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The Use of Publicly Available Image Search Engines to Find Solution Ideas

Efficient Use of TRIZ Information Resources

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Abstract. The present paper proposes a set of steps to search for data and generate relevant information to come up with solution ideas for a given problem or product improvement. Among others, the terms data and information are defined and an overview of the current state-of-the-art, which contains the TRIZ tool Function-Oriented Search and the description of possible search engines, is given. For getting relevant search results and generating information a workflow is suggested. This workflow is based on pictorial analogy to a sketched problem situation and the use of standard internet browsers with image search functionality. The task of improving the design of a tea press illustrates the workflow and its steps. The obtained solution ideas show the feasibility of the proposed workflow and lead to the conclusion that even the single use of pictorial analogy yields useful results.

Keywords: TRIZ, Pictorial Analogy, Image Search Engines, Information Resources

1 Introduction

The World Wide Web provides a lot of publicly accessible data. This data can be easily retrieved using internet search engines. Nevertheless, creating relevant information from this data to come up with solutions to a specific problem or develop specific innovation ideas could be a difficult and tedious task.

Data, information and relevancy are defined in the English Dictionary [1] in the following way:

- Data: (singular datum) a quantity, condition, fact, or other premise, given or admitted, from which other things or results may be found
- Information: notice, knowledge acquired
- Relevancy: pertinent, applicable, bearing on the matter in hand, apposite

The acquisition of knowledge after the retrieval of facts could be made more efficient if the number of retrieved facts already match a promising search or solution direction. The concept of analogy might be a suitable path to follow and perform a di-

rected search with internet search engines. In [2] different concepts of analogy are stated:

- Pictographic (same appearance within pictures, images, sketches, drawings)
- Nomologic (same rules, laws, principles)
- Functional (same functions)

Ideally, the applied analogy is not only pictographic, i.e., not only based on the same appearance within pictures, images, sketches or drawing, but show functional and nomologic analogy as well. However, it could be assumed that even pictographic analogy alone might yield better result than a completely undirected search. A TRIZ tool applying functional analogy to find solutions is Function-Oriented Search [3]. In [4] Cavalucci and Feygenson propose an algorithm to use the obtained data to create information as a resource for improving a system. Function-Oriented Search and the algorithm of Cavalucci and Feygenson focus on the generalisation of the system's main function. The term of the search is very general and the search itself makes no use of an abstract sketch which could be drawn.

The following chapter of the paper proposes a methodology to carry out a search for solutions with the help of present internet search engine using conceptual sketches or sketches representing the principle of a concept.

2 The Usage of Picture/Image Search

Sketches of solutions could be found in a variety of sources. Figure 1 shows some of these sketches with different levels of abstraction. On the left-hand side details from an engineering drawing displaying standard components, in the middle the drawing of piston together with the piston kinematic [5] and on the right-hand side a pulley [6].

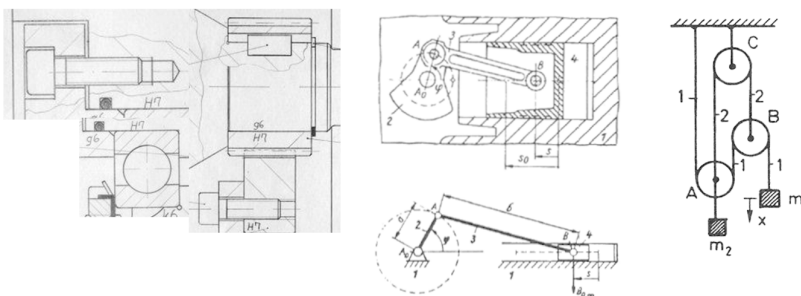


Fig. 1. Representation of design elements with different levels of abstraction – left: screws, ball bearing and gear with feather key; middle: piston [2]; right: pulley [3]

In [7] Herrig offers some more sketches which focus on the principal layout of a design (see figure 2). On the left-hand side, a gear is displayed and in the middle and on the right-hand side an umbrella in different states of operation. The system is reduced to rigid areas and joints. These joints define the possible dynamics within the system but do not cast any light on user interaction (if present) and on loads and their value.

