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Semi-automated Sorting System for Germinated Oil Palm Seeds

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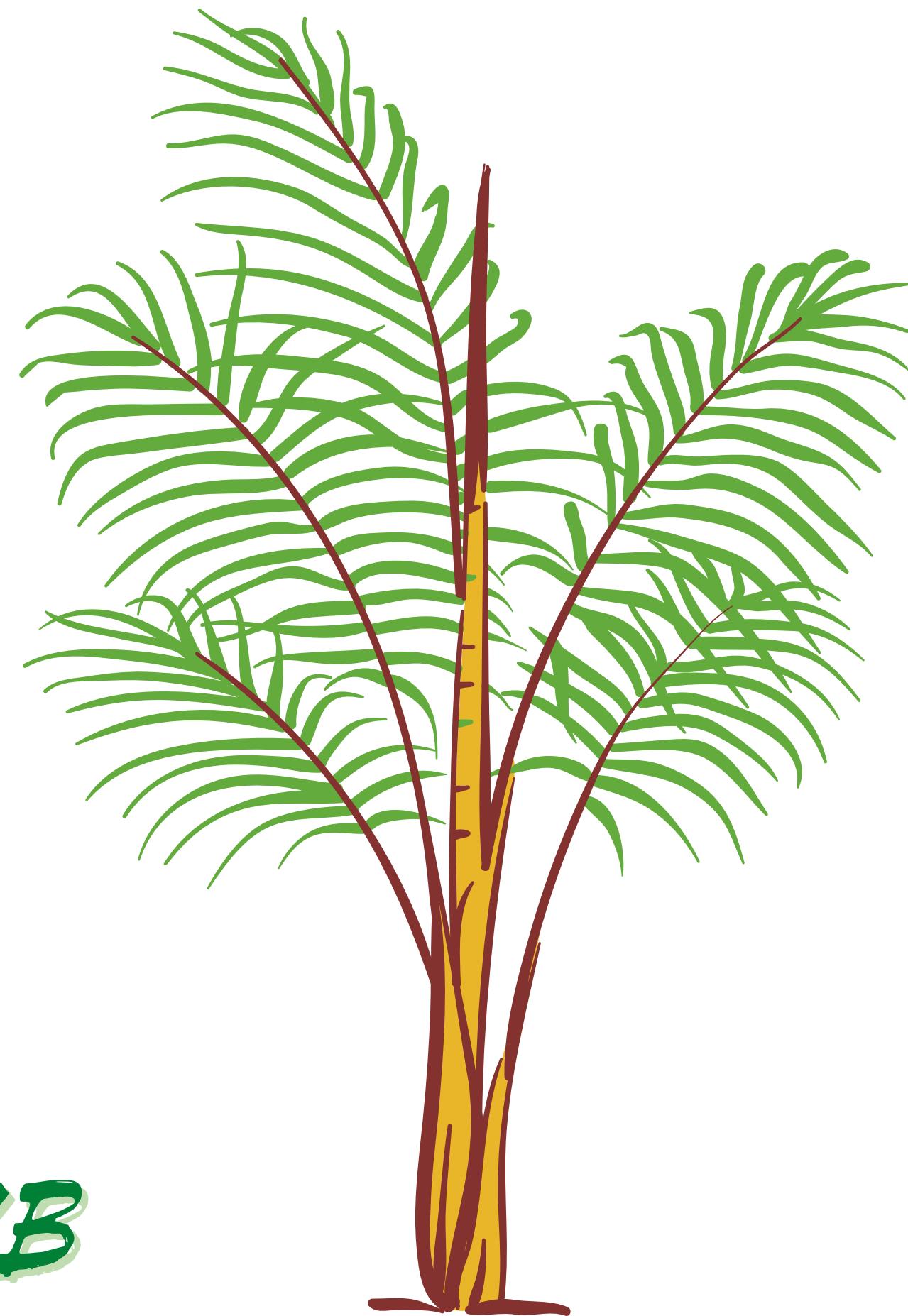
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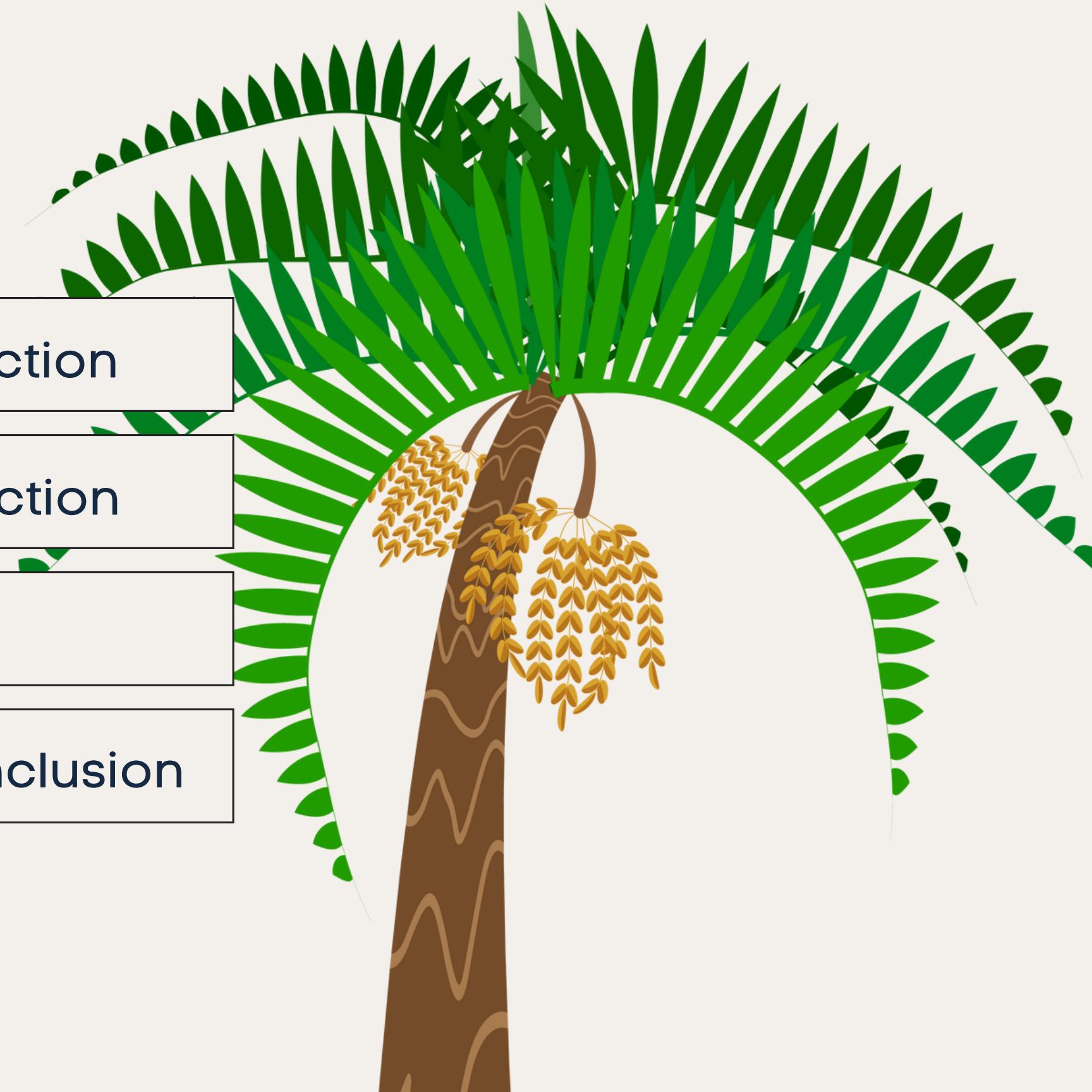
Supervised by Dr Iman Yi Liao

