



# SIGGRAPH 2003

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# Authoring of a Mixed Reality Furniture Assembly Instructor

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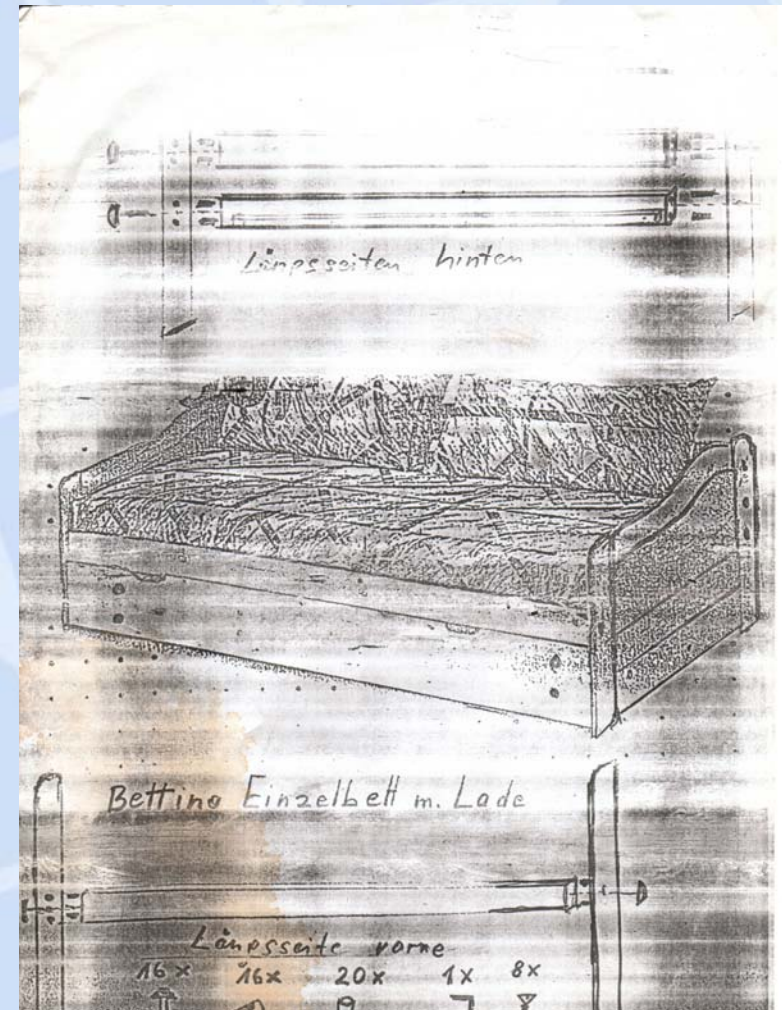
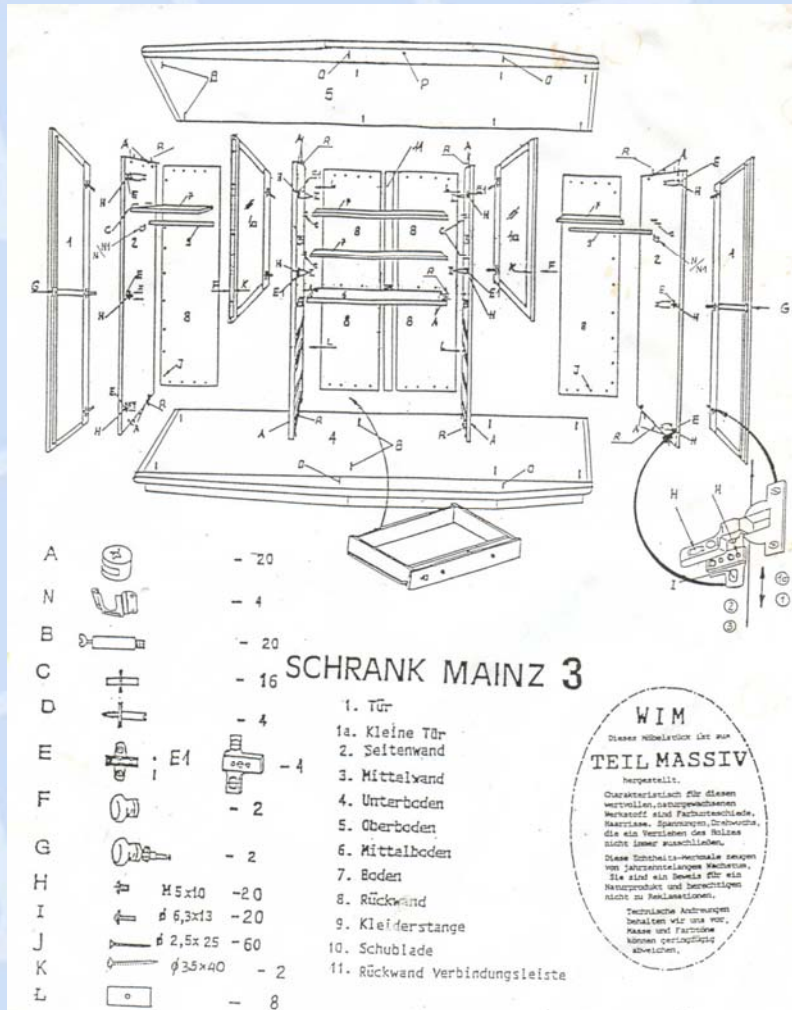