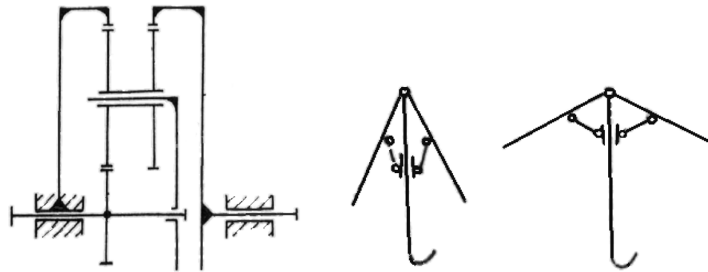


Fig. 2. Sketches of different principles of design – left: gear [7]; middle: umbrella (closed); right: umbrella (open) [7]

In [8] Herrig also presents an image of a workflow containing eight steps to develop specific solutions for a specific problem. The steps are illustrated in figure 3. In the first four steps the level of abstraction of the problem is increased until two contradicting parameters are found. Having reached this level, the next four steps deal with the solving of the problem. First, the contradiction is solved and from that a principal layout is created. This is made more specific by defining components of a structure fulfilling the needed functionality.

The general idea of the workflow is to reduce the amount of information to the necessary, crucial parts, which cause the problem. The focus is to answer the following question: What exactly is the problem? However, the TRIZ concepts of operational space and operational time, i.e., where and when the problem exists is not explicitly required or referenced. On the other hand, moving from the result state Z2 to Z3 and from result state Z6 to Z7 (German: Zustand) the application of graphical representation is clearly visible. In Figure 4 a direct search for solutions with a feasible sketch of the problem is proposed. This problem sketch is the result of a problem analysis which could be carried out using the TRIZ tools Cause-Effect-Chains Analysis and Function Analysis to be sure that the right problem is solved.

Moving from state Z2 to Z7 by conducting an image search tries to solve the problem by pictographic analogy. The TRIZ tool Function-Oriented Search uses functional analogy to identify a leading industry in which the solution of the general problem is vital for the system. This is a great difference, and the question is, if pictographic analogy alone would be sufficient to find useful solutions.

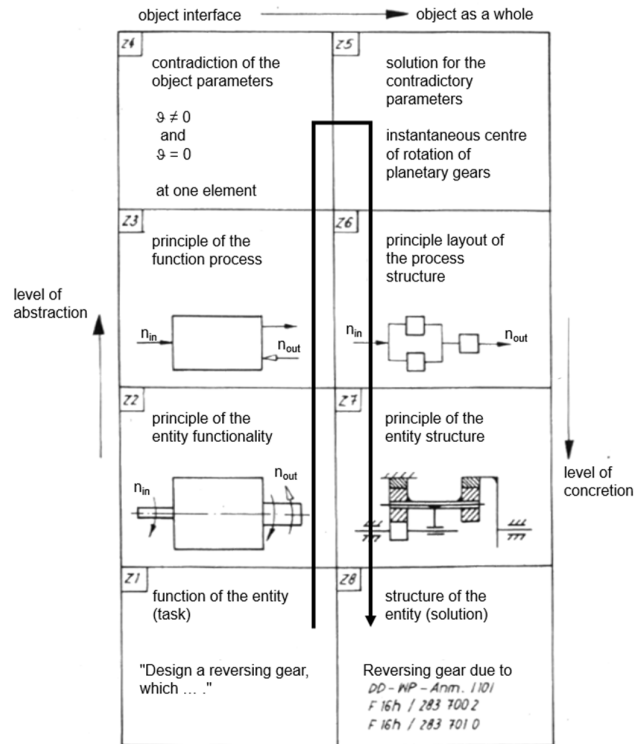


Fig. 3. Workflow from a task to a solution [8, translated by the author]

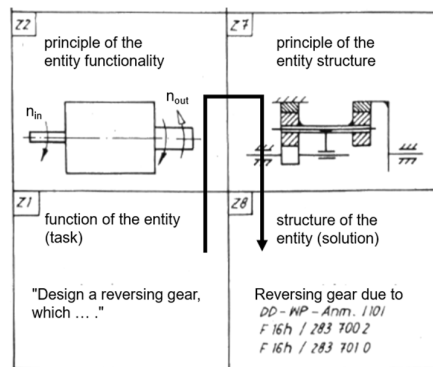


Fig. 4. Shortcut to find solutions with pictographic analogy by moving from Z2 to Z7 performing a picture search and try to get association from the search results [8, edited by the author]

