VISION+: Human-AI Collaboration for Creative Design

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Introduction

- Create and improve a product around Design-by-Analogy (DbA)
  - Retrieval: retrieve prior knowledge/experience relevant to a design problem
  - Mapping: map elements of the design problem aligned with the retrieved knowledge
  - Evaluation: evaluate application of the retrieved knowledge to solving a design problem
- Improving VISION to become VISION+
  - VISION uses an LLM to map out how all patents are related to each other and display it in an interactive graph
  - VISION+ will implement an AI chatbot that evaluates how your problem is related to the solutions of other problems.
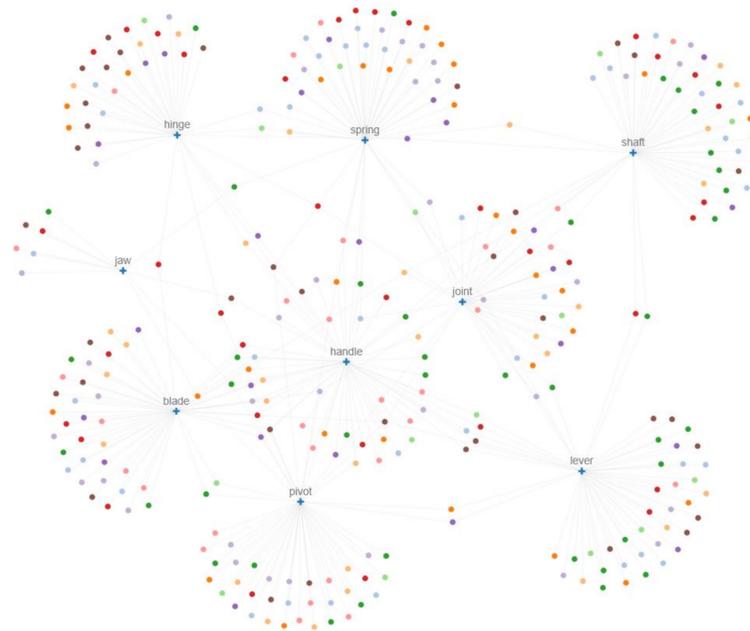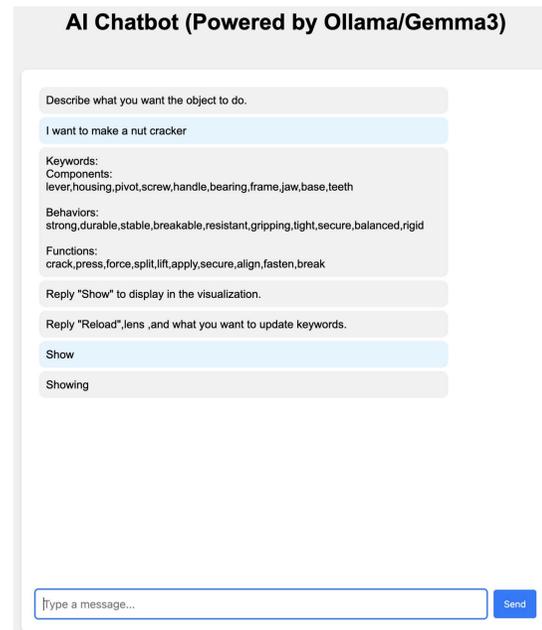

AI Chatbot (Powered by Ollama/Gemma3)

Describe what you want the object to do.

I want to make a nut cracker

Keywords:
Components:
lever,housing,pivot,screw,handle,bearing,frame,jaw,base,teeth

Behaviors:
strong,durable,stable,breakable,resistant,gripping,tight,secure,balanced,rigid

Functions:
crack,press,force,split,lift,apply,secure,align,fasten,break

Reply "Show" to display in the visualization.

Reply "Reload",lens ,and what you want to update keywords.

Show

Showing

Type a message... Send

Figure 1:Testing the VISION+ with the prompt of making a nutcracker.

Conclusion

- VISION+ does the three phases of Design-by-Analogy.
  - Retrieval: Has a database of patents
  - Mapping: Created keywords for all patents
  - Evaluation: Obtained keywords related to problem and compared with keywords in the database from the patents
- Vision+ improves on the old design of Vision
  - Adding a LLM to change how the the evaluation part of DbA was done
- Vision+ has problems with the implementation
  - Resulting in less then optimally keywords
  - Not feeling intuitive and friendly to use
  - Slow at getting keywords

Method

- VISION+ will be an AI chatbot combined with VISION
  - Chatbot will be using a the Gemma3 as the LLM
    - Gemma3 was used to extract keywords from the prompt given
    - Flask was used for the backend of chatbot to communicate with User Interface and Interactive Data Visualization
  - D3.js was used to create and control the Interactive Data Visualization