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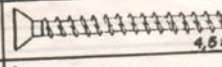
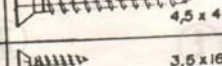
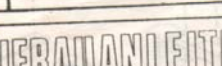
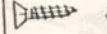
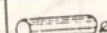








# Motivation

- Problem with conventional assembly instructions:
  - difficult to handle,
  - information overload, and
  - missing context.
- Reason:
  - need for interpretation, and
  - attention-switching.

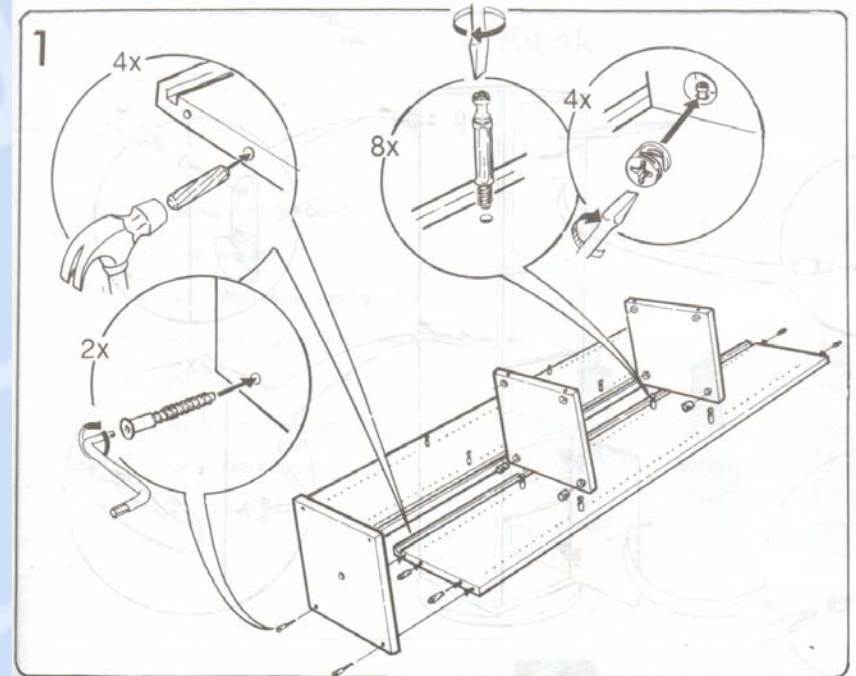
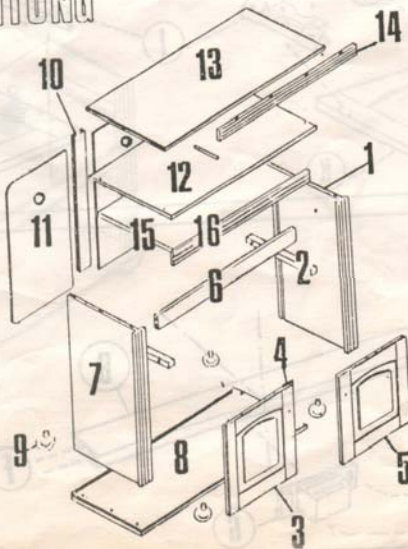
# Motivation II



