Detecting Fire Sprinkler Pipe in 360° Site Photographs

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1 Objectives

Fire pipe hides behind the ceiling

Billed by the metre, but hidden once the false ceiling is fitted.

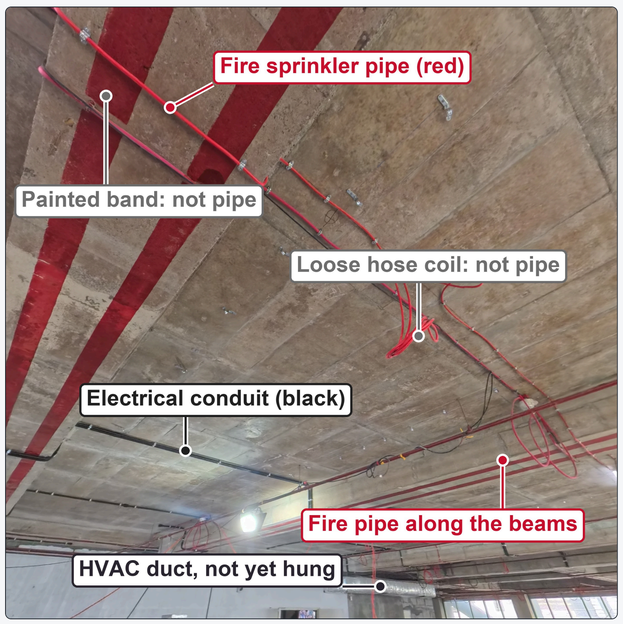


Fig. 1 Fire pipe, two look-alikes and two other services.

28 photos from one walk with a 360° camera, on a floor under fit-out, with an industry partner.

Aim

- Draw the installed fire pipe on the floor plan from one walk of 360° photos.
- Measure its length, with no training for the site.

What is new

Closest study	Needs	Reports
Maalek 2021	Point cloud from video	5.0 % length error
Chen 2023	Point cloud of the site	4.7 % length error
Wen 2025	Trained detector, 3D	Equipment located
This project	**28 photos, 2D plan**	**Layout, length**

Progress monitoring builds 3D first (Reja, Varghese and Ha, 2022); phrase wording was tested only for boxes (Madaschi et al., 2026).

2 Methodology

Result The fire pipe found in one 360° photo



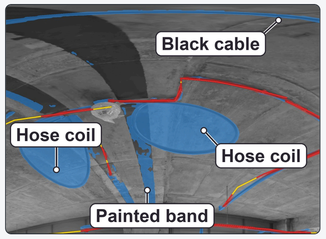
19 of 69 lines kept as fire pipe

Fig. 2 Photo 1, the whole 360° view, after all three approaches: pipe removed

Step 1 Find the pipe: three approaches

Approach 1 · SAM 3

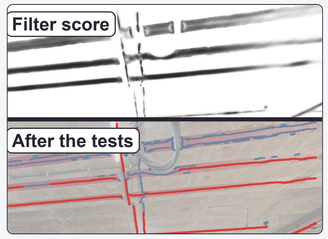
Marks what a phrase names; “red pipe” works best.



Too wide: areas, not lines

Approach 2 · Frangi filter

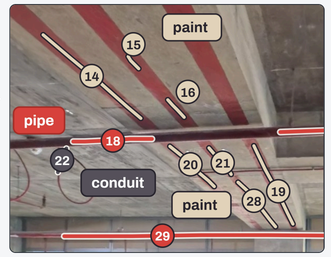
A blood-vessel filter keeps thin red strips as lines.



Paint stripes still pass

Approach 3 · VLM checker

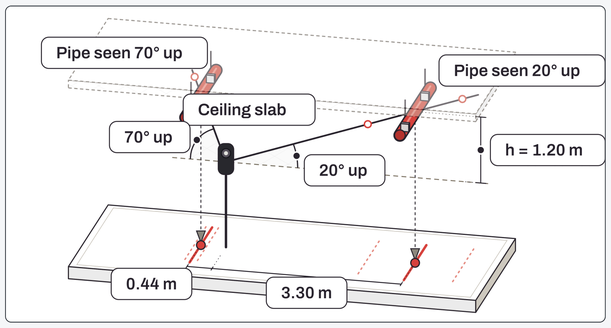
A VLM (Claude Haiku) labels each line; pipe is kept.



