

# AI based Electronic Component Identifier

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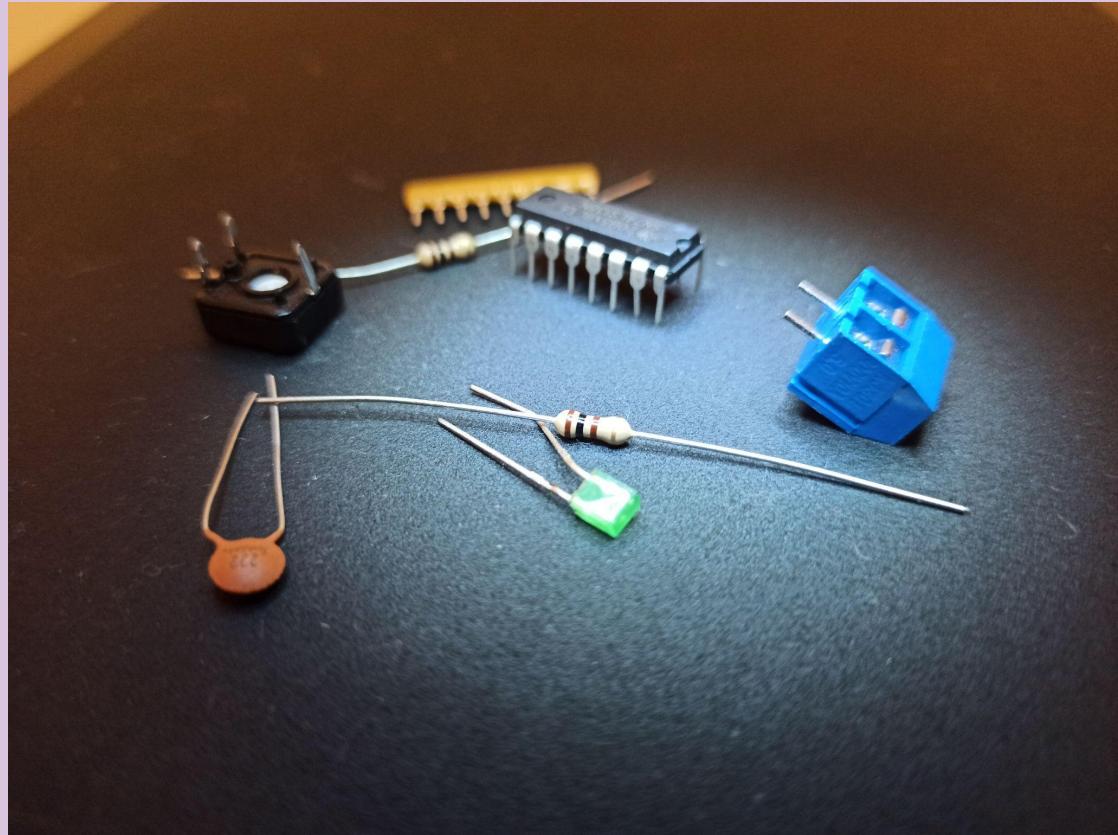
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**Course ID:** TU807

