

State of the Art for **dvi3v** project

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1 Introduction

This document surveys existing projects and products that overlap with **dvi3v** and compares them, on a common set of criteria, with **dvi3v** itself. It is a living document, updated as the field moves; the *why* of any conclusion that drives a design decision is also traced in **ResearchJournal.org**.

The survey spans command-line tools, interactive and hosted tools alike (Inkscape and Scan2CAD are GUI applications, Vectorizer.AI and Recraft are web services, ImageJ is a desktop GUI). *Non-CLI tools and ecosystems* below widens it further, to desktop creative applications, the maker / cutter ecosystem, CAD canvas calibration, and mobile measure-from-photo apps. "Headless / CLI" is one *axis* of comparison (see *Method* below), not a filter on what is surveyed.

2 Method: comparison criteria

The criteria are taken from the project concept (see [Concept](#)). A tool is judged on whether it:

Input from photo accepts an ordinary photograph (not only a clean scan or screenshot) as input.

Vector output emits a true vector silhouette (SVG and similar), not a raster embedded in a wrapper.

Real-world scale yields real dimensions (millimetres) rather than pixels, ideally derived automatically from a reference in the scene.

Object extraction isolates the object of interest from an arbitrary background, rather than tracing the whole frame.

Holes / complex shapes handles interior holes (keys, scissors) and offers fabrication aids such as a margin.

Open source is free software with available source.

Headless / CLI scriptable from the command line for batch and automation, not only an interactive GUI or a hosted web app.

Fabrication target aims at CAD / CNC / laser / cutting workflows.

3 The field

3.1 Raster-to-vector tracers (logos and artwork)

The largest neighbouring family converts a bitmap into curves. Open tools include **potrace** (the GPL tracer that **dvi3v** itself calls), **autotrace**, and Inkscape's *Trace Bitmap* (a **potrace** front end). Commercial and AI-based services include Vectorizer.AI, Vector Magic, Recraft, and many web converters; the newer ones use neural networks that fit a small number of Bezier curves rather than tracing edges pixel-by-pixel, and several export **DXF** aimed at CAD, CNC, engraving and laser workflows.^{1, 2}

What they share with **dvi3v**: true vectorisation to **SVG** (and often **DXF**). What they lack against the concept: none establish *real-world dimensions* — output is in arbitrary units — and none *extract* a subject from a cluttered photographic background; they trace the whole image and expect clean, high-contrast art. **dvi3v** sits downstream of this family (it uses **potrace**) but adds scene extraction and a measured scale.

3.2 Reference-object measurement (computer vision)

A second family measures the real size of objects in a photo using a reference of known size: the "pixels-per-metric" approach popularised by the PyImageSearch tutorial and reproduced in many OpenCV / Python projects (a coin or a printed square of known width as the reference), and the *Set Scale* feature long present in the scientific tool ImageJ.^{3, 4} The principle — find a reference of known dimension, derive pixels per millimetre, then measure everything else — is exactly the one **dvi3v** uses for scale.

What they share with **dvi3v**: reference-derived real-world dimensions and contour finding (often Canny edges plus contour detection). What they lack: the result is a *number* or an annotated bounding box, not a filled vector silhouette one can cut or import into CAD; there is no **SVG** deliverable, no hole handling, no fabrication margin, and most assume a near top-down view and a left-most reference.

3.3 Raster-to-CAD / CNC vectorisation

A third family targets manufacturing directly. The representative product is Scan2CAD: proprietary software that vectorises scanned drawings, sketches and PDFs into **DXF**, **DWG** or G-code for CAD, CNC and GIS, with raster clean-up, gap-jumping and OCR.⁵ It is strong on the vector-for-fabrication side that **dvi3v** also targets.

