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PARIS-CACHAN
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Deployment and maintenance of artificial intelligence models

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Final project

Electronics Hole qualification

Description:

Quality control is of vital importance during electronics production. As the methods of producing electronic circuits improve, there is an increasing chance of solder defects during assembling the printed circuit board (PCB). Technology like X-ray imaging is used for inspection. AI-based models are proposed in the state-of-the art. As you are AI engineer your are asked to use one of the latest segmentation models to solve this problem of void detection. SAM (segment Anything Model)

It is agnostic model that can segment every single region in the image as a new class, using a point or surrounding the target zones (You may try it here)

Try the project with SAM 2 instead of SAM 1

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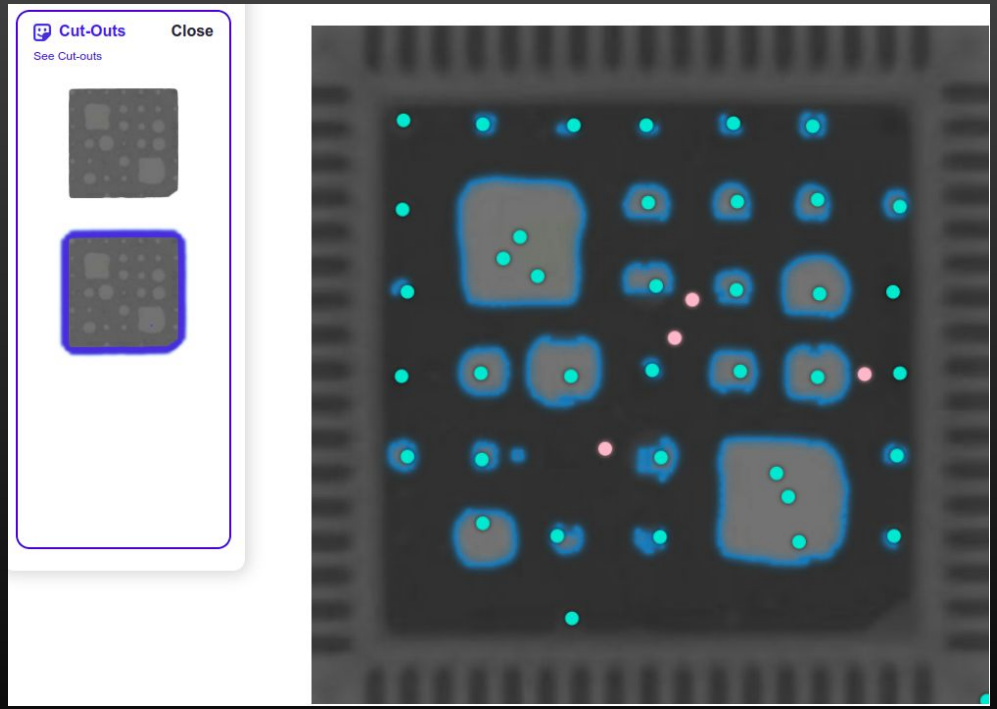
Steps:

- Understand how SAM/SAM2 does work.
- Obtain a dataset of x-ray images from here (ask for sharing if not shared)
- Annotate images using available tools or platforms including SAM/SAM2 tool (to segment by clicking or selecting zones)
- Train Yolo model on the annotated images to find the zone of each hole/void
- Now, you have a model that suggest for each hole a bounding box that you can use to deploy SAM for a better segmentation



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How SAM works, YOLO is a need

- As you see, SAM is an efficient segmentation model, that segments anything

- To segment the target, it needs a user input, a point or a rectangle indicating the target region to be segmented ⇒ therefore it suggest a semi-automatic solution

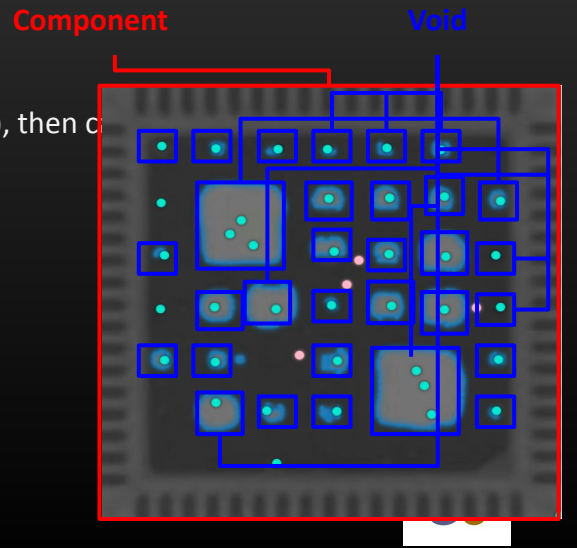
- In the project, we will make the solution fully automatic, by training a yolo on the target , to be selected (bounding box) automatically, so that SAM will segment the image using the output of YOLO that helps SAM to segment the zone determined by bounding box

What to annotate

- In order to quantify the voids, the solution will calculate the area of each void (number of pixels), then c
with regard to its component containing it.

