Optimization of Furniture Placement using Machine Learning.

Insyde.IO - Technical Assignment

AI/ML Engineering Intern

Done By:

Sk. Md. Shariff

AP21110030005

Mechanical Engineering Dept.

SRM University AP

Objective: To Develop a basic AI model that can generate a structured 2D layout based on predefined constraints such that the layout should optimize placement based on given inputs, such as obstacles, spacing rules or functional efficiency.

Tasks Available:

1. Furniture arrangement in a small room.
2. Circuit board component placement
3. Road network planning
4. Pipe layout for a building floor
5. Any own idea

Reason for choosing:

1. Furniture arrangement: Simple to understand, analyze the features according to conditions, can modify the plan according to subjective components like thermal conditions or airflow moments etc.

Reason for not choosing other options:

1. Circuit board problem: have little knowledge about the patterns like parallel, series connections, have to take care of the values i.e. min and max limits of the electrical parts etc.
2. Road network: many different optimal networks are being used currently and further optimization would have low impact.
3. Pipe layout: not as simple as it sounds, have to consider many factors (min 4-5) and more time to build a perfect optimal layout even for a building, have experience as Current Final year project is aligned to pipeline networks.

Methodology:

Preview the concept and gain a visual understanding through cad softwares like freecad, Autodesk Fusion.

Draft few prototype designs and layouts by clearly understanding the requirements.

Start building ML models in 2 different workplaces(softwares).

Input the requirements and start training by rule-based approach, direct ML optimization

Validation of the output using ai reasoning as well as manual skills, making corrections if required, further train the model.

Deploy interactive methods/ visualization.

Algorithm:

Ask the User for Room Type

Define Room-Specific Furniture Layouts

Provide constraints

Generate the Furniture Dataset

Optimize Placement for Best Fit

Visualize the Layout

Results:

Codes are attached

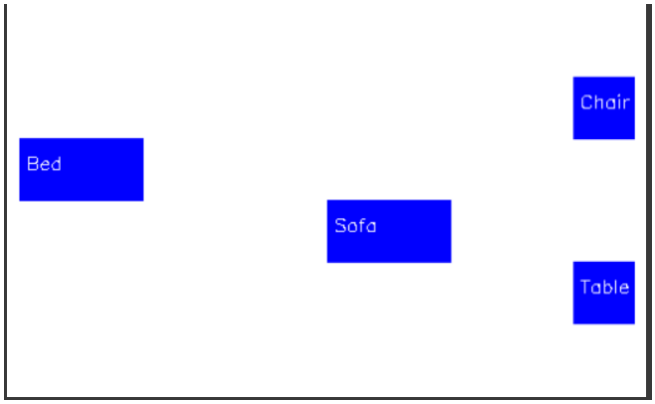

fig1. Generate a random room layout without any overlapping.

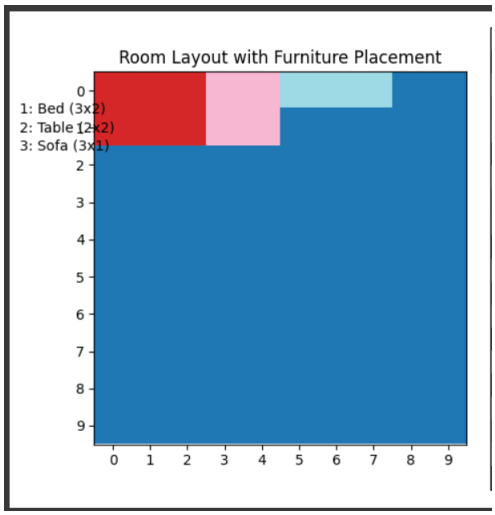

Fig 2. Trained to place the furniture at one corner for max space utilization.

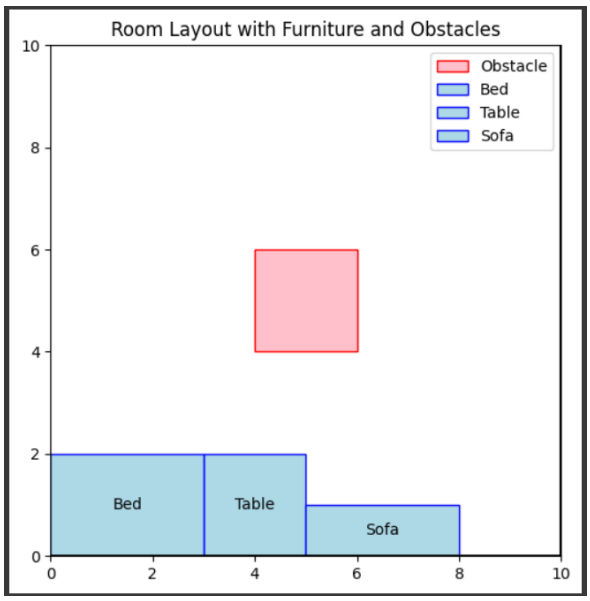

Fig 3. Trained to Block placing at certain regions.

