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# Estimating Selective Disassembly Time Using Disassembly Graph Based on Connective Complexity Metrics CIE 2012 Graduate Research Poster

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## Introduction

- End-of-Life (EOL) planning based on sustainability is very critical in order to design sustainable products.
- Recycling, reuse, remanufacturing and disposal are the main options for EOL planning.
- Disassembly is critical step in recycling, reuse and remanufacturing.
- Selective disassembly for retrieving only the components that can be reused, recycled or remanufactured can improve a products sustainability.
- Estimating and reducing selective disassembly time can assist a designer in making decisions regarding EOL of a product.

## Objective

To develop a method for estimating selective disassembly time. The focus of this particular work is on disassembling components that can be recycled.

## Methodology

- Disassembly is reverse of assembly.
- Use assembly time estimation developed by Summers et. al. for estimating total disassembly time.

$$t_d = (APL \times n^{(1.185+PLD)})$$

where, *APL* is average path length, *PLD* is path length density, is the number of relationships in the graph and $t_d$ is the estimated time

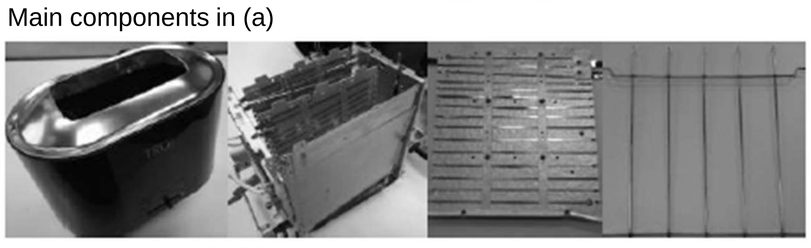
- Modify the assembly/di… by grouping connecte… s based … criteria (materia… cling) for se… disassembly.
- Use the modified … h for selecti… disassembly time esti…

## Case Study: Two Toas…

(a) Standard Toaster
(Oyster model: #6325 )

(b) Eco-Fri… oaster
(Model No: # ΓE-249)

Main components in (a)

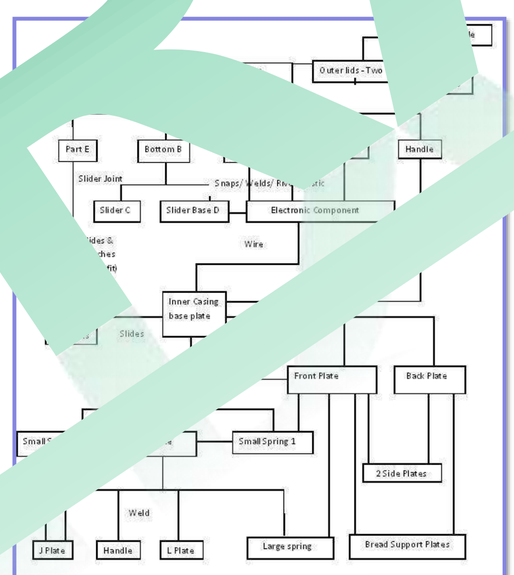


Main components in (b)

## Abstract:

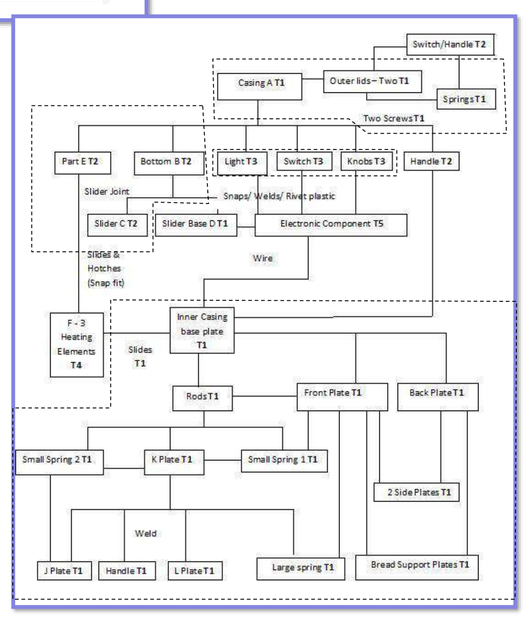
The four major processing options at the end-of-life of products are reuse, recycle, remanufacture and disposal. In these the reuse and recycle and remanufacture of products or components are more beneficial to the manufacturer, user, society and the environment only if disposal can be possibly minimized. The objective of recycling is to recover as much material as possible from the retired products by performing the necessary disassembly, sorting, and physical and/or chemical separation. However, in the case of remanufacturing, the product's identity is preserved and … o performs the required disassembly, sorting, refurbis… assembly operations to bring the product to a … level of quality. While the material and pro… overy is feasible by allowing selective separati… esired parts and materials by disassembling the … t. In t… research, we will develop a generic meth… c… plans of selective disassembly for a g… ct. Furthermore, we com… fferent selective … mbly plans for their environ… t. Our current … h is focused on sustainable … assembly of t… ls of toasters and c… ring … isassembly computation through this … eric met… ot.

K… Selective L… sem… of Life, … h, Connec… y Metr…




*Assembly Graph Through Material-Wise Separation*

**ECO-FRIENDLY TOASTER ASSEMBLY GRAPH**




## Definitions of Connective Complexity Metrics used in time estimation

- Shortest path length measurements are focused on the shortest available path which must be passed through one element to another in the system.
- Total Pat… (TPL) is the sum of all the shor… engths in the system.
- A… ath length (APL) is determined by … total path length (TPL) by the product … to… er of components in the system and the tot… er of components in the system minus th… identity.
- Path Leng… ity (PLD) is derived from average pat… by dividing the APL by the number of rel… s in the system.

## Result

| Standard Toa… | | |
|---|---|---|
| | Before … ise … on | After material-wise separation |
| Total Path Length (T… | 2712 | 2358 |
| Average Pat… | 2.733871 | 2.377016 |
| … gth …ty(PLD) | 0.049707 | 0.043218 |
| … assembly Time ($T_d$/second) | 197.3 | 167.7 |

**Table-1 Results of Standard Toaster Disassembly Time Estimation**

| Eco-Friendly Toaster | | |
|---|---|---|
| | Before material-wise separation | After material-wise separation |
| Total Path Length (TPL) | 4670 | 4316 |
| Average Path Length (APL) | 3.321479 | 3.069701 |
| Path Length Density(PLD) | 0.0511 | 0.047226 |
| Disassembly Time ($T_d$/second) | 297.9 | 271.4 |

**Table-2 Results of Eco-Friendly Toaster Disassembly Time Estimating**

## Conclusion

- Computed total disassembly time for standard and Eco-friendly toaster is 197.3 seconds and 297.9 seconds.
- Computed selective disassembly time for standard and Eco-friendly toaster is 167.7 seconds and 271.4 seconds.

## Future Work

Our future work will focus on compute selective disassembly time automatically by using program identify CAD assembly model hierarchy.

## References

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