

AI based Electronic Component Identifier

Student: Violet Concordia

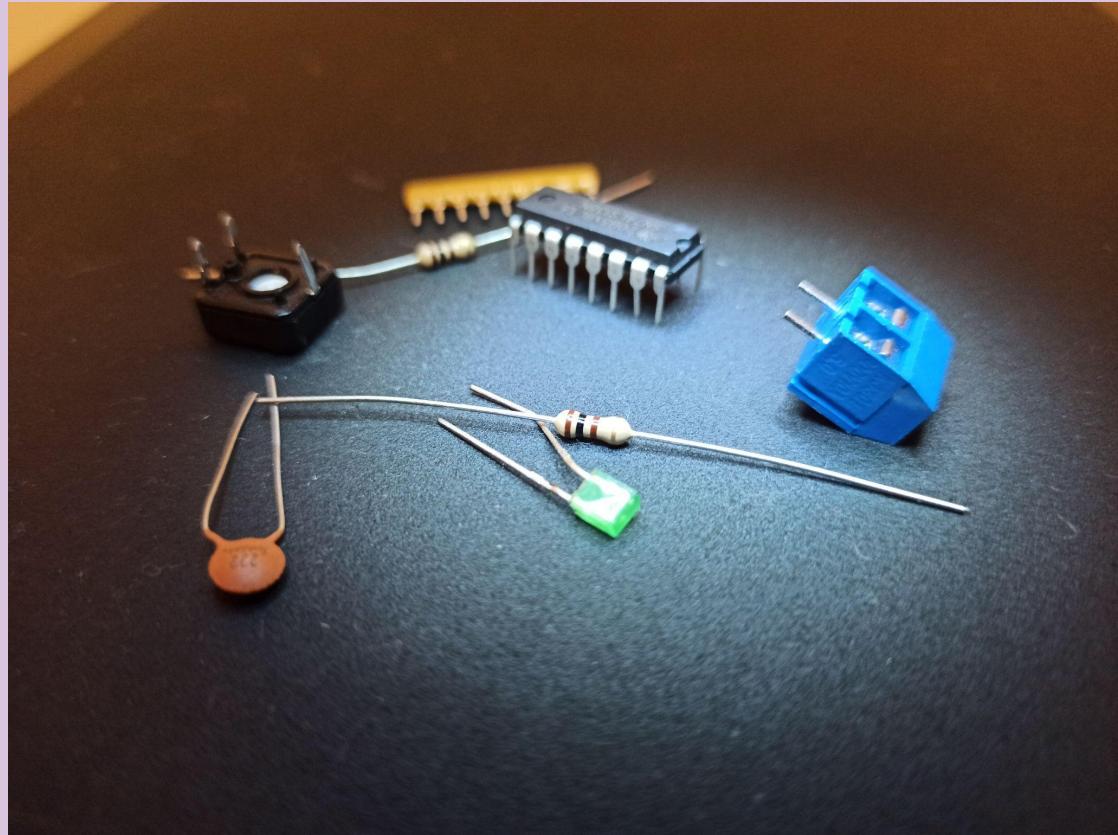
Student number: B00125142

Supervisor: Benjamin Toland

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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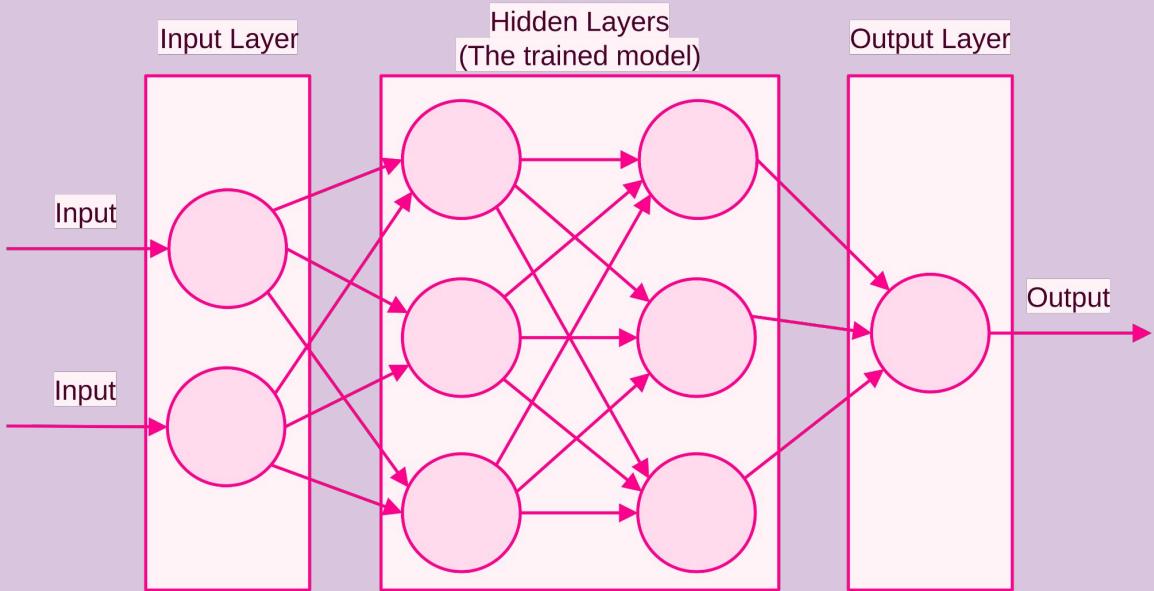
The problem

- **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.