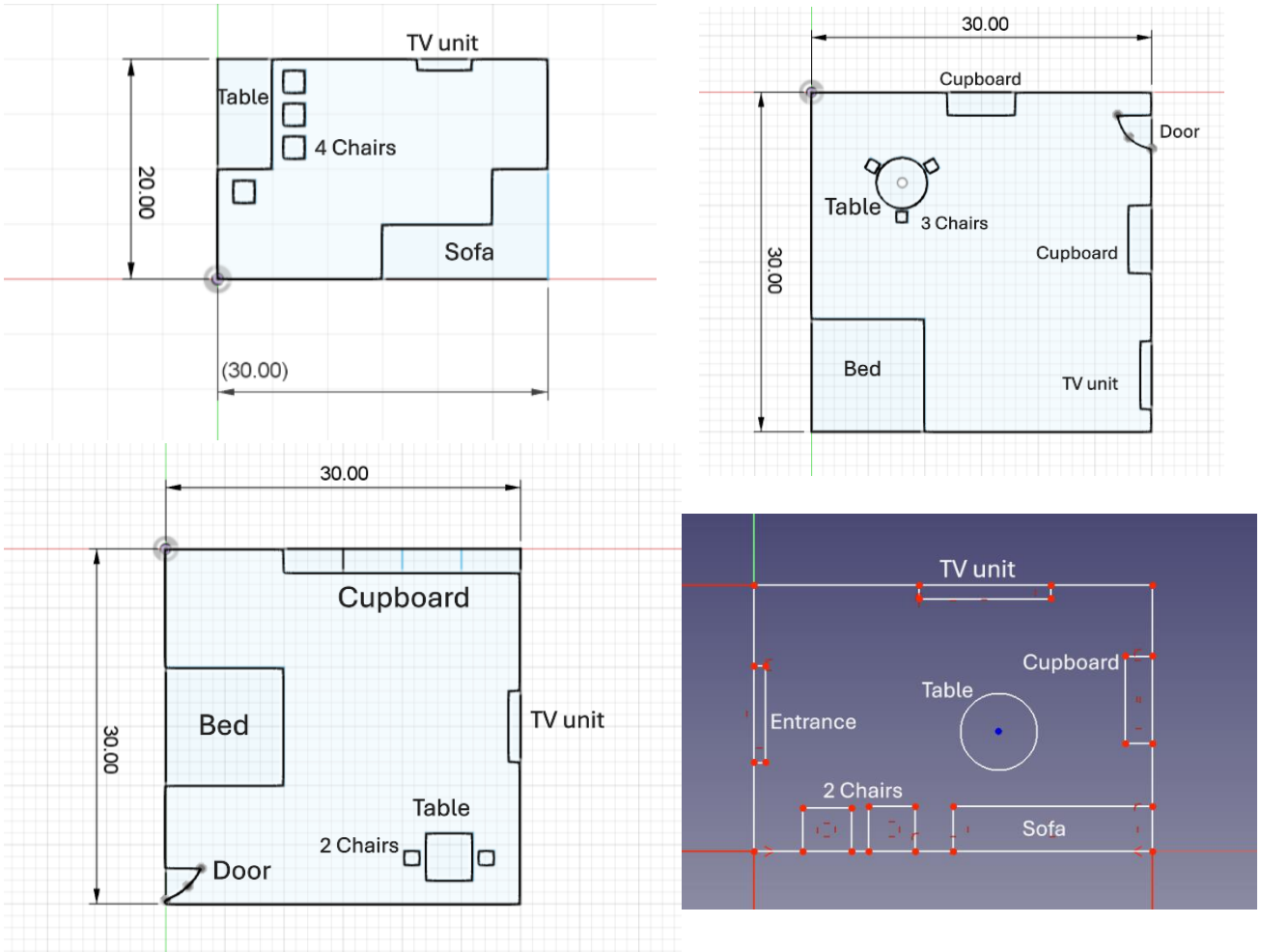

Fig 4-7: Visual ML training data set using Autodesk fusion & Freecad Softwates.

