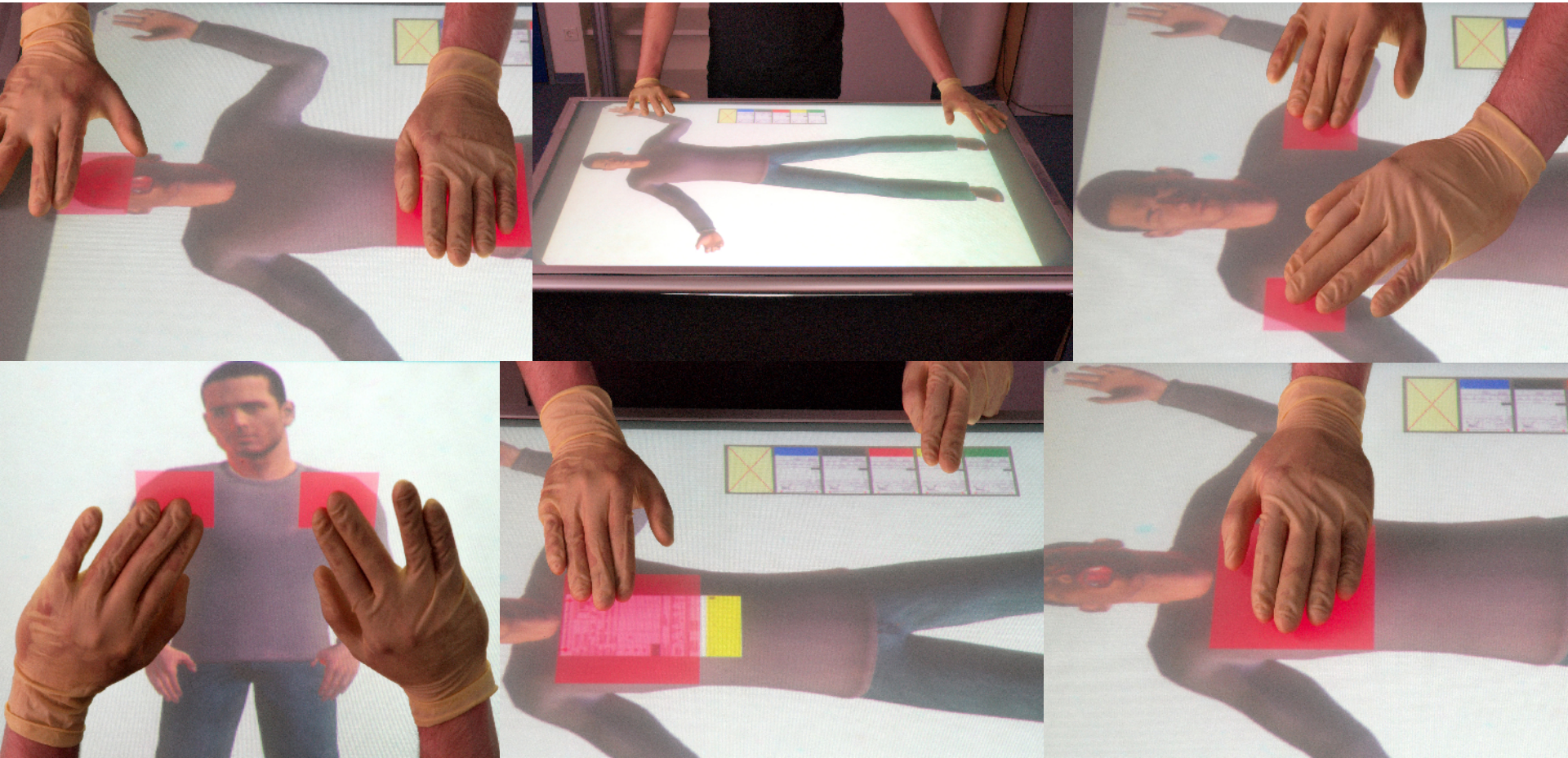


Development and Evaluation of a Virtual Reality Patient Simulation (VRPS)