Group 7B



Content Outline

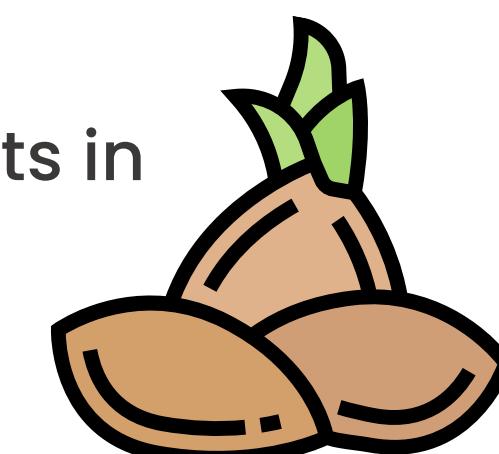
- 01 Project Introduction**
- 02 System Introduction**
- 03 Achievement**
- 04 Summary & Conclusion**



Introduce

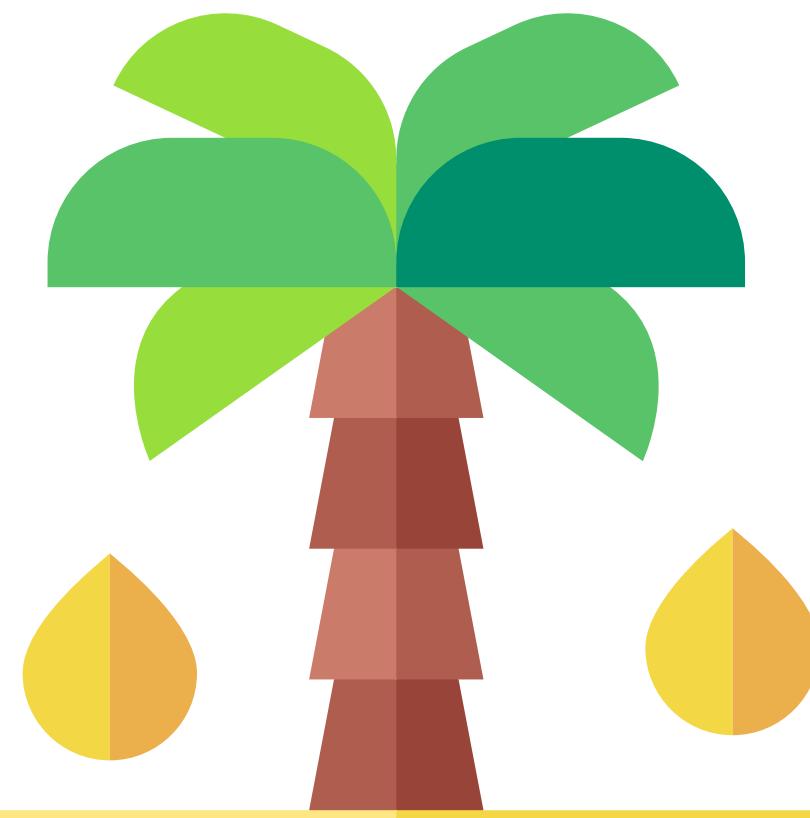
CLIENT

- Advanced Agriecological Research Sdn. Bhd.
- more than 65 research executives and 650 dedicated staff members and workers.
- More than 400,000 hectares of oil palm estates belong to their Principals and commercial clients in different countries.



GOAL

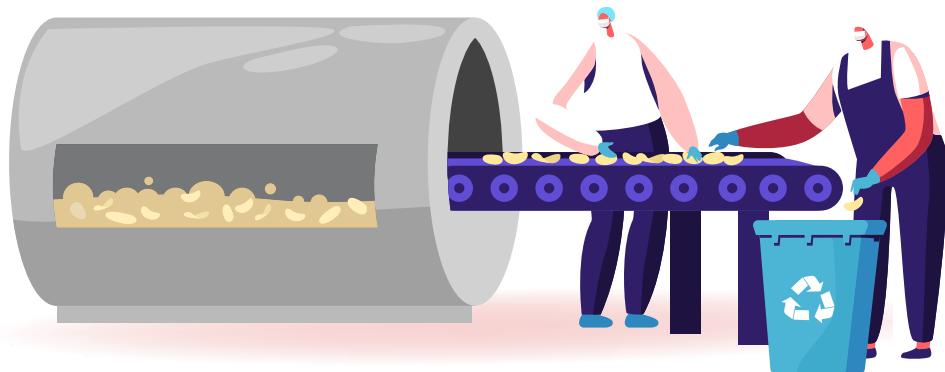
- A semi-automated sorting system for germinated oil palm seeds
 - Quality control with minimal manpower required.
 - Minimal/no use of the internet
 - Project prediction results onto tray



Current Solution

Tradition Sorting Method:

