

AI based Electronic Component Identifier

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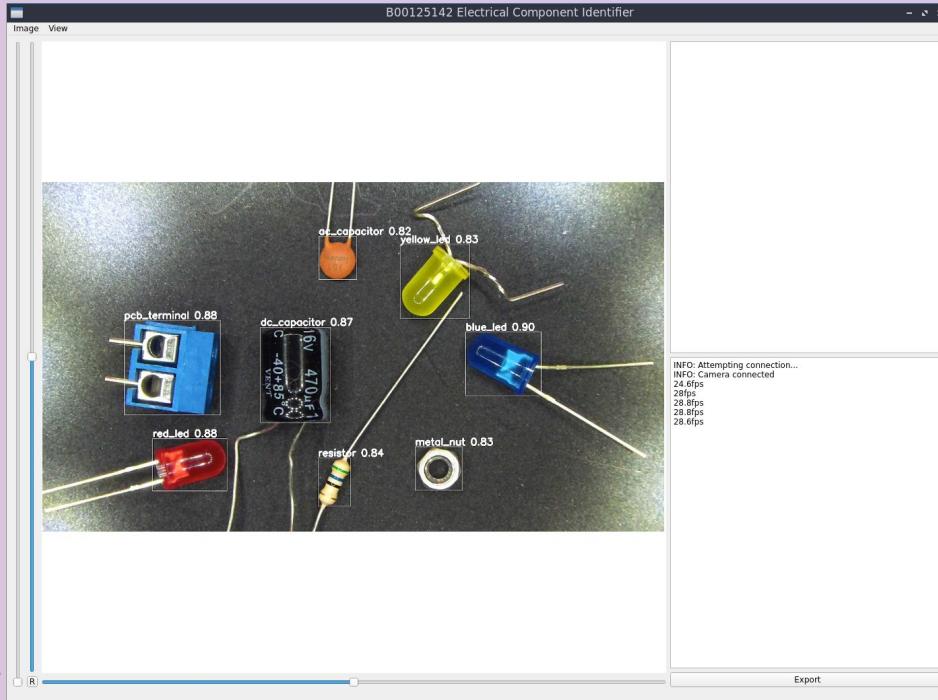
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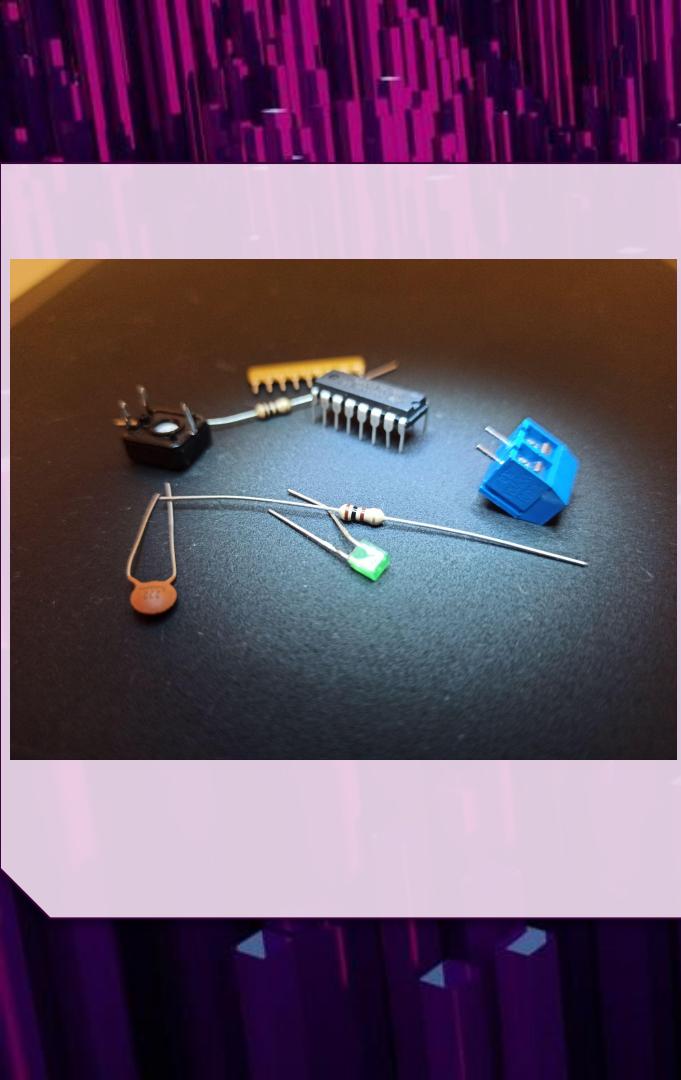
Introduction