¹Vectorizer.AI, image-to-vector (SVG, PDF, EPS, DXF) service. <https://vectorizer.ai/>

²Potrace, transforming bitmaps into vector graphics (GPL). <https://potrace.sourceforge.net/>

³A. Rosebrock, "Measuring size of objects in an image with OpenCV", PyImageSearch. <https://pyimagesearch.com/2016/03/28/measuring-size-of-objects-in-an-image-with-opencv/>

⁴Example open implementations of the pixels-per-metric method. <https://github.com/snsharma1311/object-size>

⁵Scan2CAD, raster-to-vector and PDF-to-CAD conversion (DXF / DWG / G-code). <https://www.scan2cad.com/>

What it shares with `dvi3v`: vector output destined for cutting / machining. What it differs on: scale is set from the drawing's own units or the operator's calibration, *not* derived from a reference object photographed beside the part; it is built for line drawings and scans rather than extracting a physical object from a casual photo; and it is closed source and GUI-centric.

4 Non-CLI tools and ecosystems

This section widens the survey to interactive and consumer tools.

4.1 Desktop creative applications

The mainstream vector editors all offer an interactive *trace* of a raster: Adobe Illustrator's *Image Trace*, CorelDRAW's *PowerTRACE*, Inkscape's *Trace Bitmap* (the `potrace` front end already noted), and dedicated tools such as Vector Magic. They are strong, GUI-driven tracers with manual tuning, but — like the command-line tracers — they carry no real-world scale and do not extract a subject from a cluttered photograph; they expect clean, high-contrast art and trace the whole frame.

4.2 Maker and cutter ecosystem

Laser and craft-cutter software is the closest *fabrication* neighbour. LightBurn imports a raster and traces it (a brightness cutoff and threshold, much like `dvi3v`'s own thresholding) into cut paths.⁶ Glowforge's on-bed *Trace*, Cricut's Design Space and Silhouette Studio do the same for their machines. Two differences from `dvi3v` matter: the trace works on silhouettes and clean drawings, not on an object photographed on a textured floor, so there is no background extraction; and the real-world size comes from the *machine bed or canvas* (the operator sizes the art to the material), not from a reference object captured in the same photo. Holes are handled only in so far as the tracer emits inner contours.

4.3 CAD canvas calibration

CAD packages let a photo or scan be brought in as a background "canvas" and calibrated to scale: in Autodesk Fusion the user inserts the image, then *Calibrate* by picking two points and typing the known distance between them; Onshape and others are similar.⁷ This gives a genuine real-world scale from a known reference dimension — the same idea as `dvi3v` — but the vectorisation that follows is *manual* (the user traces splines over the calibrated image); there is no automatic extraction and no silhouette output.

⁶LightBurn, *Image Tracing* documentation. <https://docs.lightburnsoftware.com/Tools/TracingImages.html>

⁷Autodesk, "How to scale (calibrate) an inserted canvas in Fusion". <https://www.autodesk.com/support/technical/article/caas/sfdcarticles/sfdcarticles/How-to-scale-an-inserted-canvas-in-Fusion-360.html>

4.4 Mobile measure-from-photo apps

A family of phone apps (for example *Easy Reference Measure* and *RefSize*) measures real dimensions from a photo by including a reference of known size — a coin, a credit card, a ruler — exactly **dvi3v**’s scale principle, now in a pocket.⁸ They are the purest expression of reference-derived scale on ordinary photos, but the result is a *number* between two tapped points (or an annotation), produced by manual tapping; there is no object extraction, no vector silhouette, and no fabrication output. (Note the contrast with AR ”measure” apps such as the built-in iOS Measure, which use depth sensing rather than a reference object and likewise yield only numbers.)

5 Comparison

Legend: Y = yes, N = no, ~ = partial / with caveats.