Manual Sorting



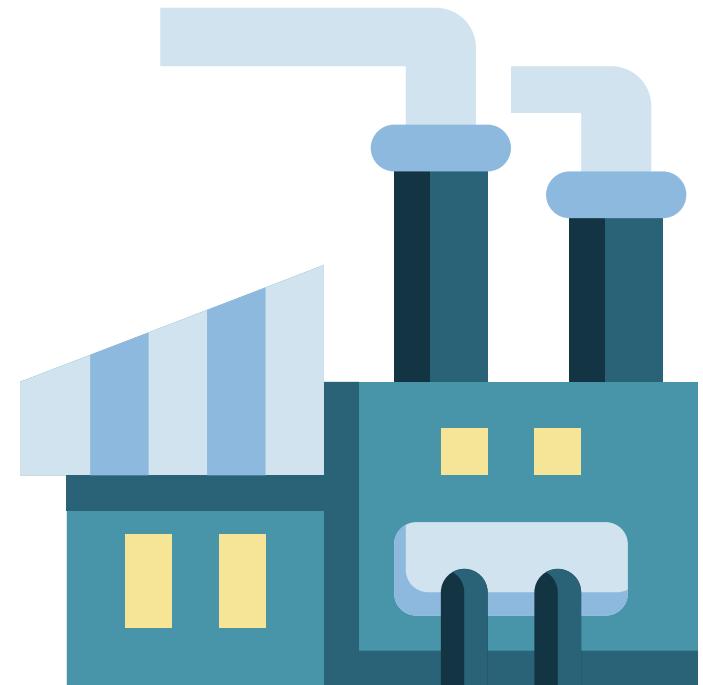
Time-consuming



Human Error-Prone



Costly

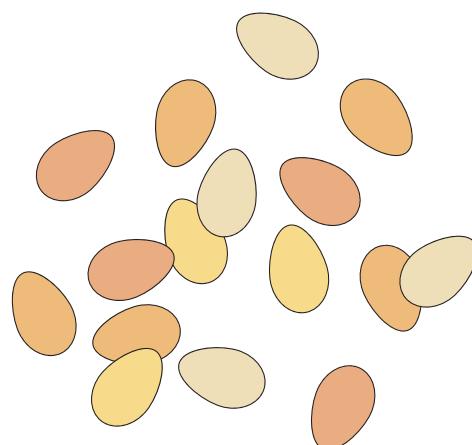


Project Scope

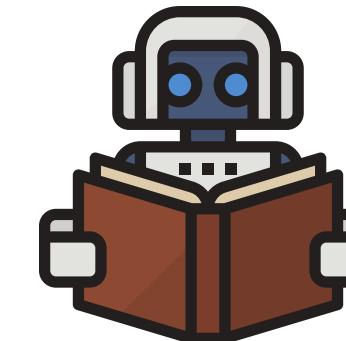


Semi-automated sorting system

A sorting system for sorting germinated oil palm seeds based on quality control

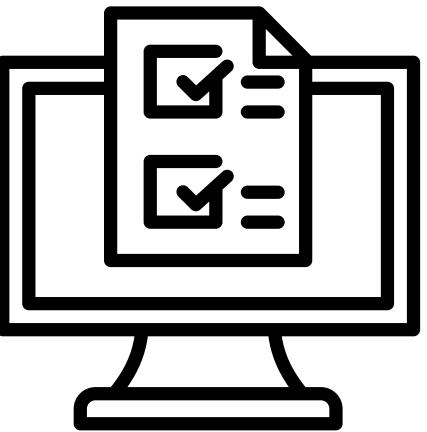


Hardware & Software Involved



- Machine Learning
- Image processing
- Human-Computer Interaction
- Conveyor belt
- Electronic Components

Project Deliverables



Focus of project

- Construct a small-scale prototype
- Classify the seeds based on their quality
- Manual sorting of seeds based on prediction with the assistance of laser illumination

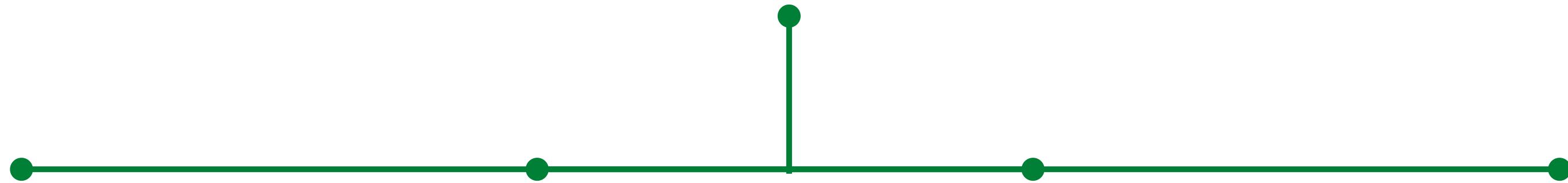
Proof-of-concept semi-automated sorting system

- Able to accurately classify the quality of seeds
- Able to work with hardware and software

Why does the client want this sorting system to be developed?