Paint gone; some pipe lost

Fig. 3 Photos 18, 1 and 10: pipe not pipe, or dropped. No training for this site.

Step 2 Place each line on the floor plan



$$r = h / \tan \varphi$$

h: pipe height above the camera, assumed 1.2 m.

3 Key findings and results

Each approach against pipe traced by hand

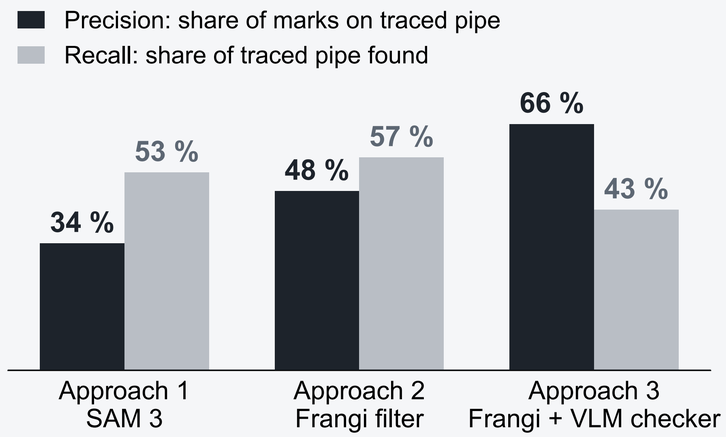


Fig. 4 A mark counts within 20 px of the tracing (about 3 cm at 3 m). Removing paint alone gives **57 %** precision.

Step 3 Join all 28 photos into one network

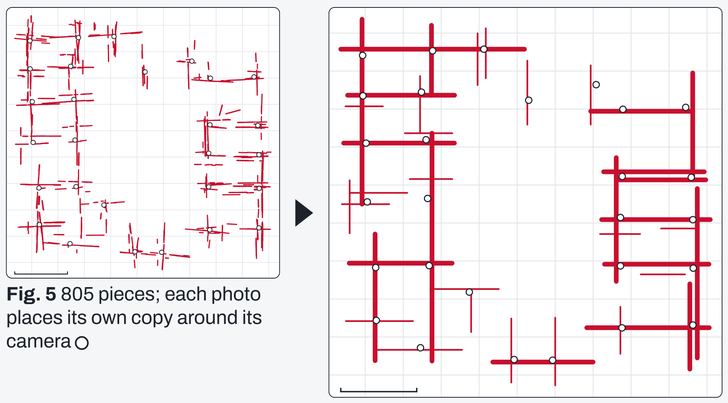


Fig. 5 805 pieces; each photo places its own copy around its camera ○

Fig. 6 Joined into 41 lines; thick where two or more photos saw the pipe

455 m of fire pipe at an assumed *h* = 1.2 m: indicative, not yet a billing quantity.

4 Conclusions

What works

- No training: the filter and the checker draw the fire pipe as mains and branches.
- Precision **34** → **48** → **66 %**.

Limits

- Height assumed: ±0.3 m gives **−118 or +63 m**.
- Recall **43 %** (58 % before checking): thin red lines on the slab, not yet identified.

Next steps

- Measure the pipe height and camera positions on site.
- Compare pipe by pipe with the shop drawing.

References: Reja, Varghese and Ha (2022) Autom. Constr. · Maalek et al. (2021) Autom. Constr. · Chen et al. (2023) ISARC · Wen et al. (2025) ISPRS J. · Madaschi et al. (2026) EC3 · Carion et al. (2025) SAM 3 · Frangi et al. (1998) MICCAI · Anthropic (2026) Claude models