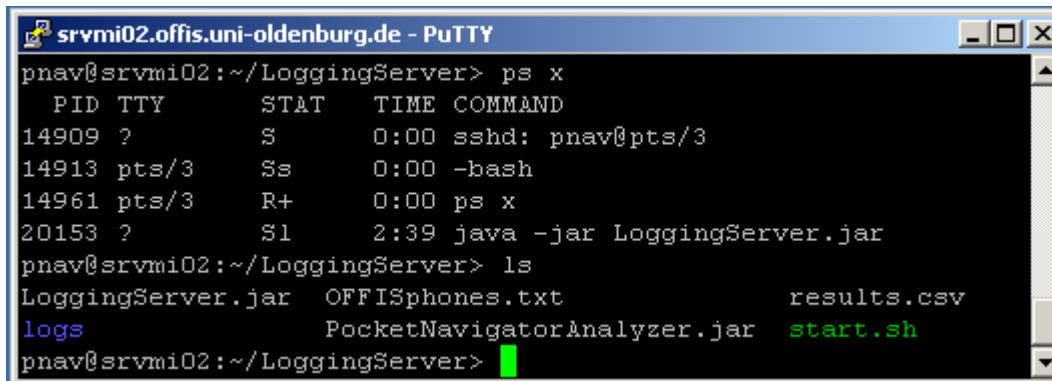
Challenge 1: Recruiting (II/II)



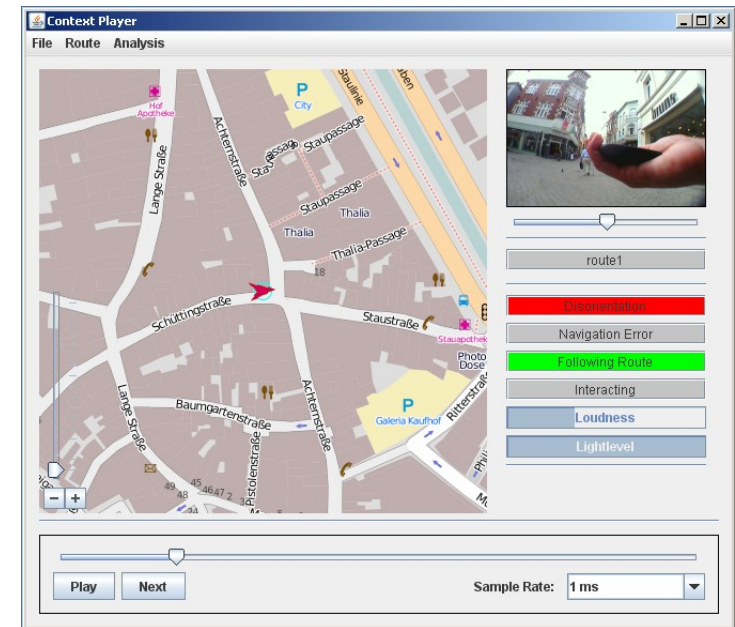
- Ethics
 - Make them aware that you log data
- Opt-In (ca. 10%)
- Opt-Out (ca. 80%)

Challenge 2: Data Analysis (MI)

- No existing infrastructure/tools, yet
 - Set up own server
 - Create own tools for analysis



```
srvmi02.offis.uni-oldenburg.de - PuTTY
pnav@srvmi02:~/LoggingServer> ps x
  PID TTY          STAT TIME  COMMAND
 14909 ?            S      0:00  sshd: pnav@pts/3
 14913 pts/3        Ss     0:00  -bash
 14961 pts/3        R+    0:00  ps x
20153 ?            Sl     2:39  java -jar LoggingServer.jar
pnav@srvmi02:~/LoggingServer> ls
LoggingServer.jar  OFFISphones.txt      results.csv
logs               PocketNavigatorAnalyz.jar  start.sh
pnav@srvmi02:~/LoggingServer>
```



Challenge 2: Data Analysis (II/1)