- Eliminate human error
- Reduce overhead
- Increase work efficiency

System Requirements



Seed Prediction

Identify and classify the quality of seeds

Results Display

Display prediction results of seeds with bounding boxes in the GUI

Illumination system

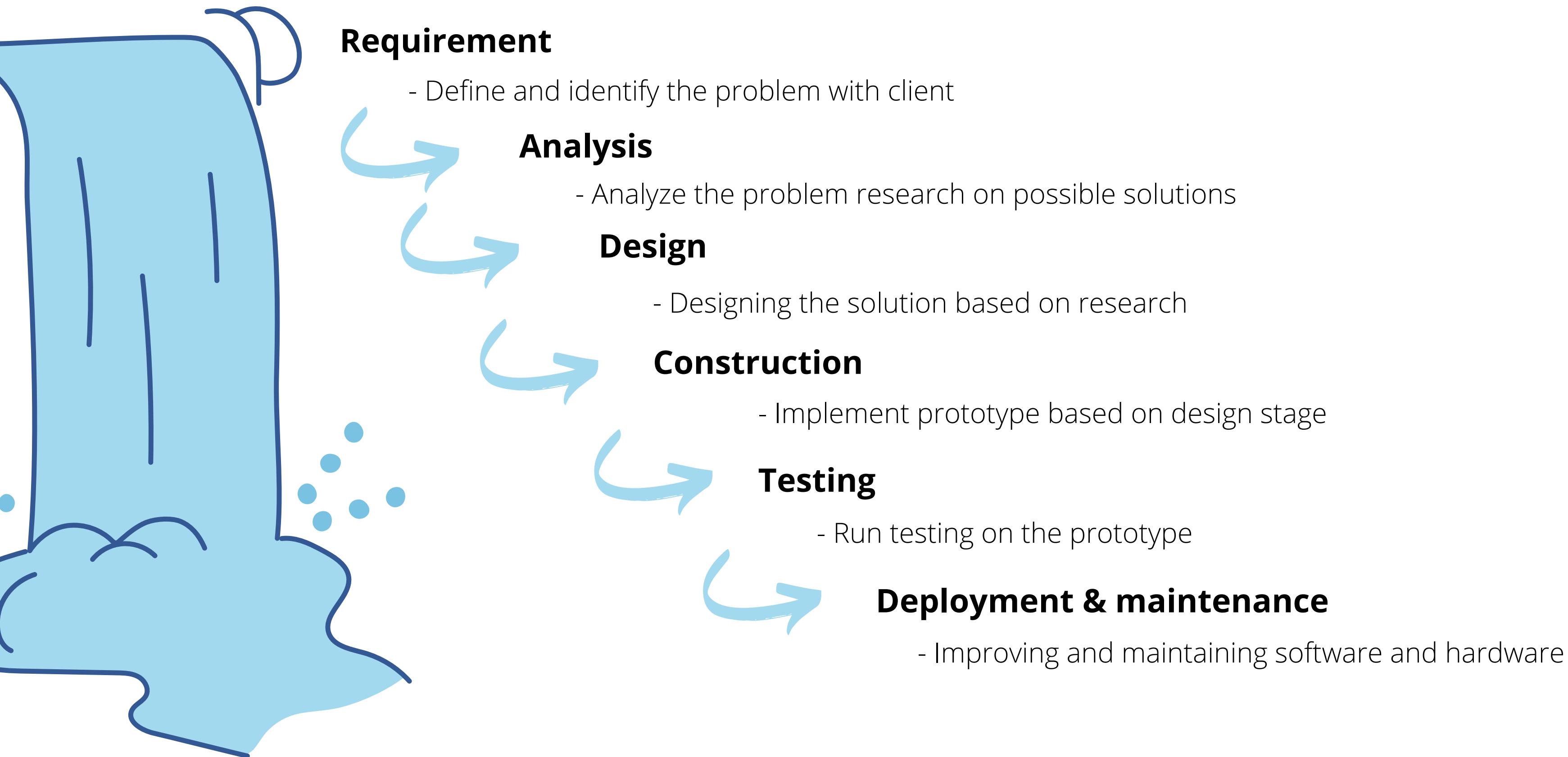
Illuminate the positions of good seeds with lasers diodes

Data Record

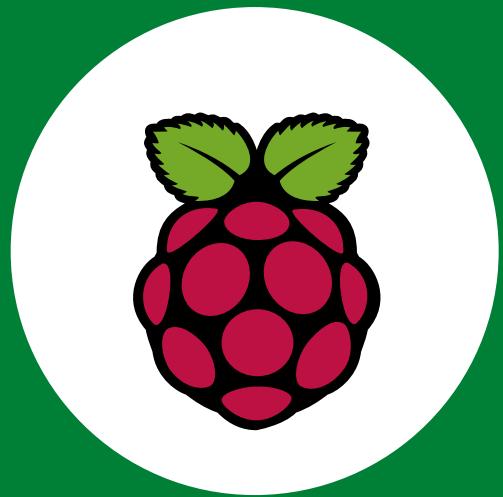
Record information of the seed quality predicted in every tray of seeds



Waterfall Methodology

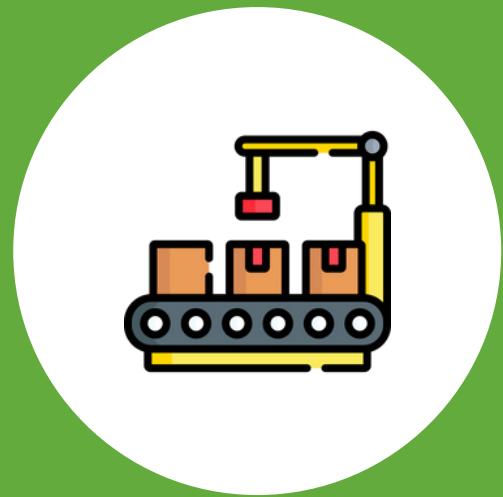


System Components



Raspberry Pi 4B

- Used to run the software program
- Used to connect the hardware to the software



Conveyor Belt

- To transport the tray of seeds from one end to another end.



Algorithm

- Seed detection, segmentation, prediction and classification model by Dr Iman.



Camera

- Capture image of the tray when detected by IR Sensor

System Components



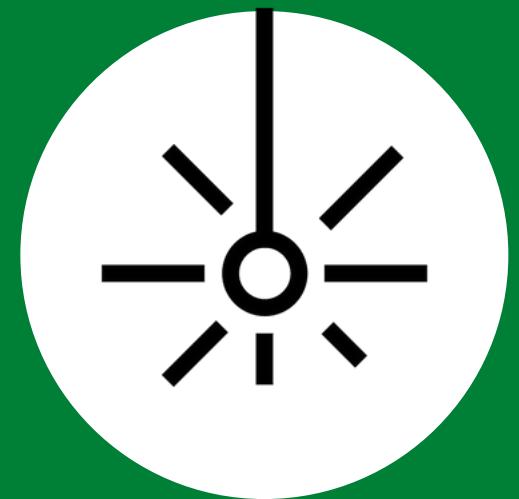
Light Stands

- Increase light intensity when taking the object images.