Simon Nestler, Manuel Huber, Florian Echtler, Andreas Dollinger, Gudrun Klinker



Introduction

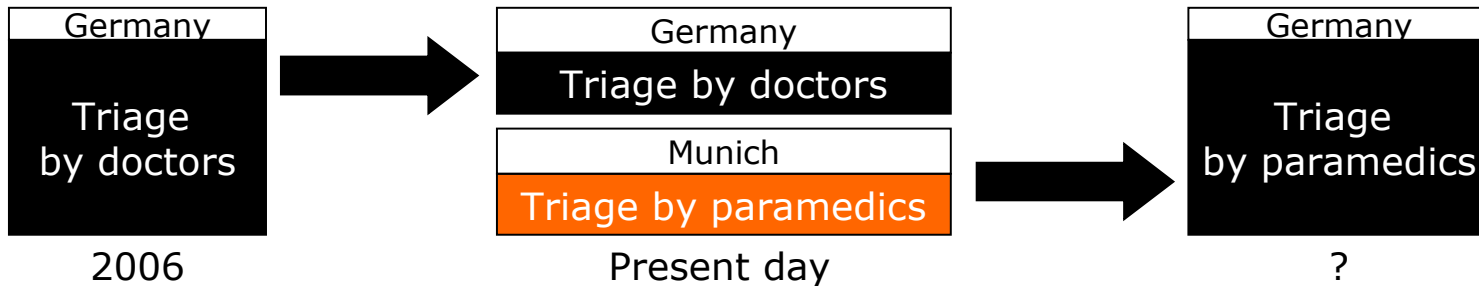
During disasters, paramedics cope with numerous tasks

- **Establishing organizational structures**
- **Triaging all involved patients (45s per patient)**
- **Medicating the patients according to their injuries**

NATO Triage Standard

Triage category	Treatment
T1	Immediate Treatment
T2	Delayed Treatment
T3	Minimal Treatment
T4	Expectant Treatment

Introduction



Triage based on the mSTaRT-algorithm:

- Check whether the patient is able to walk
- Test the patient for deadly injuries
- Check and count out breathing rate
- Apply compression bandages on serious bleedings
- Feel the patient's peripheral pulse
- Check if the patient is awake and responsive

K. Kanz, P. Hornburger, M. Kay, W. Mutschler and W. Schäuble: **mSTaRT-Algorithmus für Sichtung, Behandlung und Transport bei einem Massenanfall von Verletzten**, Notfall Rettungsmed. (2006) 264-270

Motivation

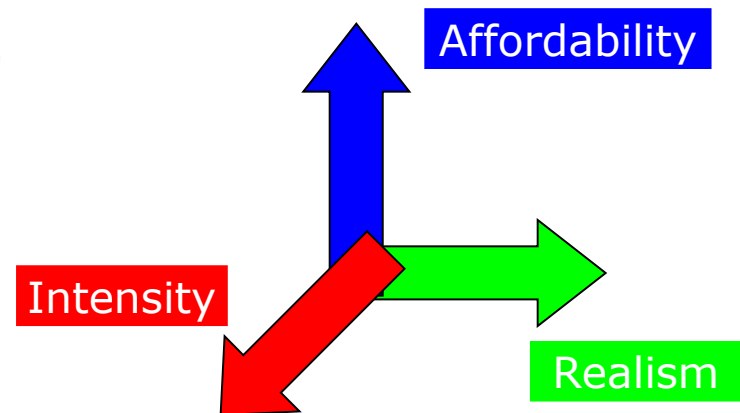
Recent introduction of new triage procedures requires intensive and continuous training

Large scale disaster control exercises are expensive and laborious

Smaller trainings offer only limited training possibilities

Triage trainings have to be optimized regarding..