# Motivation III

NR	ZUBEHÖR	ST
A	 1/4 x 5/16"	01
B	 4,5 x 50	12
C	 4,5 x 40	06
D	 3,5 x 16	10
E	 30 x 13	20
F	 28 x 30 mm	26
G		01
H		01
I		04
J		01
K		02
L		01
M		02
N	 30 x 16	08

## AUFBAUANLEITUNG

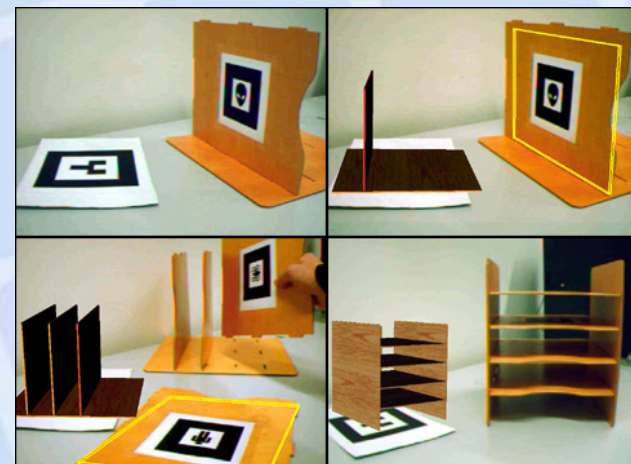
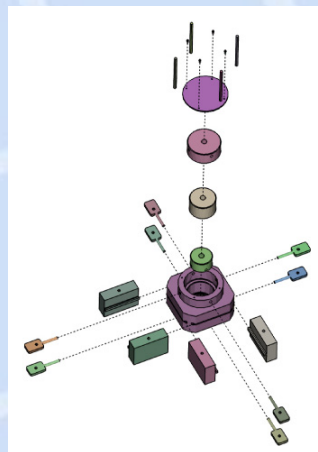




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# Related Work

- Stavros Antifakos et. al.: Proactive Instructions for Furniture Assembly (in UbiComp 2002)
- Maneesh Agrawala et. al.: Designing Effective Step-By-Step Assembly Instructions (in Siggraph 2003)
- Thomas Pintaric (AEKI, Studierstube)





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# Approach

- Solution:
  - context depending assembly instructions,
  - user interaction, and
  - clear assembly sequence.
- Approach:
  - Augmenting real furniture with assembly information (Mixed Reality technology),
  - Marker based interaction.



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# Problem classification

- Furniture Assembly Instructor (Fai<sup>MR</sup>)
  - Expert:
    - Creating assembly instructions
    - Authoring mode
  - End user:
    - Assembling a structure
    - Application mode
- Mixed reality approach for both modes.

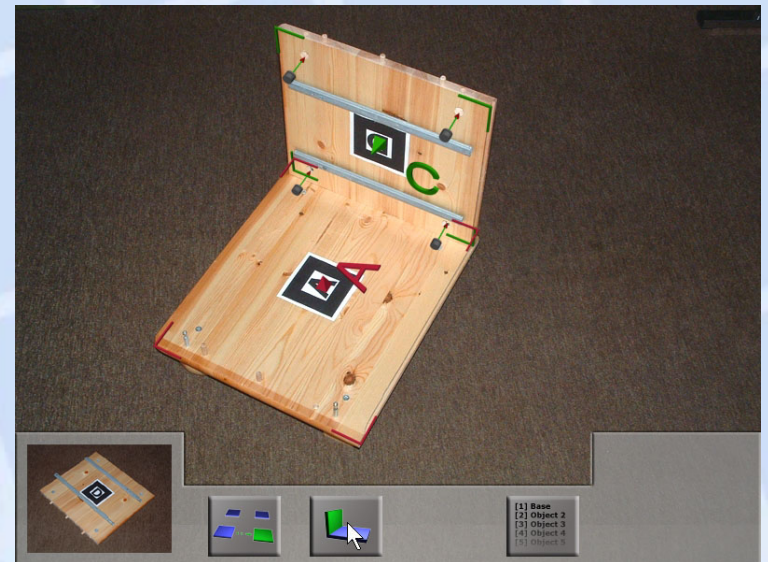




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# Authoring Mode

- Placement of parts by markers.
  - relative offset-matrix,
  - using multiple markers to avoid marker occlusion.
- Undetectable small pieces:
  - temporary marker
- Export:
  - XML based assembly instructions