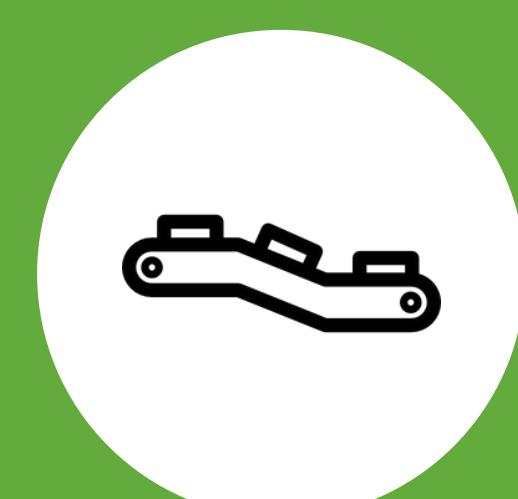
Infrared (IR) Sensor

- To detect the seed tray when it passes by.



Laser

- Illuminates the position of good seeds on the tray.



Sorting Station

- Where the illumination process takes place.
- Where the worker sort the seeds based on results.

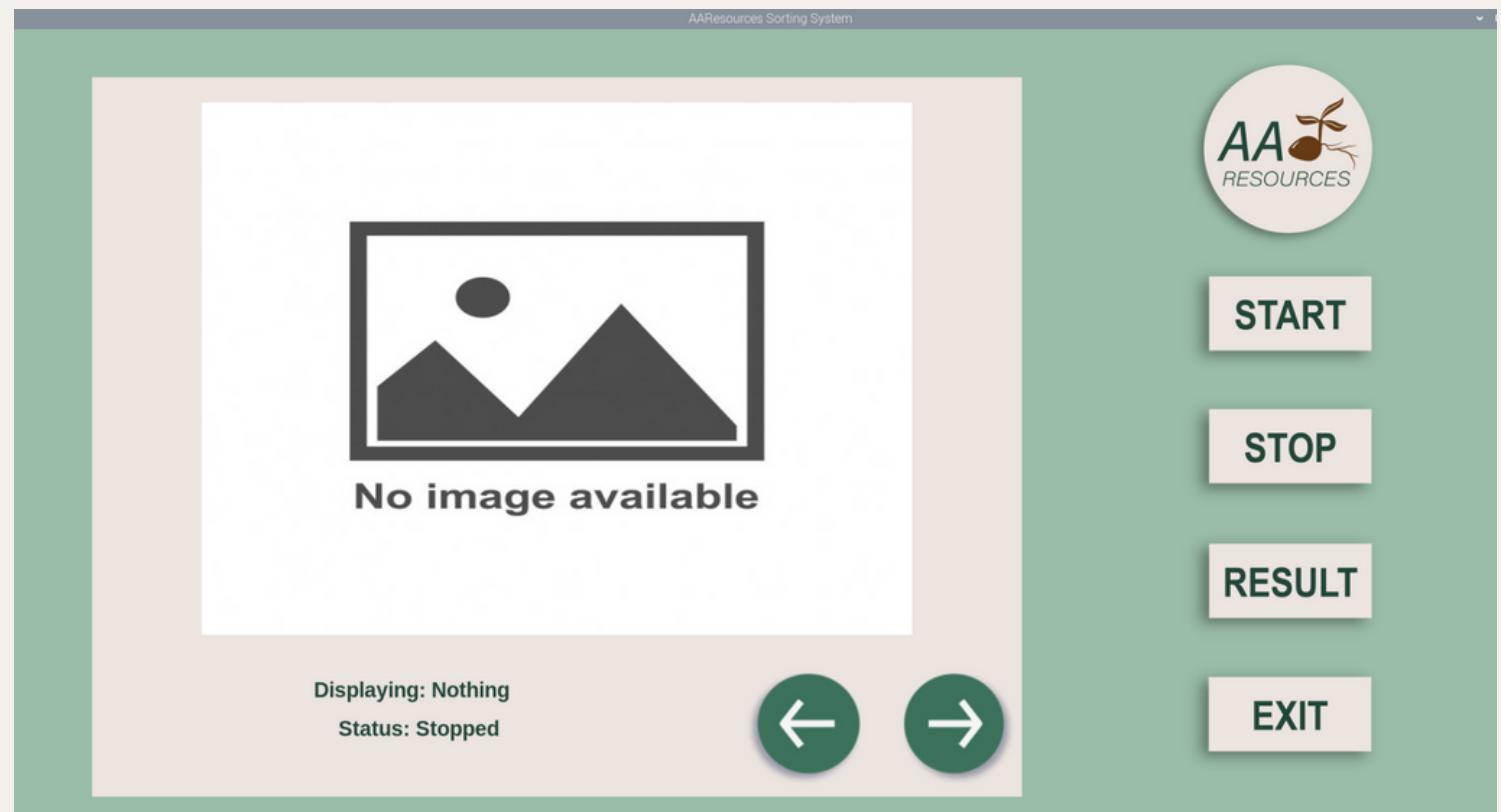
Software Design



Device

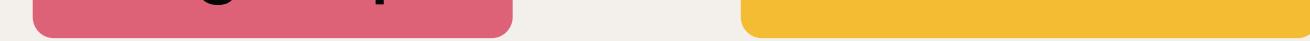
Front-end

Graphical User Interface (GUI)