- So, you need to annotate two classes - Component zone

- Voids zones found inside the component



So finally , once SAM segments both classes

Void rate = sum of voids areas (#pixels) / component area (#pixels)

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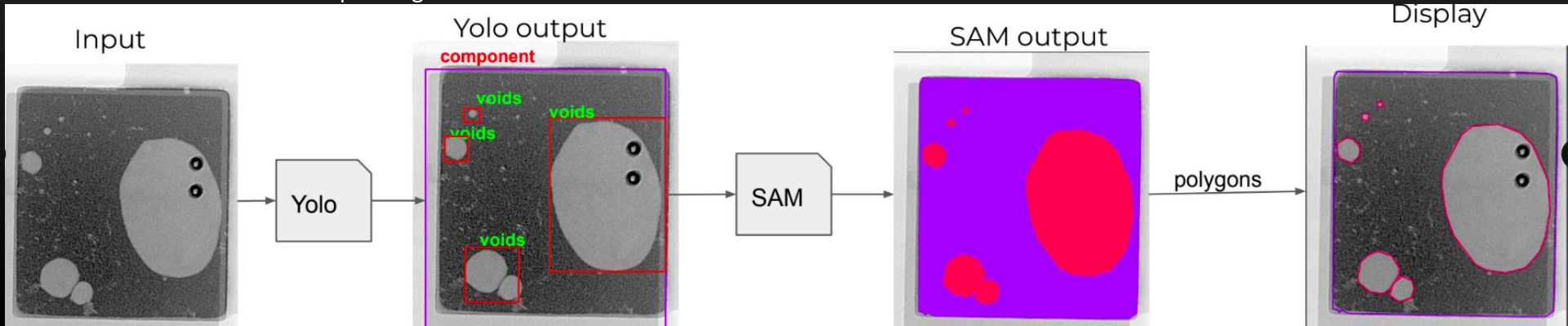
Your task :

- Development a solution :
  - On a collab to start, then on a Mobile application, Cloud or Platform as a service (PAAS) : We want it to have a minimalistic UI
- Your application is able to segment one or multiple input images
- Show each step of the project
  - Use Flask when needed
  - Annotation
  - Augmentation
  - Yolo training on **two classes**: voids and component (darer background)
  - Yolo validation
  - Using a pre-trained SAM to segment voids and background, using the output of yolo
    - Input: image and corresponding bounding boxes given by yolo as output
    - Output: segmented areas with two different masks



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Final output

- Your application will have a page for adding new image to the dataset (with labelling), and another page were you will display the results of the Yolo analysis and the areas
- Once SAM outputs a polygon points, using opencv functions you are able to calculate the area of each mask
  - Components areas
  - Void areas
  - ⇒ calculate the rate of voids : r = component area / total voids areas within a components
- Your application is able to output a report ‘csv, as shown
- **Optional ** :** Create a dockerfile of the project to run locally
- Quantize and set Yolo in the ONNX format for the deployment

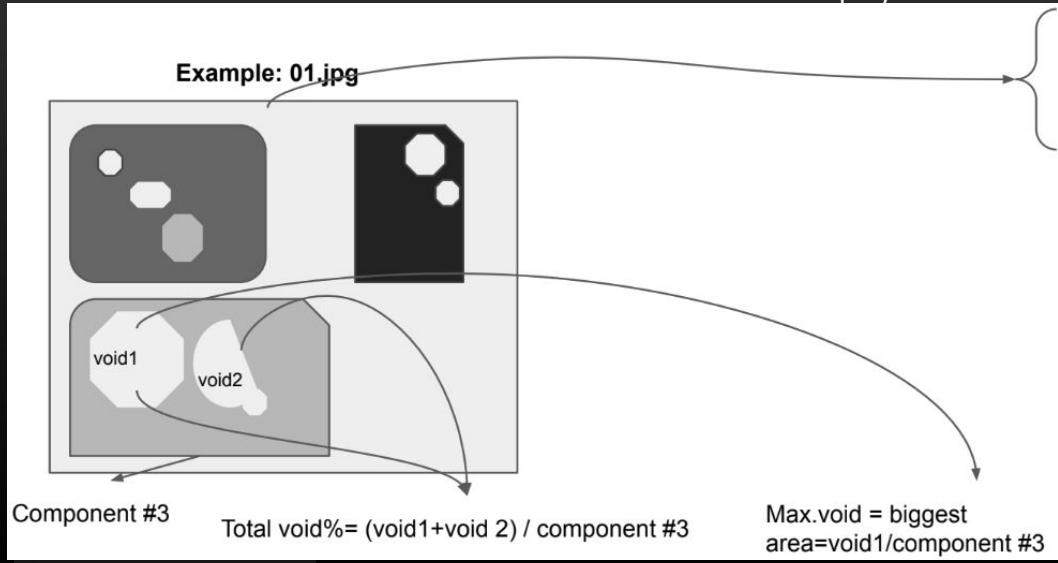

Image	Component	Area	void %	Max.void %
01.Jpg	1	100	0,25	0,15
	2	45	0,15	0,08
	3	150	0,5	0,38
02.Jpg	1	150	0,3	0,25
	2	50	0,15	0,08