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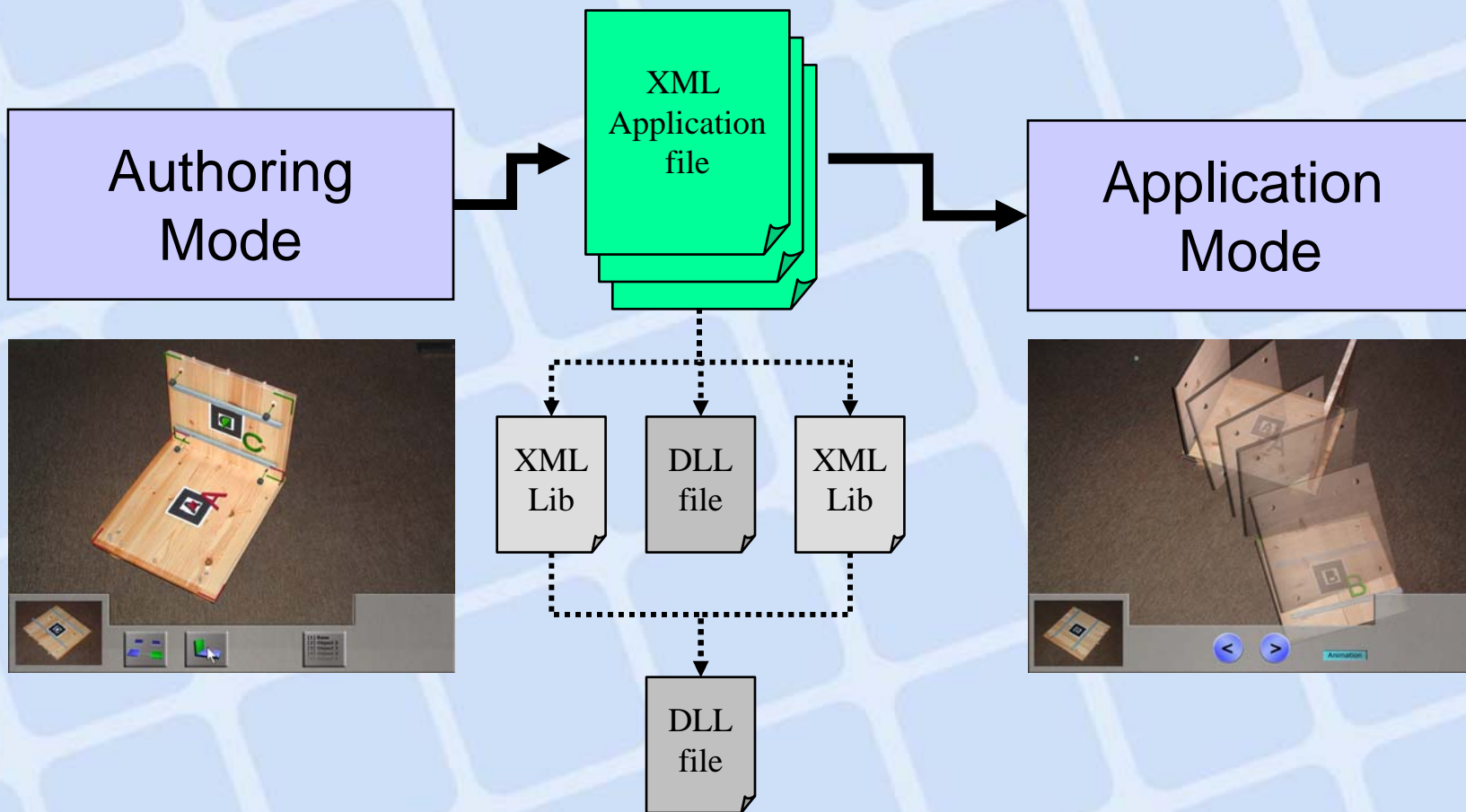