Back-end

Image Input



Seed Detection

Segmentation



Record
Results

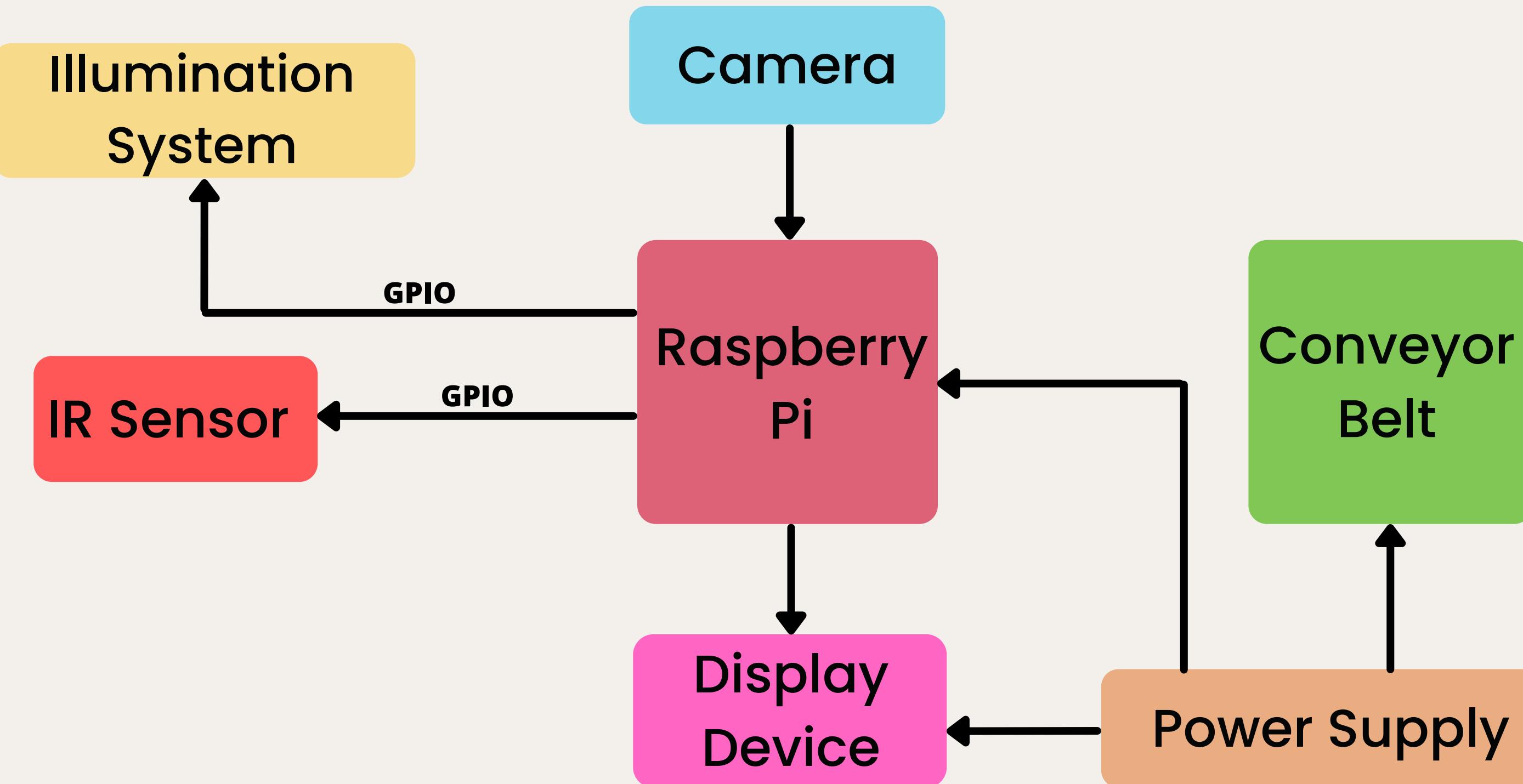
Classification

Illumination

GUI

Display
Output

Hardware Design



PROCESS OF THE SYSTEM



1

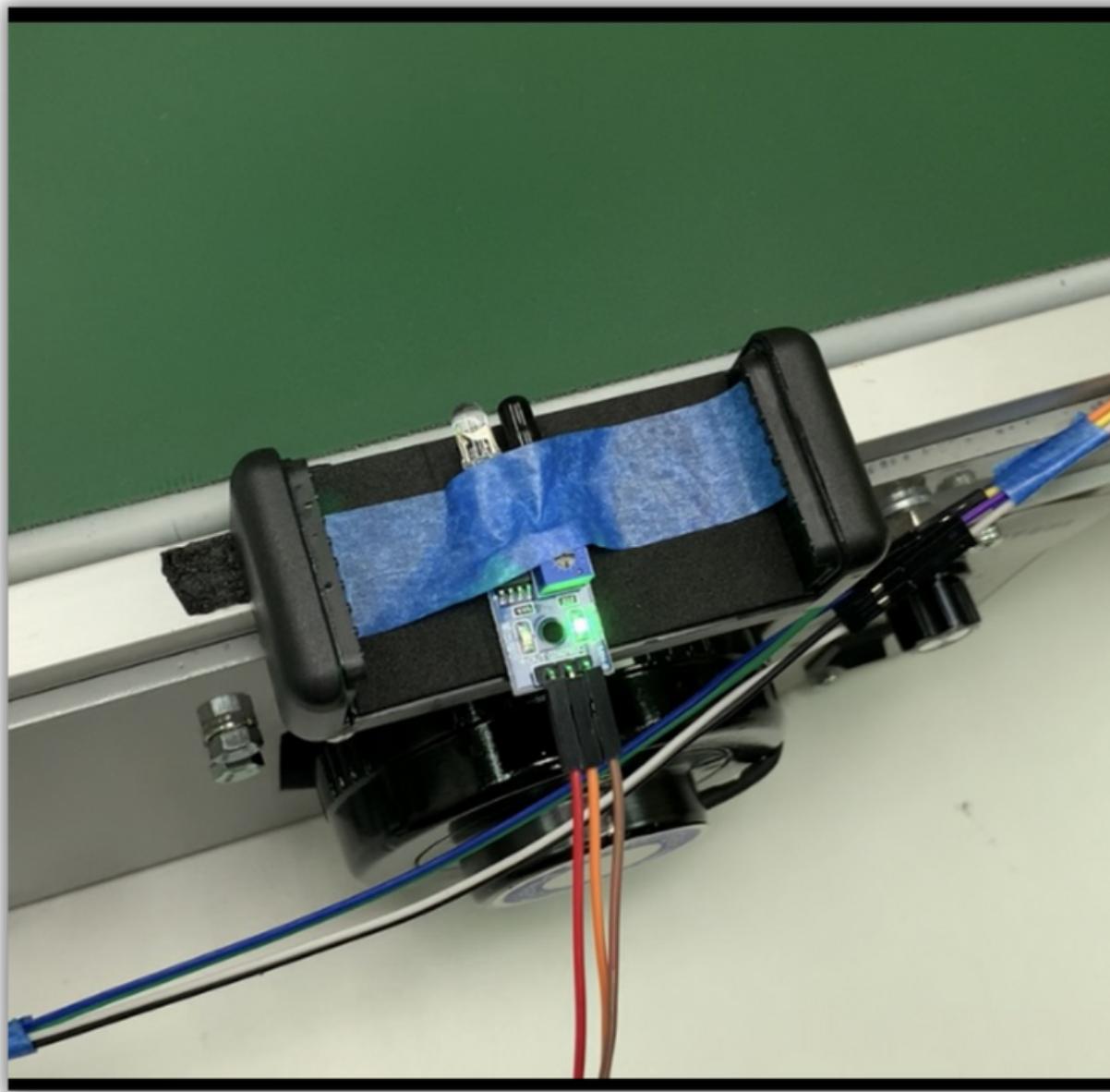
Setting Up

Connect the hardware components to Raspberry Pi and turn them on



Open up GUI to start and control the system

PROCESS OF THE SYSTEM



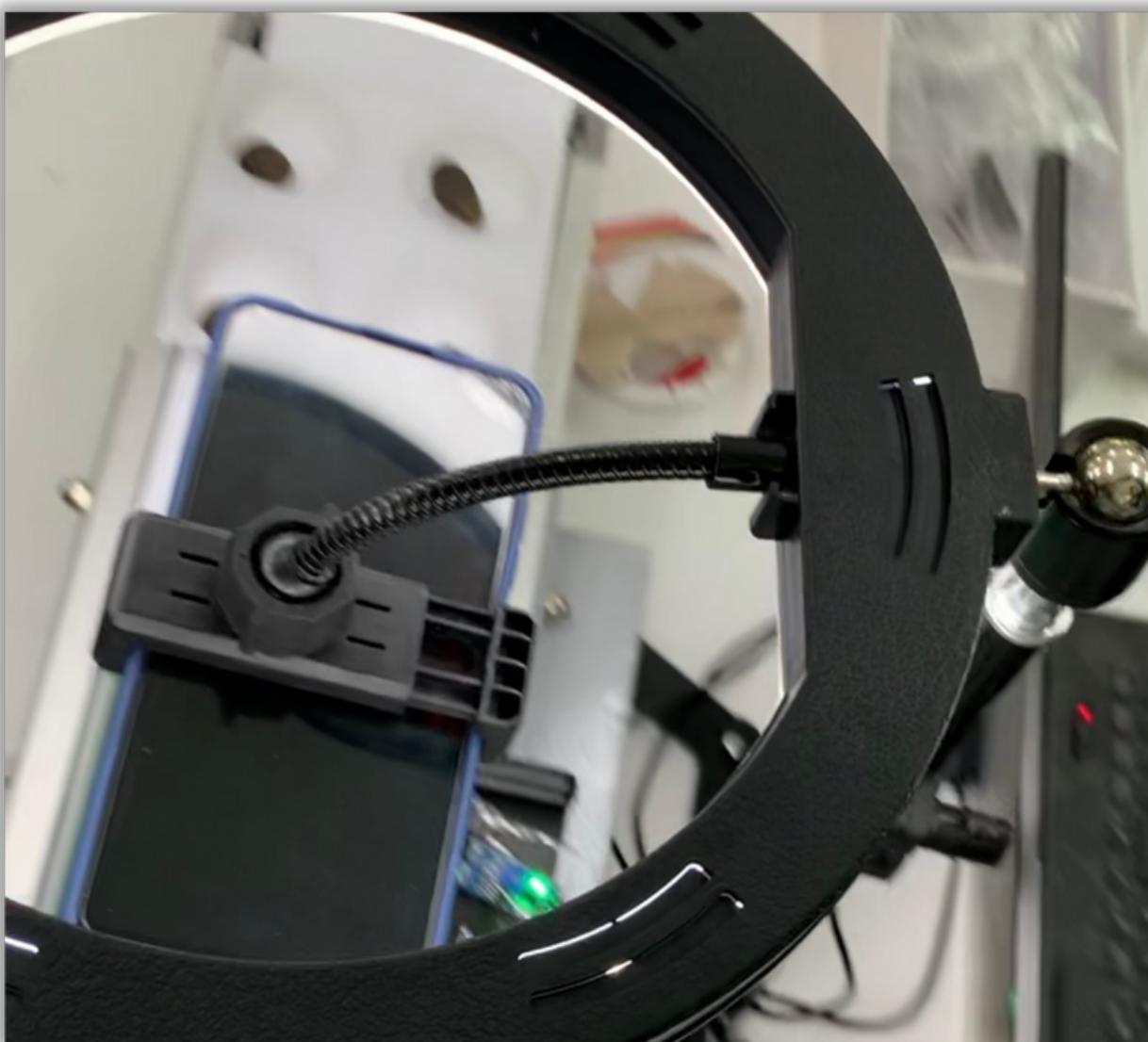
2

IR Detection

Place the tray of seeds on the conveyor belt with a white background

IR sensor will detect when a tray passes by

PROCESS OF THE SYSTEM



3

Live Capturing

The IP Camera will start streaming when
the system starts

An image will be taken at the current
frame when IR sensor detects a tray

PROCESS OF THE SYSTEM

4

Seed Prediction & Results

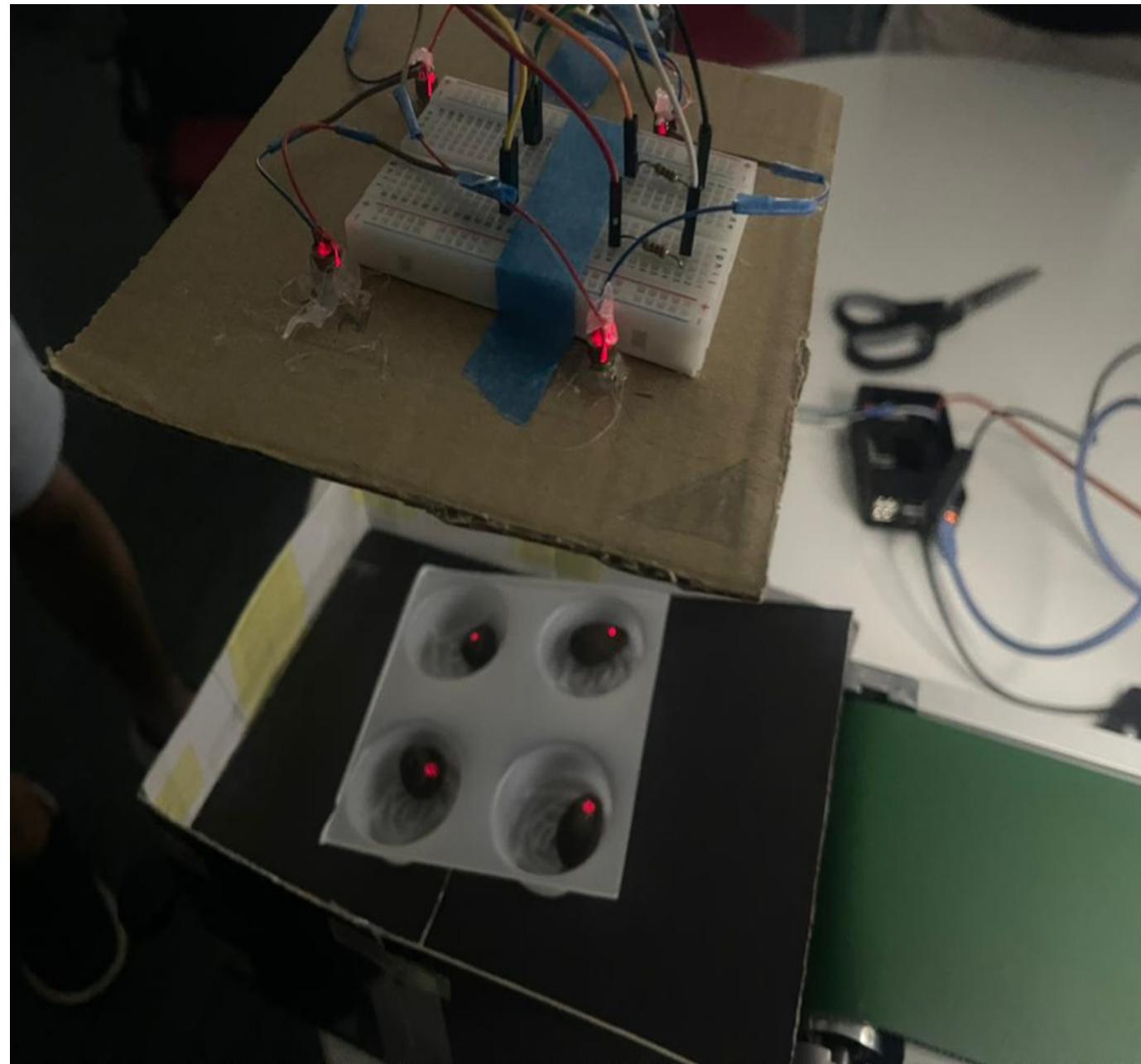


Images taken will be segmented and classified by the prediction algorithms

Seeds classified will be labelled with a bounding box and recorded in data file

The resulting image with the bounding boxes will be displayed on the GUI