Tool / family	Photo	Vector	Real mm	Extract	Holes	Open	CLI	Fabric.
dvi3v	Y	Y	Y	Y	Y	Y	Y	Y
potrace / autotrace	~	Y	N	N	Y	Y	Y	~
Inkscape Trace Bitmap	~	Y	N	N	Y	Y	N	~
Vectorizer.AI / Recraft	~	Y	N	~	Y	N	~	Y
OpenCV pixels-per-metric	Y	N	Y	~	N	Y	Y	N
ImageJ (Set Scale)	Y	N	Y	~	N	Y	~	N
Scan2CAD	~	Y	~	N	Y	N	N	Y
Illustrator / CorelDRAW	~	Y	N	N	Y	N	N	~
LightBurn / cutter trace	~	Y	~	N	Y	N	N	Y
Fusion canvas (calibr.)	Y	~	Y	N	~	N	N	Y
Mobile reference-measure	Y	N	Y	N	N	N	N	N

The columns follow the criteria of the previous section: Photo input, Vector output, Real millimetre scale, object Extraction from a background, Holes / complex shapes, Open source, CLI / headless, and a Fabrication target.

6 Positioning of dvi3v

No surveyed tool occupies the same cell as **dvi3v**. The two capabilities that define the concept — a *reference-derived real-world scale* and a *filled vector silhouette extracted from an ordinary photograph* — each exist separately:

- the measurement family has the scale but stops at numbers — including the mobile reference-measure apps, which share **dvi3v**’s exact scale principle yet output only a measured length;

⁸Reference-object measurement apps for phones, for example *Easy Reference Measure* and *RefSize Photo Dimension* on the App Store.

- the tracer, raster-to-CAD and cutter families have the vector output but take scale from the drawing, the machine bed or a manual calibration, not automatically from a reference object in a photo, and they do not extract the subject from a cluttered background.

dvi3v is, within this broadened survey (command-line, desktop GUI, web, maker and mobile alike), the only tool that joins the two: photograph in, dimensioned filled **SVG** out, with automatic object extraction, optional hole preservation and a millimetre fabrication margin, runnable headless. Its cost is breadth — it is a focused Bash + ImageMagick + **potrace** pipeline, not a general editor — and it inherits the known limits recorded elsewhere in the project (thin-feature and margin trade-offs, near-parallel camera assumption, and an automatic paper-color detection that can occasionally pick the wrong dominant color rather than the one intended).

7 Technologies compared

dvi3v Bash, ImageMagick, **potrace**, **bc**; reference-paper detection (A4 / Letter and other ISO sizes) with an EXIF-based fallback; morphological clean-up; **SVG** output with optional **DXF** (native **potrace**) and extruded **STL** (a bundled Python helper by default, or OpenSCAD); GPL.

potrace / **autotrace** C, GPL; bitmap to **SVG** / **EPS** / **DXF**; no scale, no extraction.

Inkscape C++ / GTK GUI wrapping **potrace**; GPL.

Vectorizer.AI, Recraft and similar proprietary, cloud, neural-network tracing; multi-format export including **DXF**.

OpenCV pixels-per-metric Python and OpenCV (Canny, contours, minimum-area rectangle); permissive licences; numeric output.

ImageJ Java; scientific image measurement; manual scale set from a known distance.

Scan2CAD proprietary desktop; intelligent vectorisation with OCR; **DXF** / **DWG** / G-code.

Illustrator / **CorelDRAW** proprietary desktop GUI; interactive trace (*Image Trace*, *PowerTRACE*); no real-world scale, no extraction.

LightBurn and cutter software proprietary desktop GUI; brightness / threshold trace to cut paths; scale taken from the machine bed or canvas, not from a reference in the photo.

Fusion (canvas calibration) proprietary CAD; image inserted as a calibrated canvas (two points plus a known distance), then *manual* spline tracing; real scale, no automatic extraction or silhouette.

Mobile reference-measure apps phone apps; reference-object scale (coin / card / ruler) with manual point tapping; numeric output only.

8 Threats and opportunities

- Learning-based segmentation (for example general "segment anything" models) could make object extraction far more robust than the current threshold-and-centre heuristic, and is a candidate future direction rather than a competitor today.
- Perspective correction (recovering a true top-down view from an angled photo) is offered by none of the close neighbours for this use; adding it would widen `dvi3v`'s accuracy envelope.
- The reference-object measurement scripts are easy to combine with a tracer; the integration `dvi3v` already provides is its moat, but it is a reproducible one.

9 References