Figure 5 shows a proposed workflow, which defines the steps to perform a picture search. After a deep analysis of the problem, the specific sketch is used to generate an abstract sketch. This is done by a human expert but could possibly be supported by feature extraction software in the future. The abstract sketch is a model of the problem containing the relevant information with reduced complexity to perform a useful search of analogue images using an existing search engine. This limitation to the relevant features increases the chance to get good results. The search results are evaluated either by the same expert or by a small team to reduce subjectivity. This is done by comparing it to the problem situation. In case there is no fit, the abstract sketch could be adapted, and the search is rerun until a satisfying fit is achieved. The manual iteration is stopped when a suitable solution is found with the help of the pictographic analogy. Then, the problem solving could move on to generating the specific solution. The step of creating the specific drawing is optional because more often it could be easier more time efficient making an abstract drawing right from the start.

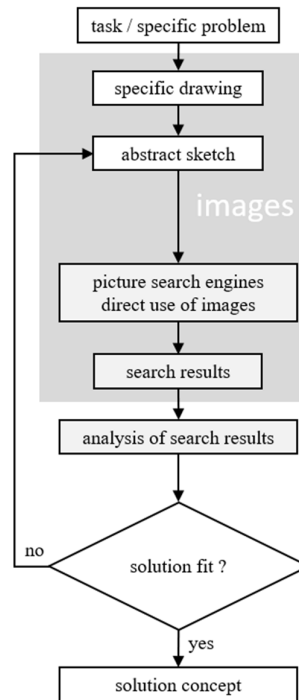


Fig. 5. Proposed workflow using image search engine to find solution ideas

The basic idea of moving from a specific situation to a general sketch of the problem is now further detailed with a case study. This study deals with improving the design of a tea press during the operating time of pressing the knob of the plunger down. This results in capturing the tealeaves between the sieve and the plunger after seeping.

Figure 6 shows the tea press with its components, the operating time (moving the knob down) and the final state which is reached after the complete movement. Figure 7 shows a function model of the addressed system, in this case the press assembly, during this operating time and figure 8 displays the situation with the help of first sketches of the problem situation. The problem is perceived to be the bending of the rod due to the applied force for moving. Now the first two steps of the workflow have been carried out, the problem analysis and the drawing of the problem sketch.

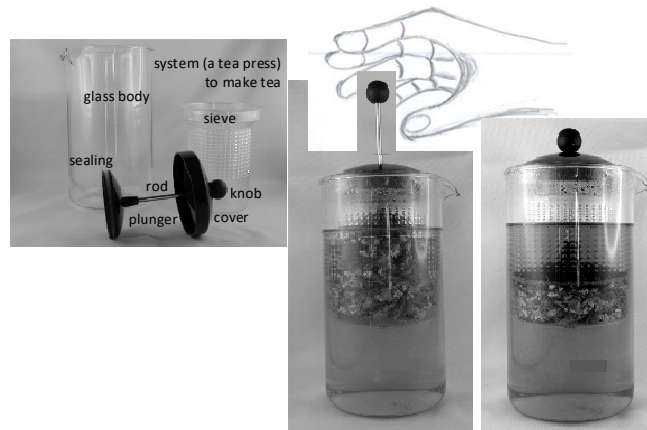


Fig. 6. A household tea press and its components (left), tea press filled with tealeaves and hot water (middle) and tea press after the knob has been moved down [9]

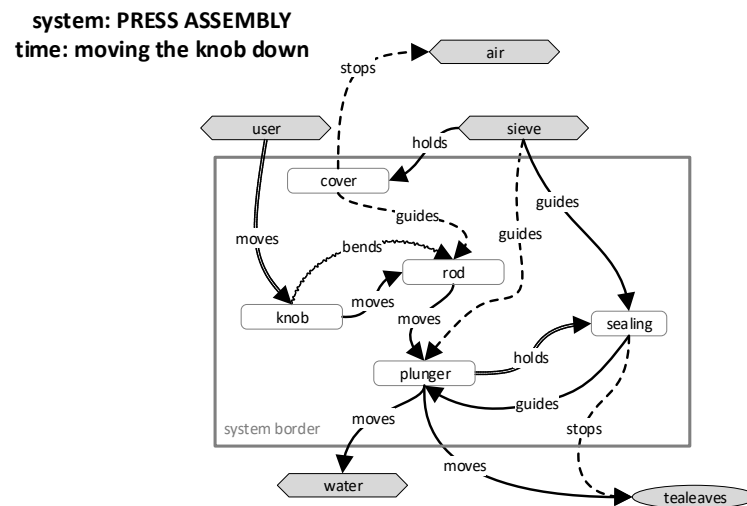


Fig. 7. Function model of the tea press [9]