- Uses **AI** to detect objects from **images**.
- Detects **electronic components**.
 - **Identifies** their properties.
 - Type
 - Color/number code
 - Marking code
- Designed as a **tool for engineers**.
 - Assists bulk analysis.
- **Light** to run.
 - Potential **mobile device** deployment.
- **Incredibly heavy** to set-up.
 - **Training** is done on a **powerful machine**.



Object detection

- Important in
 - Security
 - Notifying concerns
 - People
 - Animals
 - Flora
 - Production
 - Discarding defects
 - Damage
 - Analysis
 - Quality inspection
 - Scratches
 - Spots
 - Classification
 - Resistor
 - Capacitor
 - Total and class count



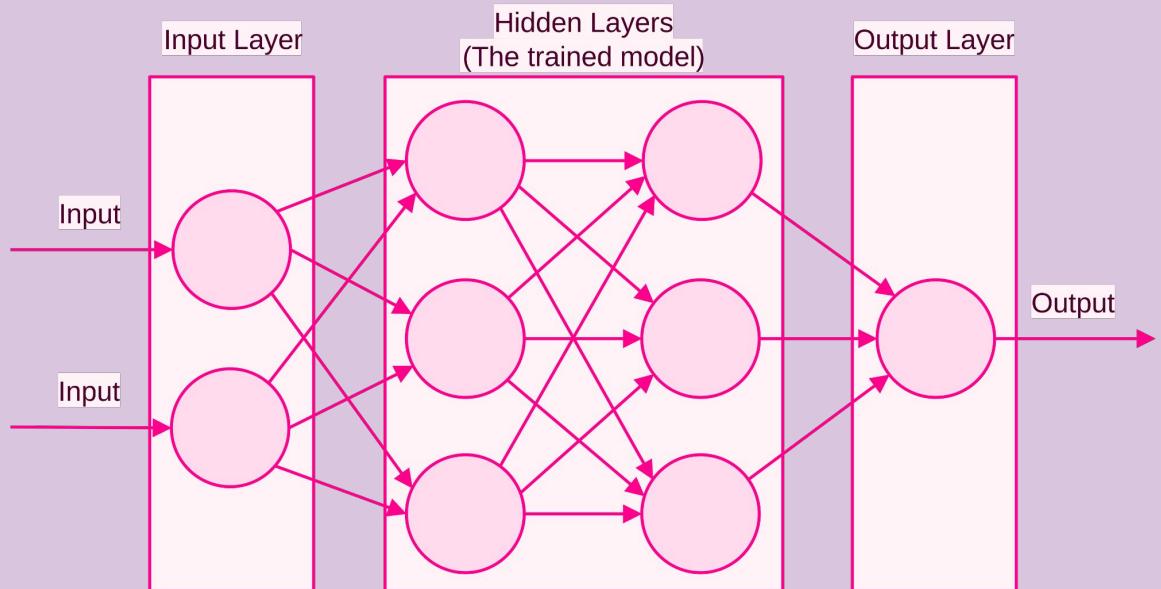
The problem

Object detection from images:

- Natural to **intelligent** creatures.
 - Designed for **object detection** through evolution.
 - Second nature.
- **Binary data to computers.**
 - Has no concept of object, image, or color.
 - Everything is perceived the same.