- Regularly check if you get results
- Iteratively update application

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	USER_ID	ROUTE_ID	APPYEF	DEVICEMODEL	TOTAL_S	ROUTE_AVAILABLE	USER_MOVING	MORE_THAN_ONE	FOLLOWING_ROUTE	TACTILE_FEEDBACK	SCANNING_T	SCANNING_NT	IN_HAND	IN_HAND_W	
11	4a1bd11a24	0	7	null	88	1	0,36363637	1	0,92045456			0,056818184		0,488636	
12	4c18c9210c	0	6	null	433	1	0,86374134	1	0,5588915			0,046189375		0,943192	
13	736eb7203	0	7	null	424	1	0,2971698	1	0,9316038	0,4716981	0,28537735	0,33726415	0,471698	0,525943	
14	8ab9121b7e	0	7	null	90	1	0,98888886		0,9						
15	909642bbd	1	6	null	19	1	0,42105263	0,7368421	1			0,94736844		1	
16	913ed7129c	4	6	null	55	1	1		0,96363634					0,145455	
17	972346db0	1	7	null	209	1	0,009569378	1	0,98564595					0,023923	
18	972346db0	2	7	null	38	1	0,84210527	1	1					0,026316	
19	972346db0	5	7	null	12	1	1		1					1	
20	98cfa6e02	5	6	null	27	1	0,11111111		0,962963			0,6296296		0,740741	
21	9b0be9fe0	0	7	null	15	1	1	0,33333334	1		1	0,6		1	
22	9b0be9fe0	5	7	null	263	1	0,98859316	1	0,9961977	0,09505703	0,03422053	0,44106463	0,095057	0,904943	
23	9b5ca4946	0	6	null	90	1	0,36666667	1	0,93333334			0,16666667		0,5	
24	9da7d65b8	0	7	null	1504	1	0,29055852	1	0,90890956			0,38636808		0,988697	
25	a3f428a56	1	7	null	168	1	1	0,22619048	0,22619048						
26	aa6c8c912	0	7	null	73	1	0,39726028	0,56164384	1			0,04109589		1	
27	b1d3e2f8be	0	7	null	15	1	0,13333334	1	1			0,26666668		1	
28	b682fda55	0	7	null	4638	1	0,9991376	1	0,92927986	0,006683915		0,002156102	0,005821	0,750108	
29	b8617ca54	2	6	null	721	1	0,5339806	1	0,9611651	0,8085992	0,21914008	0,10818308	0,808599	0,151179	
30	b8617ca54	3	7	null	55	1	0,4909091	1	0,9818182			0,79090909		0,727273	
31	c7304cbef	0	7	null	75	1	0,34666666	1	1			0,6933333		1	
32		1	6	null	342	1	0,10818713	1	0,99707603			0,081871346		0,125731	
33		3	6	null	199	1	0,1758794	1	0,9798995			0,07537688		0,301508	
34		4	7	null	2	1	1	1	1					1	
35		5	7	null	982	1	0,9083503	1	0,8645621			0,014256619		0,356415	
36		6	7	null	2059	1	0,67265666	1	0,97765905			0,053423993		0,177271	
37	cb66a1896	0	7	null	3	1	1	1	1					1	
38	d078ba252	0	7	null	813	1	0,26691267	1	0,99877			0,9335793		1	
39	d4ee5d347	0	7	null	26	1	0,96153843	1	1					1	
40		1	7	null	13	1	1	1	1			0,23076923		1	
41		2	7	null	88	1	0,2159091	1	0,84090906			0,10227273		1	
42		3	7	null	10	1	1	1	1			0,3		1	
43		4	7	null	2316	1	0,9499136	1	0,9879102			0,98877376		1	
44		1	7	null	79	1	0,4556962	1	0,84810126			0,30379745		1	
45		4	7	null	289	1	0,9653979	1	1			0,5363322		0,851211	
46		5	7	null	195	1	0,61538464	1	0,9948718			0,41025642		0,876923	
47		6	7	null	494	1	0,84412956	1	0,937247	0,94129556	0,402834	0,02834008	0,939271	0,058704	
48	e826632f7	0	6	null	73	1	0,12328767	0,98630136	0,98630136	0,8082192					
49	Mean	1,8085106	6,76596		390,7872	1	0,624893159	0,939801752	0,938999348	0,588800334	0,302851373	0,294840773	0,521189	0,706783	
50	Median	1	7		90	1	0,61764705	1	0,983732075	0,7787611	0,279856815	0,17625369	0,465938	0,896916	
51															
52		19	Teilnehmer												
53		47	Routen												
54		2,4736842	RoutenTeilnehmer												

Challenge 3: Internal Validity (I/M)

- *How confident can the observed effects be attributed to the experimental manipulation*
- Two factors that threaten internal validity in market experiments
 - Experiment vs. Quasi-Experiment
 - Unpredictable Usage

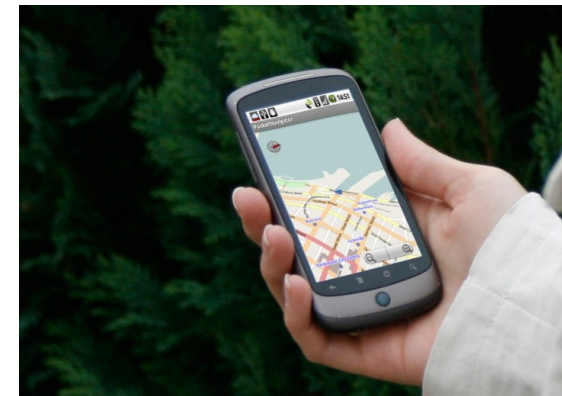
Challenge 3: Internal Validity (II/II)

- Experiment vs. Quasi-Experiment
 - User can select condition on their own
 - Otherwise the App would be hard to advertise
- Unpredictable Usage
 - Needs to be identified and removed



Conclusion

- Market studies are interesting & have potential
- Might overcome the scalability & obtrusiveness issues
- Many open questions and only a few practical experiences so far



Thank you! Questions?