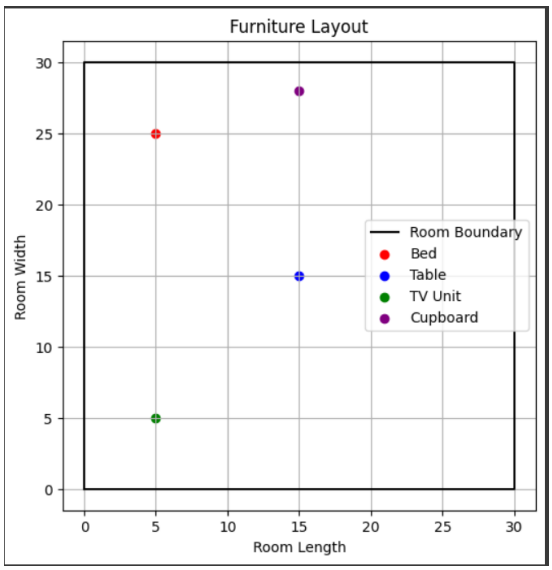

Fig 8. Final Optimized layout 01

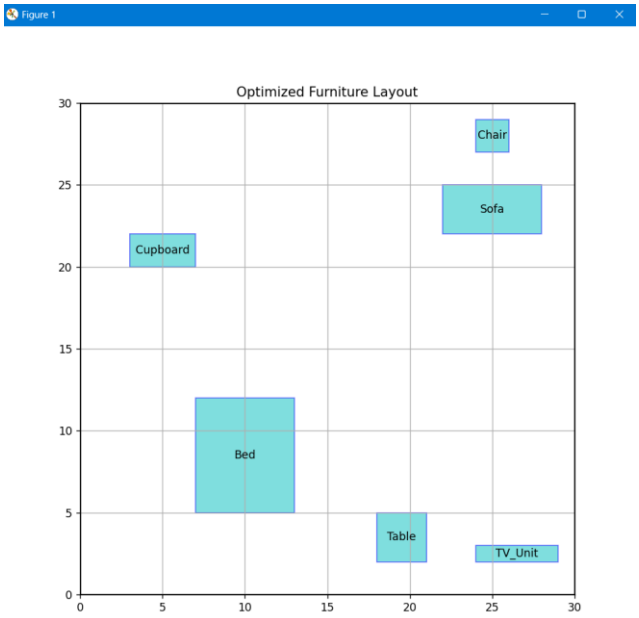

Fig 9. Placement of all the furniture from the training data set

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Enter room type (bedroom/hall): hall
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Fig 10. Fine tuning the input

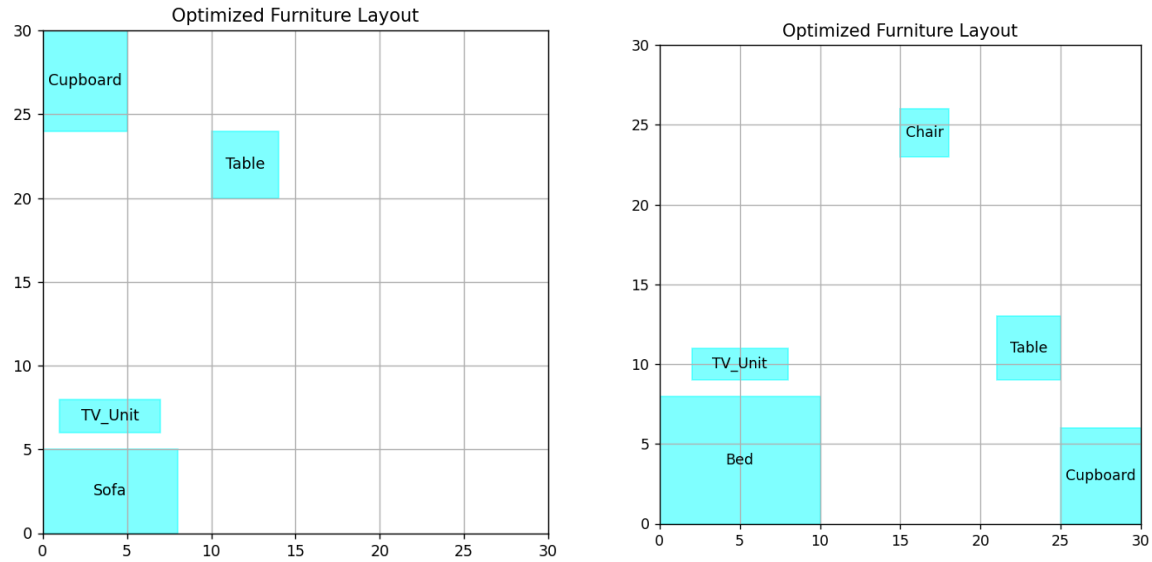

Fig 11-12. Simple syn data custom required optimised layouts

Achieved Mean Square errors:

1. 0.2617

2. 0.0610

Completion of the task:

Designs – own designs, self-knowledge, firsthand experience with cad.

Algorithms, idea – Developed by self, have understanding of the pseudo code.

Code – Used the help of AI for Syntaxes, errors, connections etc. (have worked on Synthetic data generation, applying correlations but not Optimization problems)

Why am I a suitable candidate:

1. Have prior experience (& currently working) of solving mechanical problems using ML.
2. Worked with CNN in my specialization course
3. Can workout on algorithms by self and provide proper prompting to AI
4. Have exposure and experience to University level and Industrial level 2D,3D cad Designs.
5. Have good fundamentals of Core Mechanical Skills

THANK YOU