Simple Neural Network Diagram



Chosen architecture



The solution

Neural Networks

- Complex networks of **neurons**.
- Each **neuron**
 - Holds **weight**.
 - **biases** the output.

Inference

- Utilises a **trained model** to **detect objects**.
 - Architecture used: **YOLO**
 - **You Only Look Once**[1]

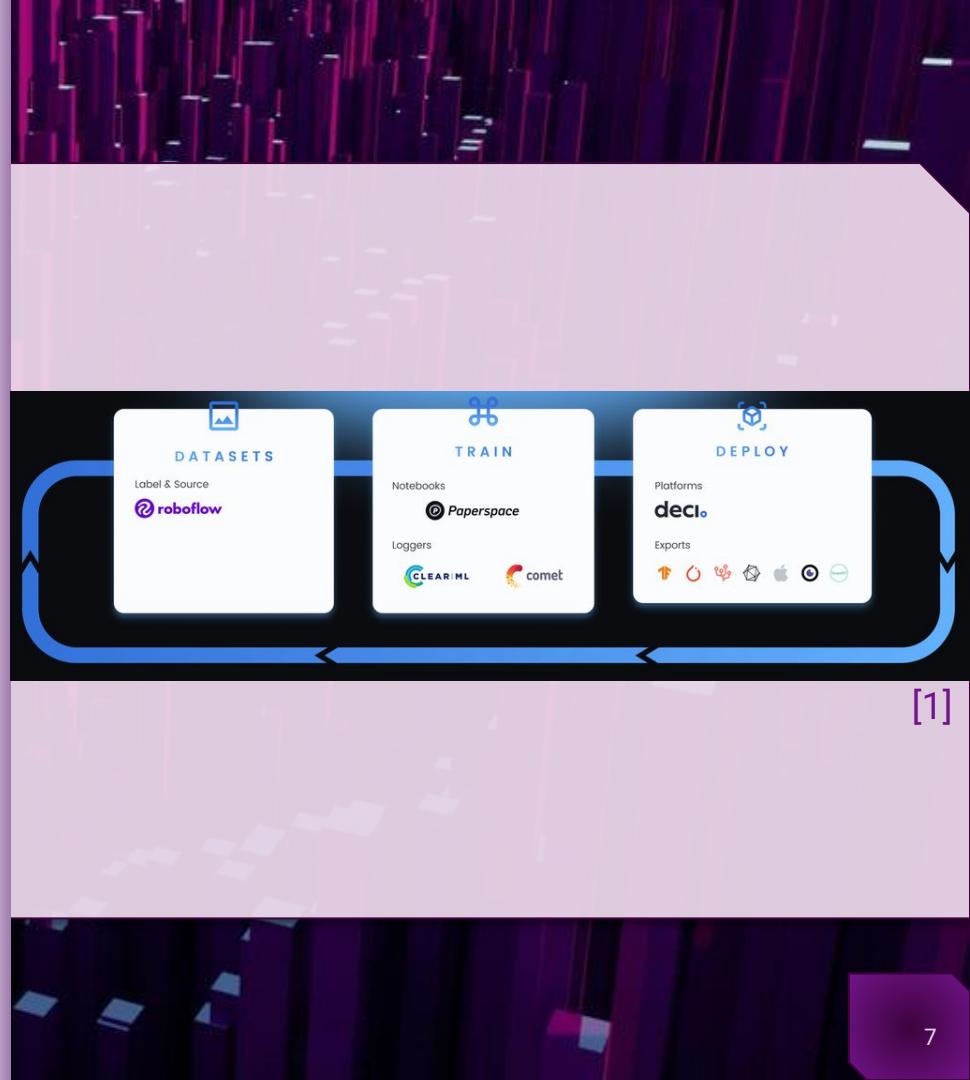
Model Training

- **Images must be labeled manually.**
 - A **label** represents **where** and **what class** is contained.
- **Each picture** should have some **variation** in conditions.
 - **Position**
 - **Rotation**
 - **Lighting**