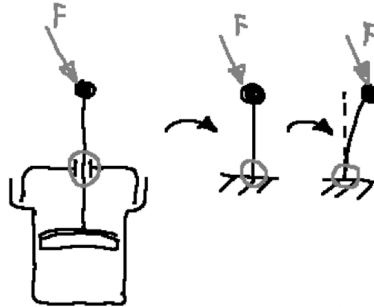


Fig. 8. Reduction of the amount of detail for the problem – sketch of the time tea and the acting loads on the rod and its support

The sketches still contain specific information which are not suitable for an image search. To make them more general or abstract the loads are removed and the deformed state is left out. The cover is model as a fixed mounting for the rod and all other details are removed because there are no issues there. Now only two parts are left, the knob and the rod. The sketch is shown as image number two in figure 9. This sketch is used to run a search with internet search engines that allow image search with a picture or a sketch. In the example the following search engines have been considered (in alphabetical order):

- bing - <https://www.bing.com/?scope=images&nr=1&FORM=NOFORM>, last accessed 22.06.2021
- gettyimages - <https://www.gettyimages.de/>, last accessed 22.06.2021
- google - <https://images.google.com/>, last accessed 22.06.2021
- nypl (New York Public Library) - <https://digitalcollections.nypl.org/>, last accessed 22.06.2021
- picsearch - <https://www.picsearch.com/index.cgi?q=>, last accessed 22.06.2021
- shutterstock - <https://www.shutterstock.com/de/>, last accessed 22.06.2021
- TinEye - <https://tineye.com/>, last accessed 22.06.2021
- yahoo - <https://images.search.yahoo.com/>, last accessed 22.06.2021
- yandex - <https://yandex.ru/images/?rdrnd=662869&redircnt=1625165951.1>, last accessed 22.06.2021

Some of the above listed search engines only allow a search for images with the help of search terms, these could not be used.

As hinted earlier, the picture quality and level of abstraction plays an important role for getting useful hits. To get an impression of the impact of these two parameters the search was carried out with eight pictures.

These search images are shown in figure 9. Starting from left to right and from top to down the level of abstraction is reduced and in some case the parameter of perspective is added. The last two images represent a combination of a photo with a sketch and a section of a photo.

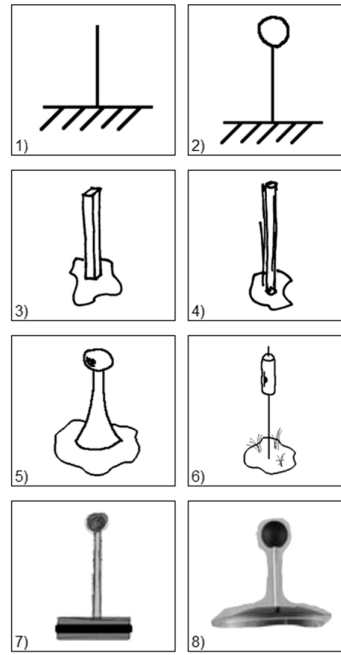


Fig. 9. Images used for the direct picture search using standard search engines

The number of obtained pictures were huge. The list below shows associations which were assumed useful together with the search engine that produced the result:

- Bing
 - 1) no direct association
 - 2) knot path, tree
 - 3) no results
 - 4) two legs, bone, chisel, streetlamp
 - 5) tower, flask, tuba, test tube
 - 6) buoy, wire suspension of a lamp, syringe with needle
 - 7) tool handle, support, tripod
 - 8) office stool, handle
- Gettyimages
 - 1) pyramid, dust bin
 - 2) no direct association
 - 3) no results
 - 4) to 6) no direct association
 - 7) tool, syringe with needle, test tube, fork,
 - 8) no results