# 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



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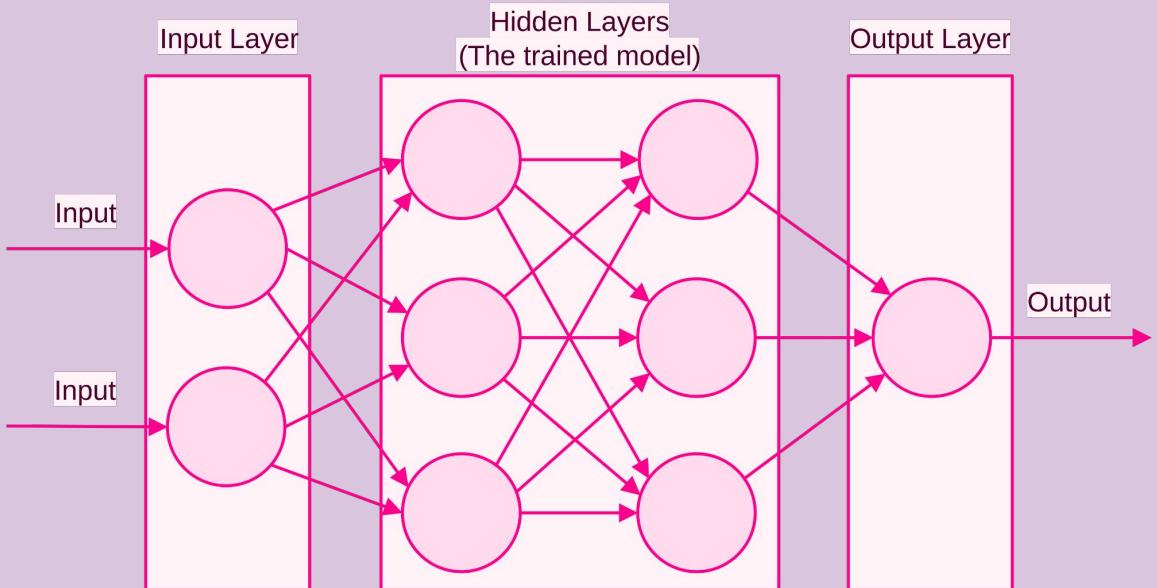
# The problem

- **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 processed the same.

# The solution

- **Neural Networks**
  - Complex networks of **neurons**.
  - Each **neuron** holds weight for specific input bias.
    - Trained against certain **datasets**, in hope of recreating the function.
  - The **output** is processed by the **neurons**.
- In image **object detection**, input is each individual pixel.

## Simple Neural Network Diagram



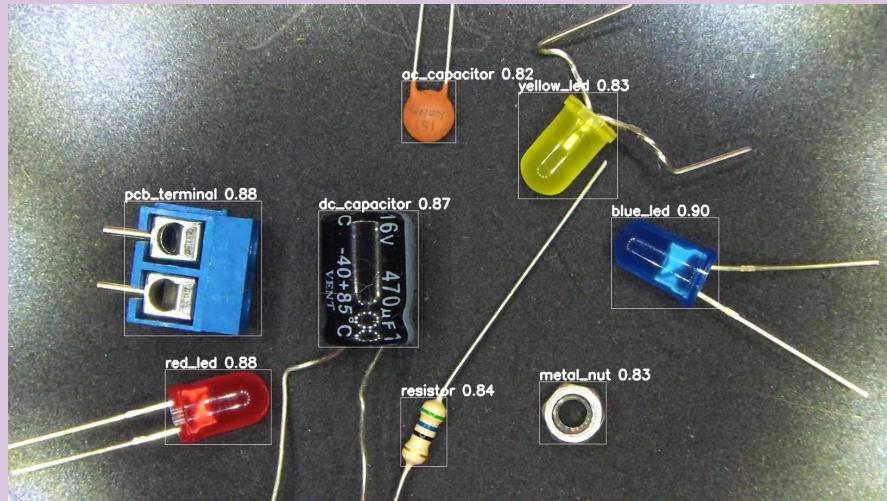
Chosen architecture



# AI based Electronic Component Identification

## GUI display

- **Identifies:**
  - **Position** (Bounding Box on a live display).
  - **Class name.**
    - Resistor
    - Capacitor
  - **Confidence** (Percentage).
  - **Quantity.**
  - Potential **extra information:**
    - Resistors - **Color code** to Ohms.
    - Capacitors - **Number code** to farad.
    - IC - **Pin count, text on the IC if visible.**