Model Training

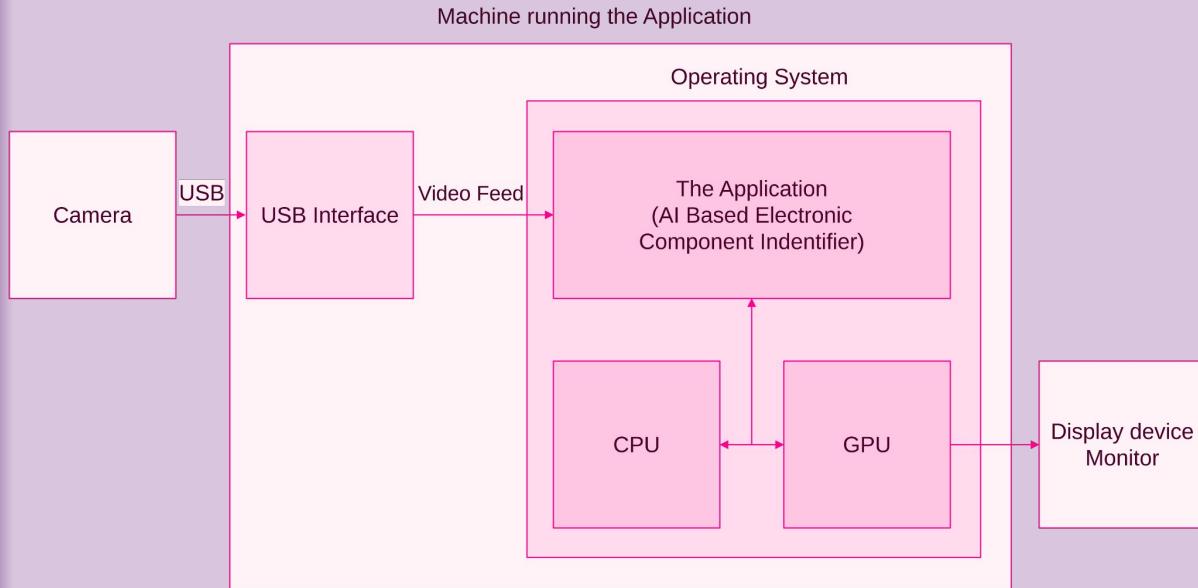
- Training requires **two labeled datasets** to train on.
 - Bigger: for **training**.
 - Smaller: for **evaluation**.
- Trained on over **3000** images.
 - Manually **labeled**.
 - **Classes:**
 - Resistor (Single, SIP)
 - Capacitor (AC, DC)
 - LED (Red, Green, Blue, Yellow, Clear)
 - Metal Nut
 - Integrated Circuits
 - Light Dependant Resistor
 - Diode



System Block Diagram

Concept Diagram

- **Camera** is External.
- Communication through **USB**.
- The application utilises both **CPU** and **GPU**.



IC
0.98
Pins: 8x2
Label: Unknown



LED
0.95
color: RED



Resistor
0.92

color code: 1014
value: 100Ohm*±4%



Capacitor
0.94

Capacitance: 220uF
Rated for: 25V



Note: For now, this was achieved through image manipulation.

Post-Processing

Additional processing of the **output** provided by the **inference**.