- **Affordability (number of exercise actors)**
- **Intensity (number of triage processes)**
- **Realism (actor make-up, environment)**



Motivation

Advantages of computer-based triage trainings:

- Low lead time
- Scalable
- No actors required
- No organisational overhead

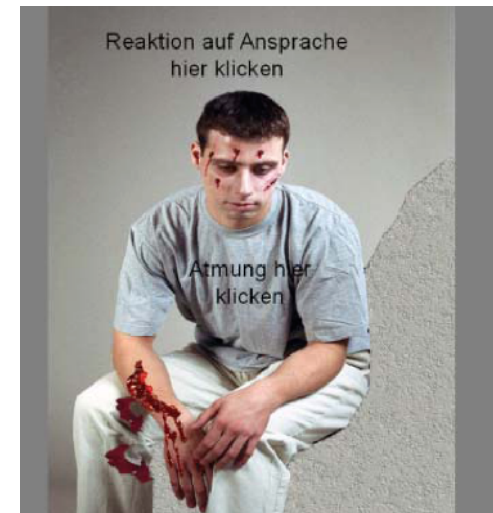
Advantages of multi-touch table top interfaces:

- Intuitive interaction
- Two-handed interaction
- Collaborative interaction

Designing virtual patients

**Gutsch et al. presented a desktop computer-based triage simulation
For continuous training of paramedics their approach is insufficient:**

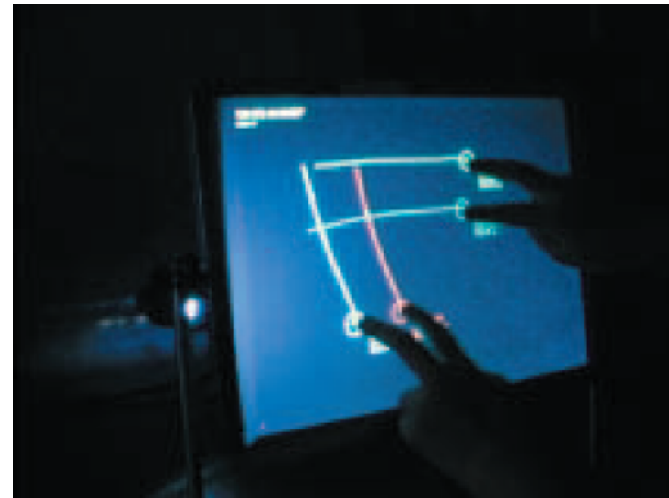
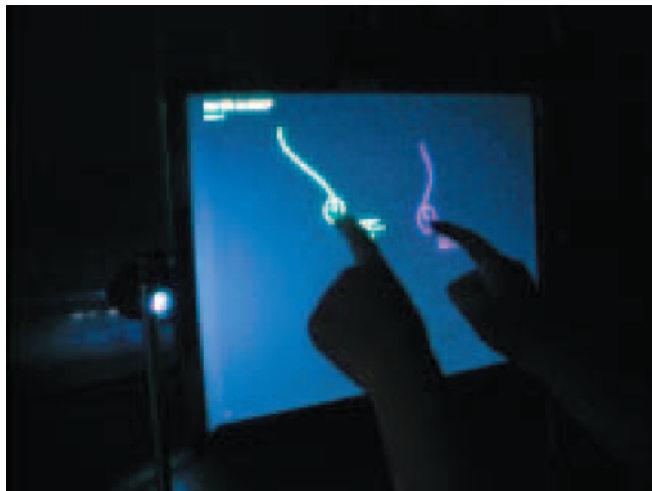
- **No collaboration**
- **No interaction metaphors**
- **“Multiple-choice” training**
- **No two-hand interactions**
- **No possibility to make mistakes**



W. Gutsch, T. Huppertz, C. Zollner, P. Hornburger, M. Kay, U. Kreimeier, W. Schäuble and K. Kanz: **Initiale Sichtung durch Rettungsassistenten**. Notfall Rettungsm., 9(4):384-388, 2006.