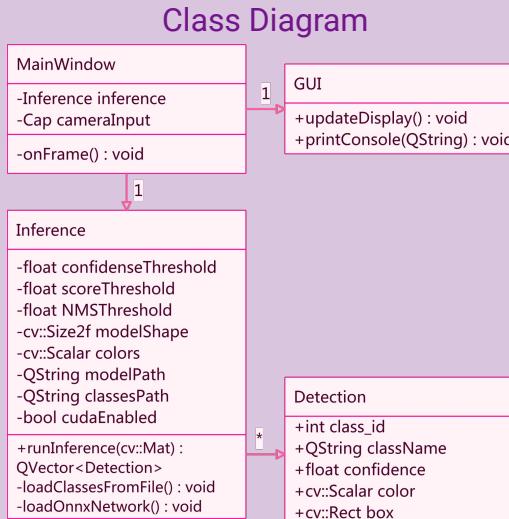
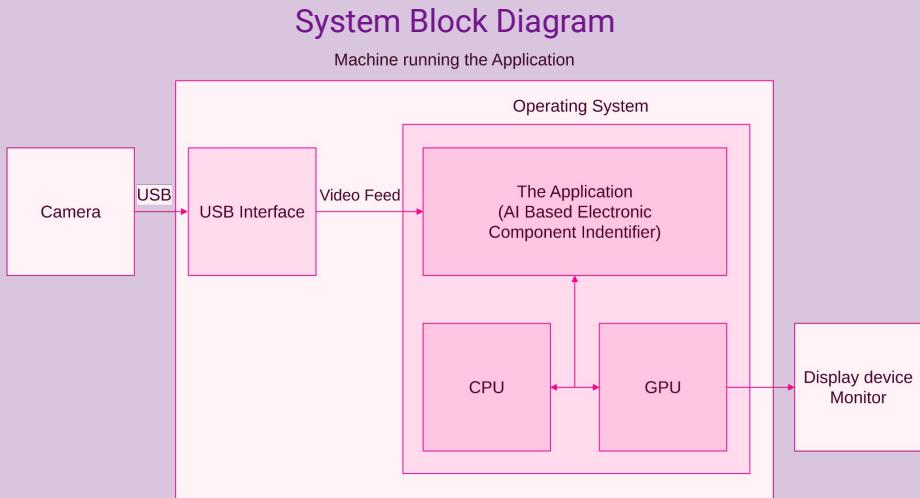


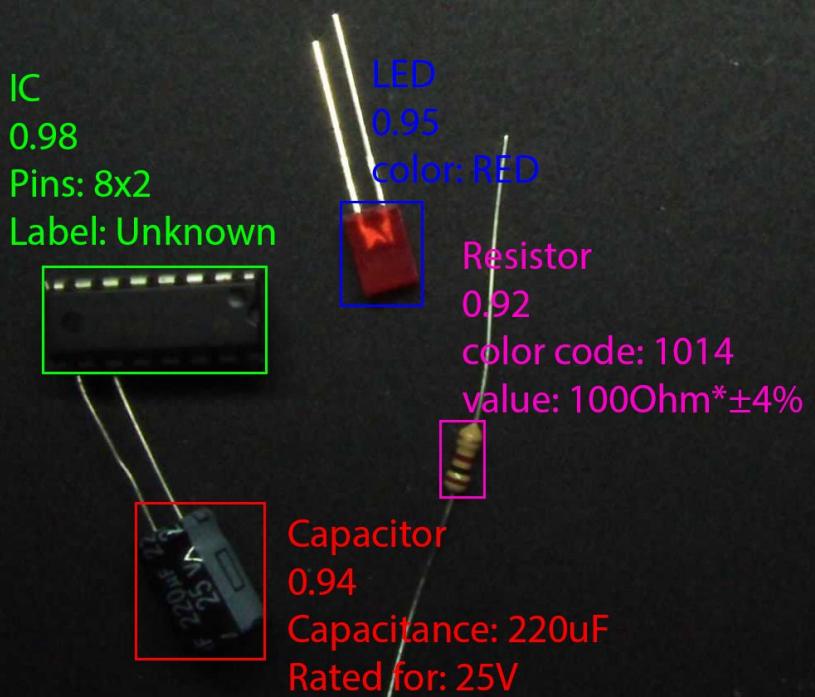
# Model Training

- Trained on over 3000 images.
    - Taken on the rig.
    - Manually labeled.
    - Classes:
      - Resistor (Single, SIP)
      - Capacitor (AC, DC)
      - LED (Red, Green, Blue, Yellow, Clear)
      - Metal Nut
      - Integrated Circuits
      - Light Dependant Resistor
      - Diode
  - Each picture should have some variation in conditions.
    - Position
    - Rotation
    - Lighting

# Concept Diagrams

- System Block Diagram
  - Camera is External.
  - Communication through **USB**.
  - The application utilises both **CPU** and **GPU**.
- Class Diagram
  - MainWindow is the controller.
  - **Inference** is responsible for **object detection**.
  - **GUI** is the output.