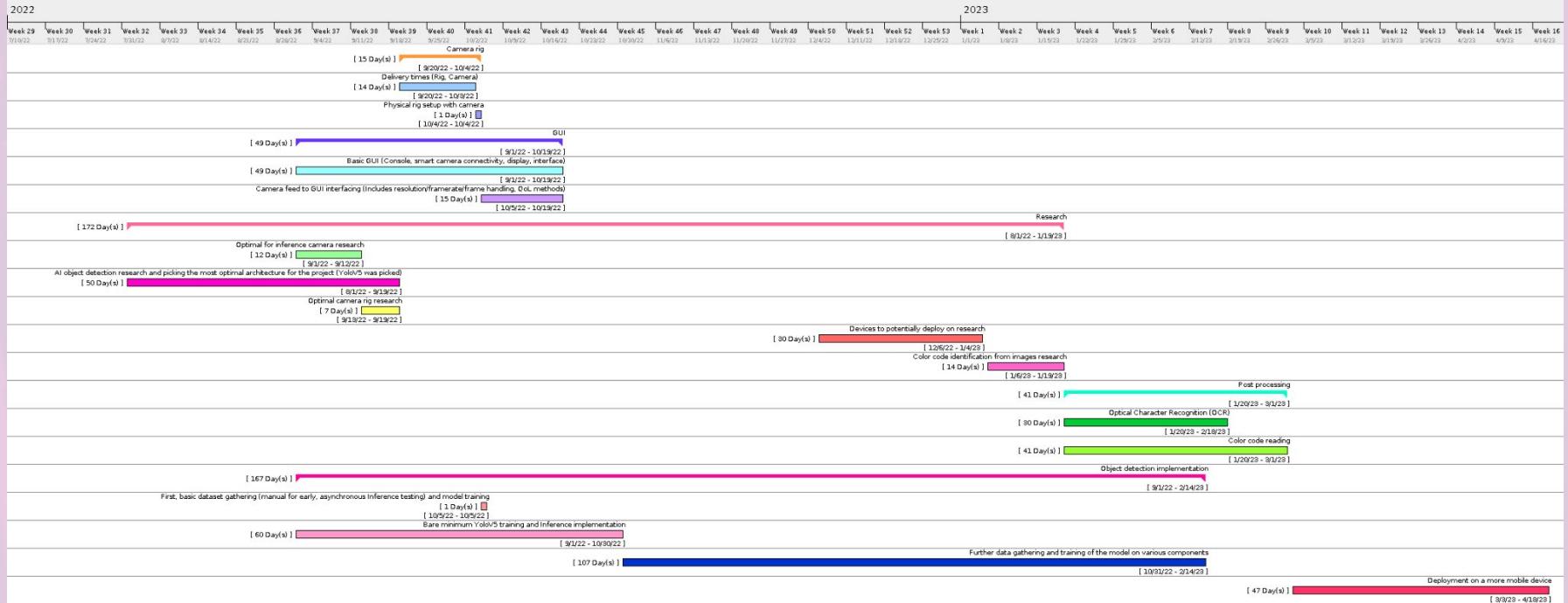
- **Identification** of (For those that apply)
 - **Labels** using **Text Recognition**
 - **Color/number codes**
 - **Pin count**
 - **Color** (LED)

Progress

- **Rig**
 - Fully setup.
 - Has an attachable **ring light**.
 - Used to **gather** all of the **training data**.
 - Taken over **300 labeled images** of each **class**.
- **Model Training**
 - Achieving confidence **up to 99%**.
 - Usually **above 80%**.
- **Inference**
 - Running at real-time **30fps** (Camera limitation).
- **Post-processing**
 - Only lightly touched, not in good shape yet.



Timetable



[2]

Discussion

- In comparison to **algorithms**, and sometimes even **humans** - inference is capable of extracting an **Extremely high** level of detail from an input image.
 - **Post-processing** will be more prone to **error**.
- The **training** of the current **model** for **300 epochs** takes over **10 hours**.

Conclusion

- Sufficient amount of **data** has now been **gathered**, yielding **impressive results**.
 - While the **project** is mostly **software focused**, a **high quality rig setup** was essential in gathering a **high quality dataset**.
 - This **concludes** the **gathering** of data.
- The project is coming along great so far!
 - The next focus will be the **post-processing**.

References

- [1] YoloV5 <https://github.com/ultralytics/yolov5>, accessed on 6th of November, 2022
- [2] Gantt Project <https://www.ganttproject.biz/>, accessed on 6th of February, 2023



The end

Any questions?