Technical background

Multi-touch technologies have first been presented by Lee et al. Our multi-touch table top is based on the technology of Jeff Han



Multi-touch sensing through frustrated total internal reflection

S. Lee, W. Buxton and K. Smith: **A multi-touch three dimensional touchsensitive tablet**. In CHI '85: Proceedings of the ACM Human Factors in Computing Systems Conference, San Francisco, California, USA, 1985.

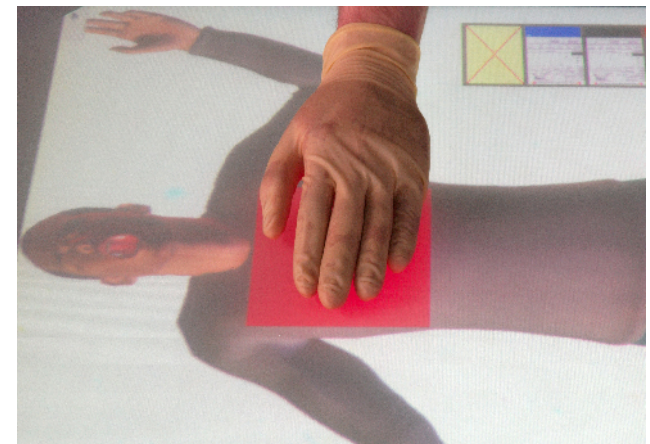
J. Han. **Low-cost multi-touch sensing through frustrated total internal reflection**. In UIST '05: Proceedings of the 18th annual ACM symposium on User interface software and technology, pages 115-118, New York, NY, USA, 2005.

Implementation

- Removing foreign bodies
- Performing the head tilt-chin lift manoeuvre and looking for foreign bodies
- Checking the patients' breathing

Paramedics are familiar with the basic procedures

Red boxes are not visible during triage training



Implementation

Changing patient position

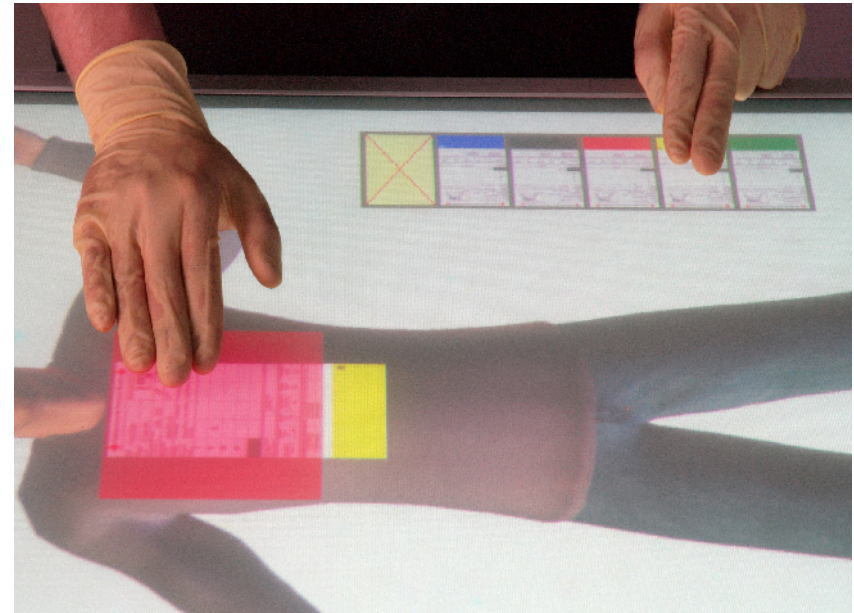
- Propping up the patient
- Putting down the patient



Implementation

Allocation of coloured patient tags

- Select patient tag (hand 1)
- Apply it to the patient (hand 2)