PROCESS OF THE SYSTEM



5

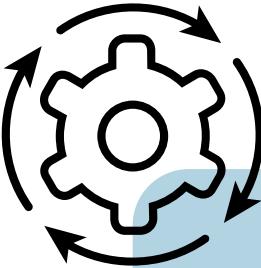
Illumination System



At illumination stage, the tray of seeds will be stopped at sorting station

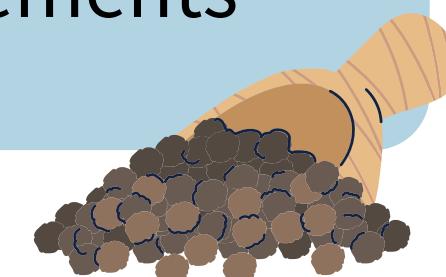
The laser on top pinpoint the seeds based on the result

ACHIEVEMENTS



Operable on Edge Device

- Efficient and fast software program
- Low operating cost and requirements



Proof of Concept

- Developed a complete & fully operational sorting system prototype
- Fulfilled the client's requirement
- Scalable to meet industrial needs



Intuitive User Interface

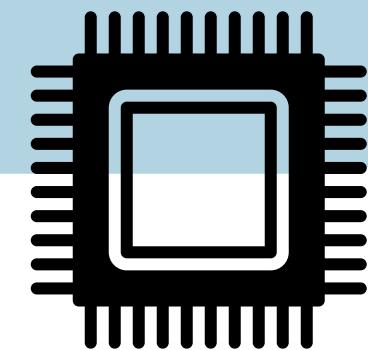
- Simple and consistent design language in GUI
- Functionality and performance of system are unaffected



ACHIEVEMENTS

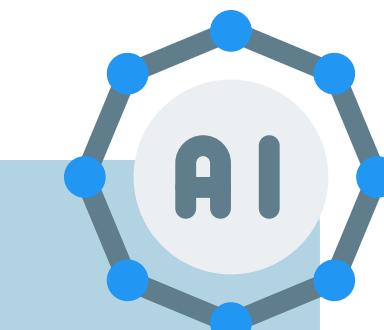
Implementation of Hardware Components

- Sourced and designed hardware systems albeit limited knowledge in engineering
- Laser Illumination System



Integration of AI Algorithms

- Successful implementation of seed detection & classification algorithms
- Modified the algorithms to suit the system requirements