# Authoring video



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# Dataflow

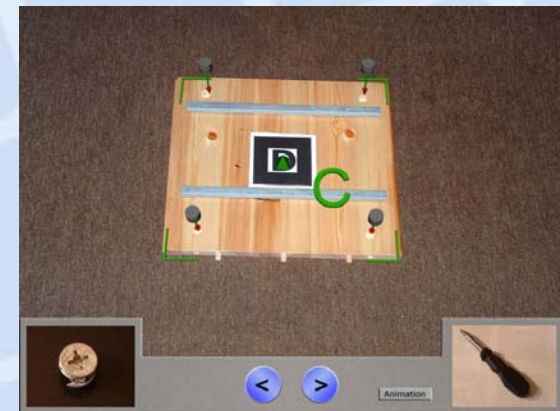
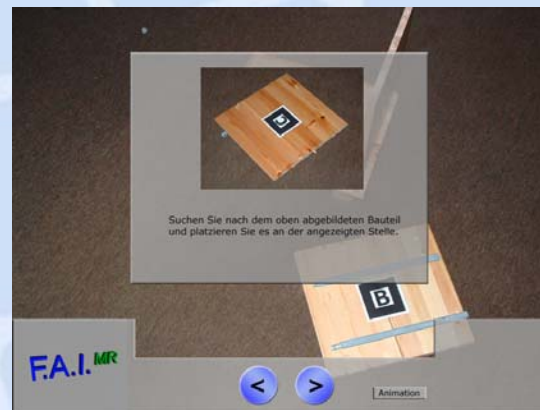




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# Application Mode

- Step-by-step assembly
  - Avoiding confusing multiple paths
  - Easy to handle data structure
- Indication of part placement by:
  - quaternion based animation (slerp-interpolation)

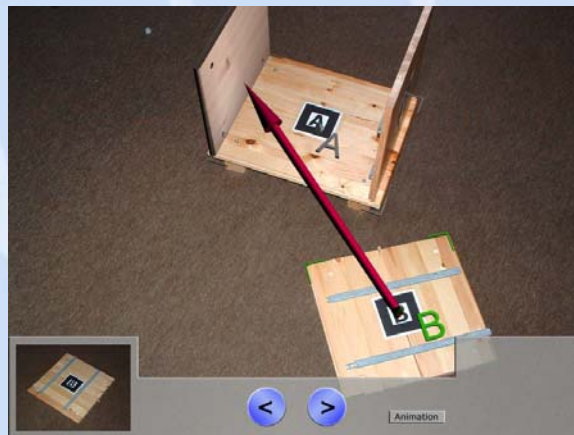




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# Application Mode II

- Step-by-step assembly
  - Avoiding confusing multiple paths
  - Easy to handle data structure
- Indication of part placement by:
  - quaternion based animation (slerp-interpolation)



# Application video



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# Used Technology

- Marker detection: ARToolkit
- Framework: AMIRE (Authoring of Mixed Reality)
  - Component based approach:
    - 3D-Models, GUI
    - Marker based “object” detection
  - OpenGL, OpenSceneGraph



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# AMIRE framework

- EU funded project (IST-34024)
- Authoring tool for Mixed Reality applications
- Component based approach
- Authoring oriented design
- Plug-in-mechanism, e.g.
  - Marker detection
  - Image loading, geometry loading
  - ...



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# Conclusion

- Intuitive proactive way
- Information is provided for the actual context
- The user's attention is focused on the assembly
- Authoring can be done by assembly experts instead of programmers
- Undetectable parts (small pieces) are problematic



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# Future work

- Hierarchical structures
- Speech recognition (cf. command & control)
- Integration of other tracking technologies.
- Multiple markers for single parts
- Authoring of the marker-part-relation
- Applying the assembly instructor to other application fields

# Questions



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