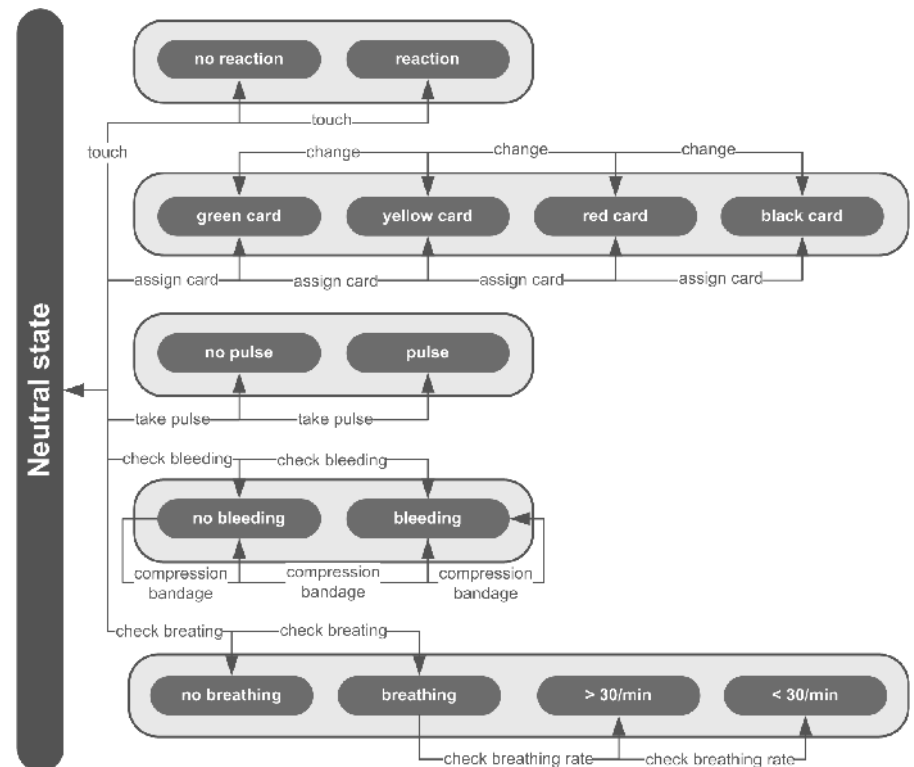


Patient model

General behaviour of patients can be described by state machines

General interactions

- Touch
- Check breathing
- Take pulse
- Check bleeding
- Assign card



Patient patterns

**Concrete patient information is contained in specific patient patterns
(= additional state transitions)**

**More than 300 different patient patterns have been designed by the fire
department Munich**

**Patient model and patient patterns have to be combined, resulting in a
single large state machine**

Evaluation

**Comparison to real-life triage trainings:
time per triage process**

**Average time for one triage process is
about half as long as in real disaster
control exercises (22s vs. 41s)**

Value	Reference [Gut06]	Table top
n	132	160
AVG	41s	22s
Minimum	10s	3s
25%-Quantile	25s	12s
50%-Quantile	35s	20s
75%-Quantile	49s	28s
Maximum	121s	71s

Evaluation

Quality of triage processes

Comparison of results to real-life triage trainings

reference [Gut06]	red _{patient}	\neg red _{patient}	sum
red _{triage}	30	6	36
\neg red _{triage}	4	92	96
sum	34	98	132

table top	red _{patient}	\neg red _{patient}	sum
red _{triage}	41	9	50
\neg red _{triage}	7	103	110
sum	48	112	160

In the real-life disaster control exercise about 85 percent of all patients were triaged correctly, in the table top training 89 percent of all patients were triaged correctly => no significant difference.

Conclusion and future work

VRPS does not prevent inaccurate triage decisions

Retaining the possibility to make errors is important

Table top device is adequate to be used in disaster control exercises

More frequent trainings of the paramedics can improve preparedness for real disasters

Training effects will be the topic of our future work

Three groups of paramedics: the first group trains on the table top, the second one performs no training and the third one trains with real mimes

Acknowledgements:

Mr. Tretschok

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