Project Completion

- Completed the project within time limit
- Managed to keep project cost below budget given



Future Improvement

Fully-Automated Sorting System

Eliminates the need for manual sorting and increases efficiency.



Increase size of tray and amount of lasers

Allows for more seeds to be processed and sorted per batch

Higher definition camera

Allows for more seeds to be captured in an image

Retraining of prediction model with more dataset

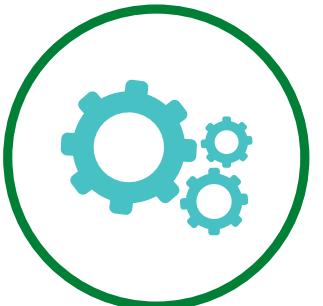
Allows for a more accurate segmentation and prediction of seeds

Improve versatility of system

Allows for prediction and sorting on other types of seeds aside palm oil



Project Conclusion



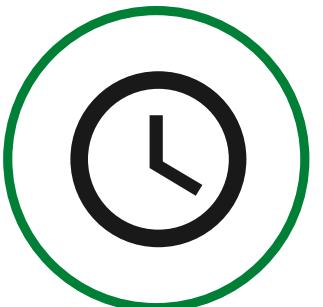
Summary

Build an efficient semi-operated seed sorting system to detect seed quality accurately



Performance Analysis

Able to successfully operate efficiently and reduce as much human work



Time Taken

Took approximately 32 weeks to complete this project



Budget

RM3360.00 is provided and RM2735.35 is used up