Results

- AI Chatbot works to get prompts and reply
  - Prompts are used to give instruction to users
  - Gives back keywords related to the given prompt
    - 3 lists of keywords are given for the 3 different lenses
  - Gives keywords to the Interactive Data Visualization to filter
  - Able to update keywords with more details of the problem
- User Interface works with Interactive Data Visualization and AI Chatbot
  - User Interface would show all the keywords given to patents that are related to your problem
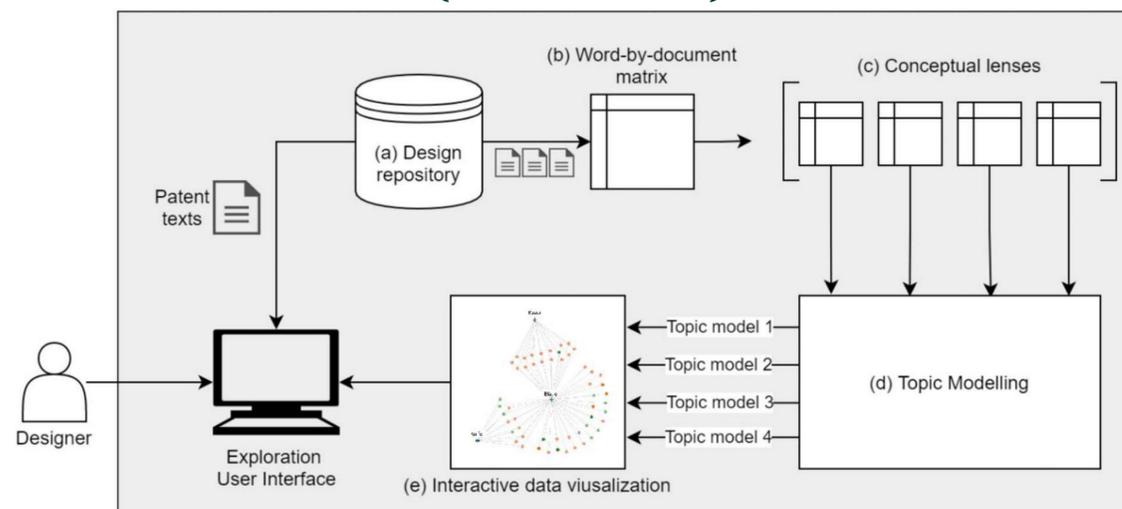
Case Study

- Studies with professors and students
  - Keywords provided are not the most informative.
    - Example: "base"
      - Not informative about the design of the patent.
- LLM is a bit slow
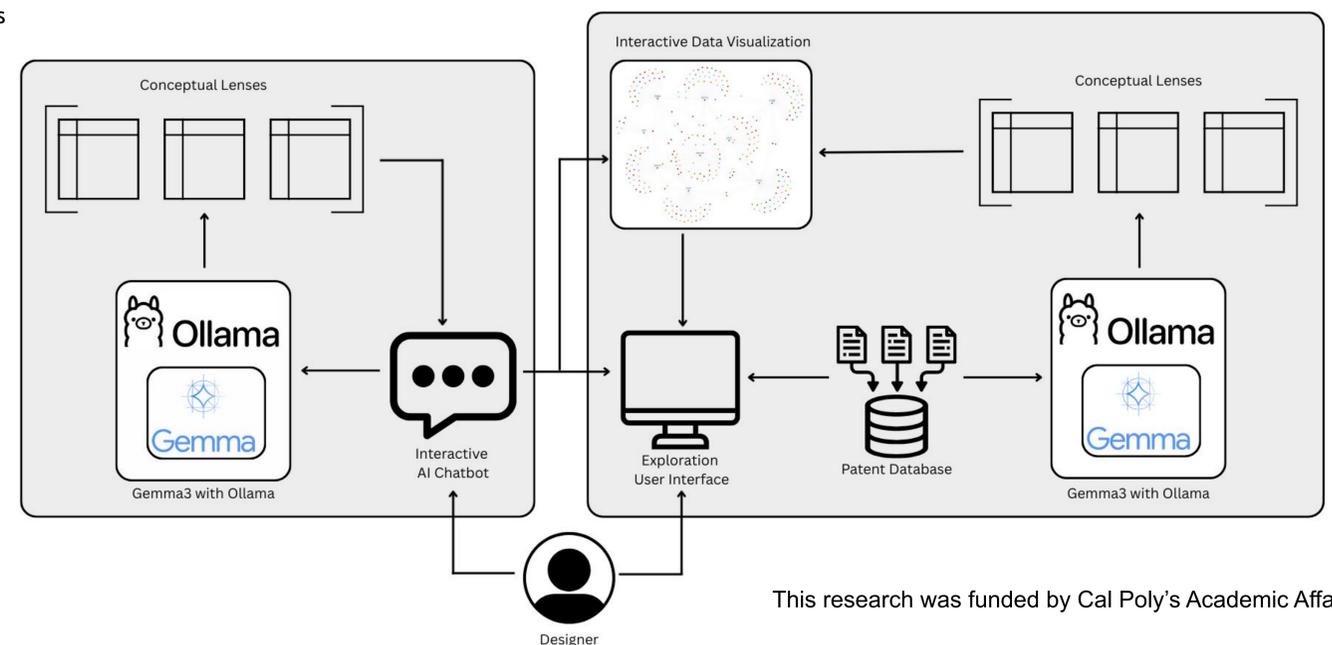- UI was not intuitive

Improvements

- Improvement of keywords
  - Create a filtered word list
  - Change scope of text from the patents given to LLM
- Improvement in LLM evaluation speed
  - Change LLM used (currently using Gemma3:12b)
    - Mistral
    - ChatGPT (less secure)
    - Gemma3:4b (different parameter sizes)

VISION (First Version)

VISION+ (Latest Version)