- Google:
 - 1) chandelier
 - 2) rail for sliding gate
 - 3) test tube, lighthouse, exhaust pipe, flask, grid or drilled wires, syringe with needle, tripod, tower, tuba, nail, paperclip, stub + additional info: cylinder (with first ideas for variation)
 - 4) tree, bamboo, cactus, wind wheel
 - 5) flask, tower, barrel, lighthouse, moka, water tap
 - 6) flask, test tube, syringe with needle, tree +additional info: cylinder
 - 7) u-shaped metal part, damper, handle of floor wiper, tool handle, two or more rods in parallel, cylinder head valves, telescope supports, tripods +additional info: cylinder
 - 8) funnel, spoon, pop-up stopper, fence top
- Nypl:
 - No direct use of images
- Picsearch:
 - No direct use of images
- Shutterstock:
 - 1) handle of tool, sword, syringe with needle
 - 2) tree, umbrella
 - 3) cactus
 - 4) flask, test tube, bone
 - 5) streetlamp, tower
 - 6) streetlamp
 - 7) handle
 - 8) bone
- TinEye
 - No direct use of images
- Yahoo
 - No direct use of images
- Yandex
 - 1) tool handle, rake
 - 2) rake
 - 3) bone, two or more supports in parallel
 - 4) hollow cylinder, bone, nested tubes, tree, two or more supports in parallel, pillar, grid, chisel, plant, cactus, rolled metal tool, needle
 - 5) flask, bone, tower, valve
 - 6) flask, tower, needle, thermometer
 - 7) tool handle, support, tower, valve
 - 8) tool handle, railway track, valve, flask

Possible associations for solving the problem are:

- Chandelier – use multiple rods in parallel (increase the number of rods while possibly decreasing the diameter of the individual rod)

- Rail for sliding gate, spoon – higher dimension (moving material to a greater diameter and introduction of hollow centre)
- Test tube, lighthouse and tower – moving the material to the outside without changing the mass of the rod (see above)
- Stub, tree – local quality (rigid close to the surface and ductile in the near the centre) (heat treatment)
- Cactus, pop-up stopper, fence top – higher dimension (star shaped cross-section)
- Damper – nested doll (rod with multiple sections, telescope)
- Funnel – higher dimension, hollow (change of outer diameter)
- Buoy – the other way round (could the plunger be pulled with a rope rather than pushed)

This list of free associations is built from the result analysis and the comparison to the problem situation. All ideas are perceived to have a fit to the solution and could be used in the next step to create a solution concept. Combinations of solution ideas and minimal changes of the system could indicate the ideality of the sketched concept.

If the concepts are not suitable the picture search could be repeated with a slightly different sketch. The level of abstraction of the sketches should decrease for the following iterations, e.g., moving from sketch 1 to sketch 3 [see figure 9]. This could be applied to a certain detail or the complete sketch.

3 Results

First of all, it could be said that the obtained results show a suitable and sufficient analogy to the problem situation. It seems that even a solely pictorial analogy could be used to search for solution ideas. A comparison of the search results shows the amount, and the quality of the hits depend strongly on the quality of the created sketch. It appears that 3d pictures are more likely to come across good and numerous results. The pixel size also plays an important role. Due to the size some search engines have not returned any results at all. The more artistic or organic the search image the more closely the results images are to nature. Straight lines and perpendicular angles yield results, which bear a more technical area. If photos are used there might be the danger of limiting the search due to the metal surface texture. Though in the tea press example this was not the case.

For details the reader is asked to carry out the described searches for himself. Pictures of the result hits have been omitted because the number would be quite large. Figure 10 shows the layout of the hits of a very useful search engine. This engine also provides a further and additional information in a column on the right-hand side. This information contains an associated symbolic image and first suggestions of a result variation.

The search engine also provides additional keywords. These could be taken for an image search using the keyword search instead of the images.

The searches have been carried out using the English language and search engines of English-speaking countries except for yandex. The navigation in the later search engine was perceived very difficult by the author due to the language barrier. The

advantage of a picture search is that it is not limited to a certain language. Nevertheless, language specifics should be taken into account.

