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

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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

<table>
<thead>
<tr>
<th>Triage category</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>Immediate Treatment</td>
</tr>
<tr>
<td>T2</td>
<td>Delayed Treatment</td>
</tr>
<tr>
<td>T3</td>
<td>Minimal Treatment</td>
</tr>
<tr>
<td>T4</td>
<td>Expectant Treatment</td>
</tr>
</tbody>
</table>
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

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

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.


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)

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<td>22s</td>
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<td>3s</td>
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<td>12s</td>
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<td>50%-Quantile</td>
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<td>Maximum</td>
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Evaluation

Quality of triage processes
Comparision of results to real-life triage trainings

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</table>

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

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