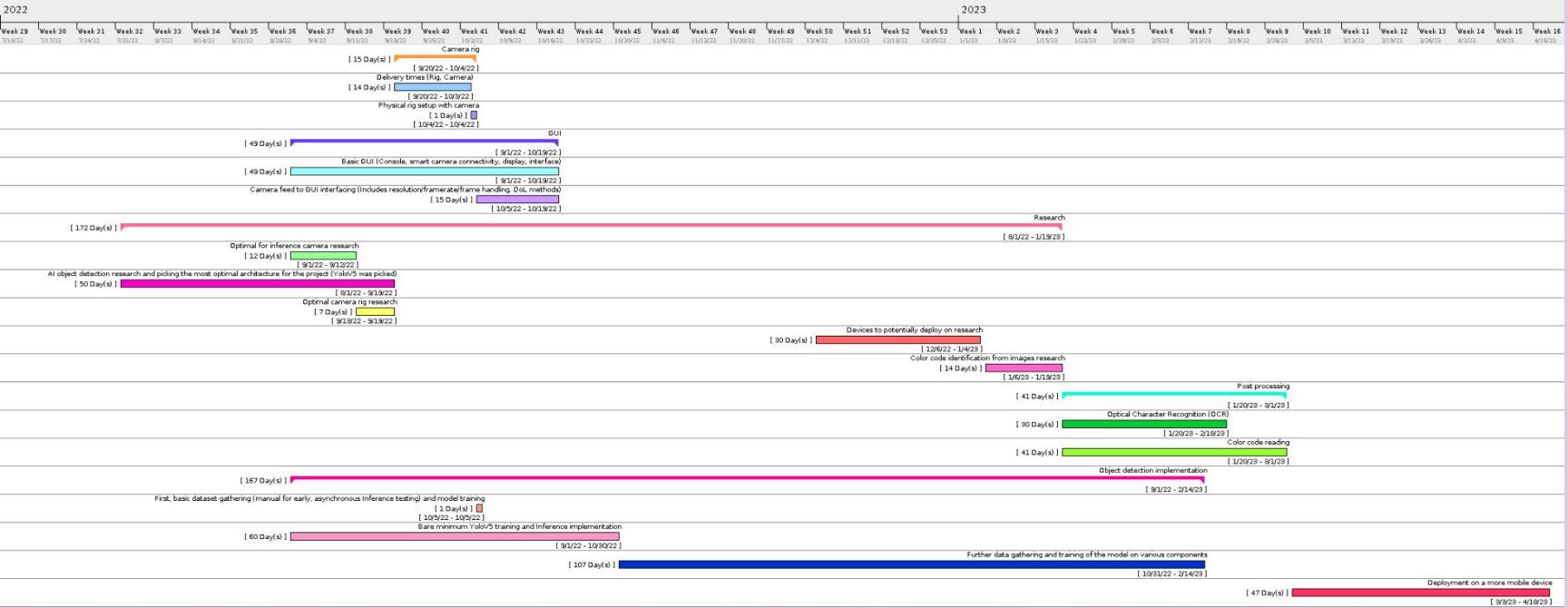
Note: For now, this was achieved through image manipulation.

# 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)

# 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.
  - As **post-processing** is **algorithmic**, it is expected to be **considerably less accurate**.
    - **Missed letters** must depend on **auto-correction**, which is another **algorithm**.
    - **Color shift** may result in a **wrong color code read**.
- **Gathered** over **3000 labeled images**.
  - 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 additional **data** to prioritise **other milestones**.
- 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?