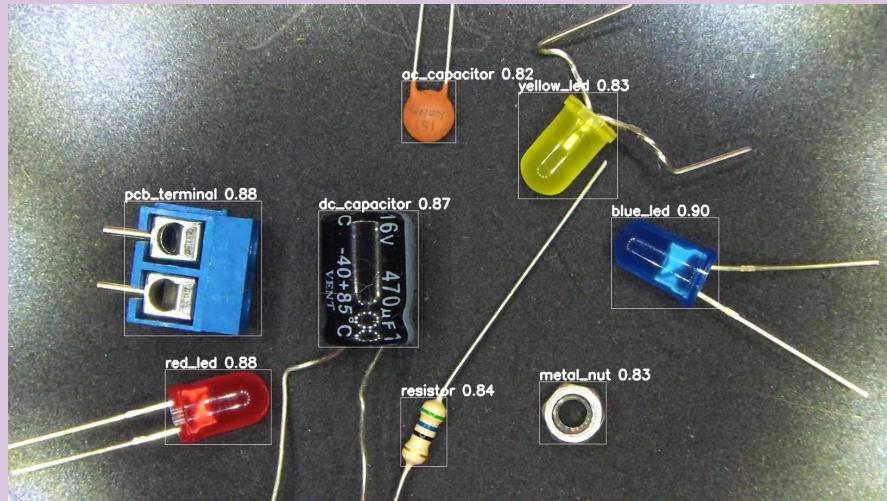
Simple Neural Network Diagram



AI based Electronic Component Identification

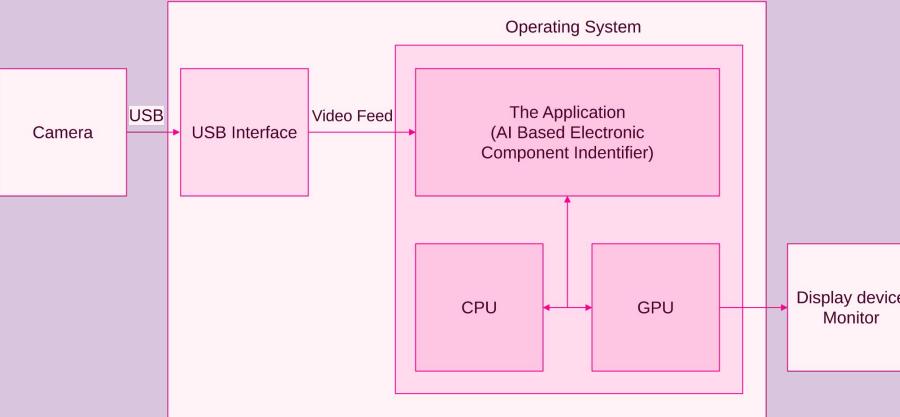
GUI display

- **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.**

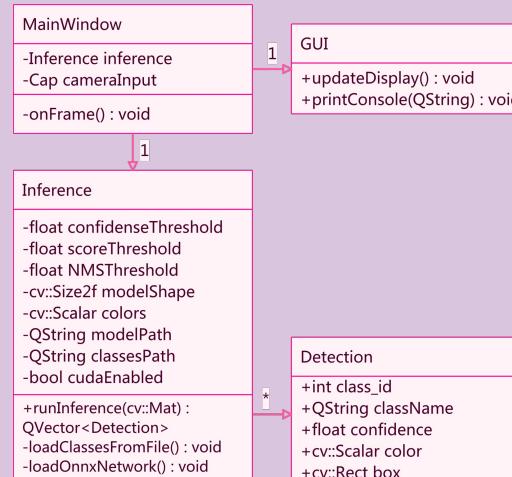


System Block Diagram

Machine running the Application



Class Diagram



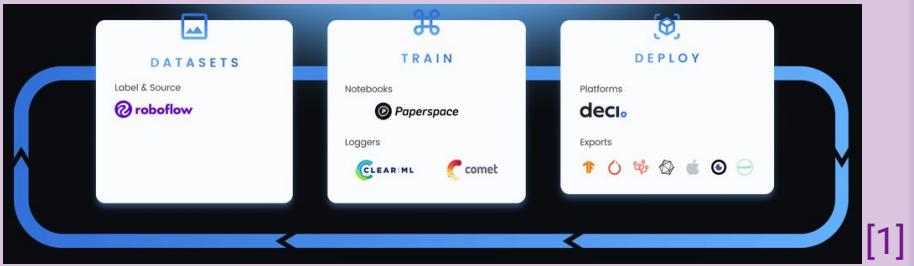
Concept Diagrams

- **System Block Diagram**

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

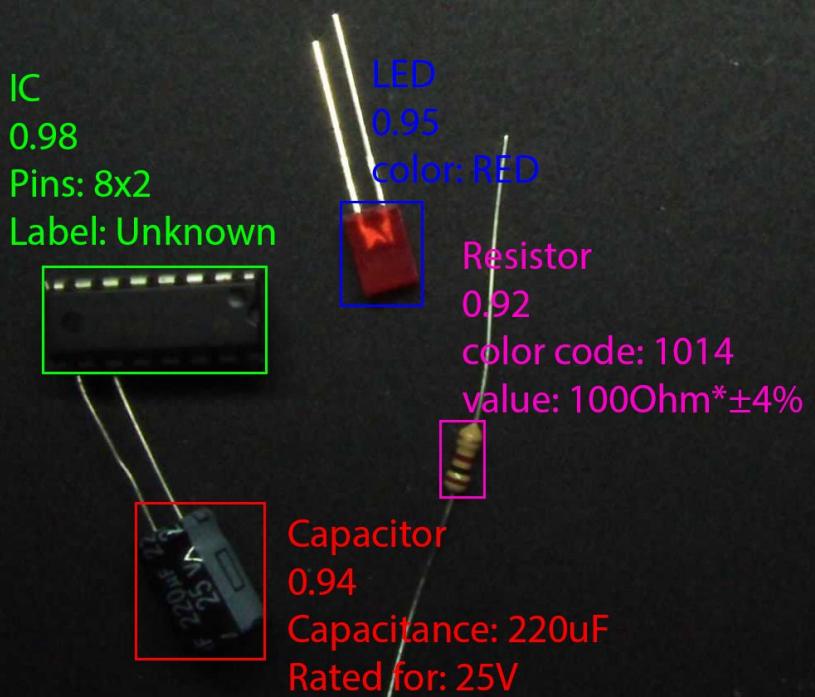
- **Class Diagram**

- MainWindow is the controller.
- **Inference** is responsible for **object detection**.
- **GUI** is the output.



Model Training

- Trained on over **3000** images
 - Taken on the **rig**.
 - Manually **labeled**.
- **Each picture** should have some **variation** in conditions.
 - Position
 - Rotation
 - Lighting



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)

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**.

References

- [1] YoloV5 <https://github.com/ultralytics/yolov5>, accessed on 6th of November, 2022



The end

Any questions?