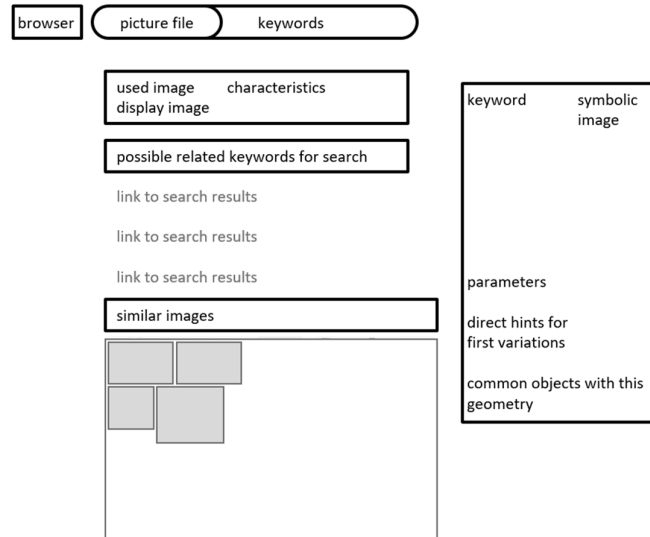


Fig. 10. Result depiction of the search engine google

The described parameter variation contains some elements of the acronym “galfmobs”, which was later extended to “galfmorbus” [10]. This German acronym stands for:

- Größe – size
- Anzahl – amount/number
- Lage – position/orientation
- Form – shape/geometry
- Material – material
- Oberfläche- surface/surface finish
- Reihenfolge – order
- Bewegungsart – type of movement
- Umgebung – environment
- Schlussart – type of connection/coupling

Overall it is noticeable, that the quality of the result images gives a good impression of possible fields of industry where the sketched situation plays a vital role for function fulfilment. Usually, the image search also supplies new keywords with which a reverse search could be carried out.

The validity of the proposed workflow has to be substantiated with further case studies. Nevertheless, the case study was carried out with eight sample sketches and returned useful images to come up with associations for solution ideas.

4 Conclusions

The assumption was that the single application of pictorial analogy could be sufficient for a search to find useful solution ideas. To carry out this search in a systematic and directed way a workflow with an iteration loop is proposed. This workflow is illustrated by means of an example to facilitate the application. Due to the application of images the workflow possesses the advantage that it is not restricted to language specifics. The obtained results of the example support the assumption that solely pictorial analogy could be enough. Furthermore, no special software is needed, the functionality of present software tools and internet browsers seem to be adequate.

However, the retrieved data has to be transformed into relevant information to deploy it for a problem solution. This could be done by looking at the required amount of changes of the system. The smaller the changes the more ideal the solution seems to be.

5 References

1. Hayward, A., Sparkes, J.: The Concise English Dictionary. Orbis Verlag, 4th edition (1990). ISBN 3-572-01024-1. pp. 284, 604, 966.
2. Hill, B.: Innovationsquelle Natur. Shaker Verlag (1997). ISBN 3-8265-2887-5. p. 48.
3. Litvin, S.: Training Material Level 3, GEN TRIZ Training Material (2019).
4. Savelli, S., Feygenson, O.: Algorithm of Enhanced Function-Oriented Search. International TRIZ Association – MATRIZ (2019), ISSN 2374-2275. p. 23-34.
5. Schneider, J.: Konstruktionskataloge in der Antriebstechnik. Hoppenstedt (1986). ISBN 3-8203-0127-5. p. 9.
6. Gross, D., Wriggers P., Reese S.: Aufgabensammlung Technische Mechanik III. Institut für Mechanik (1991). p. 18.
7. Herrig, D.: Programmpaket HEUREKA – Hilfsmittel zum Erfinden unter Rechner- und Karteinutzung. Bauakademie der DDR (1988). p. 25, 39.
8. Herrig, D.: Rechnerunterstütztes Erfinden – eine Einführung. „Freies Wort“ Suhl (1986). p. 23.
9. Wessner, J.: Time and FTA with Function Analysis. International TRIZ Association – MATRIZ (2019), ISSN 2374-2275. p. 392, 395
10. Linde, H.; Hill, B.: Erfolgreich erfinden. Hoppenstedt Technik Tabellen Verlag (1993). ISBN 3-87807-174-4. p. 187-195.