Vision-based Automated FFB Grabber Proposal

Prepared for: UPM-SDPR

Prepared by: Khairul Izwan Bin Kamsani

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EXECUTIVE SUMMARY

Objective

Automated the Manual Fresh Fruit Bunch (FFB) Grabber without interfering existing system — trucks, machinery etc…

Goals

Change manually controlled FFB grabber to automated FFB grabber system without human interferences.

Solution

Introduce a vision-based system combined with an electronic control unit of the hydraulic system and encoders (linear and rotary) to build a fully automated grabber system.

Project Outline

The overall project divided into five parts:

- Vision system
  - FFB detection and recognition — Deep Learning + Image Processing
- Hydarulic system
  - Electronic Control Unit
- Control system
  - Rotary and linear absolute encoder — feedback
- Full system integration
  - ROS — Operating System
- Data acquisition
  - On field testing and troubleshooting

BUDGET

Equipment and Workmanship

Required equipment; hardware and electronic part including the workmanships — consultation, system development and integration including data acquisition; on-field testing cost.

Item	Description	Quantity	Unit Price	Cost
1	Intel® NUC Mini PC	1	RM 4,000	RM 4,000
2	15.6-inch IPS 1920x1080 HDMI Display with Built-in Speaker	1	RM 550	RM 550
3	Jetson AGX Xavier Developer Kit	2	RM 3,700	RM 7,400
4	Intel® RealSense™ Tracking Camera T265	2	RM 900	RM 1,800
5	Electronic Hydraulic System	1	RM 10,000	RM10,000
6	Rotary Absolute Encoder	1	RM 3,000	RM 3,000
7	Linear Absolute Encoder	2	RM 3,000	RM 6,000
8	Electrical — Power, Cables, etc…	1	RM 15,000	RM15,000
9	Workmanship	1	RM 15,000	RM15,000
	Total			**RM62,750**

REFERENCE

Intel® NUC Mini PC

- <u>Meet the mighty, tiny mini PC only Intel could build</u>. https://www.intel.com/content/www/us/en/products/boards-kits/nuc.html
- <u>Intel NUC10i7FNH L10 Core i7 NUC Mini PC</u>. https://shopee.com.my/product/4887351/4534929960?smtt=0.205015904-1612569097.3

15.6-inch IPS 1920x1080 HDMI Display with Built-in Speaker

- <u>15.6-inch IPS 1920x1080 HDMI Display with Built-in Speaker</u>. https://my.cytron.io/p-15p6-inch-ips-1920x1080-hdmi-display-built-in-speaker?search=hdmi%20display&description=1

Jetson AGX Xavier Developer Kit

- <u>Jetson AGX Xavier Developer Kit</u>. https://developer.nvidia.com/EMBEDDED/jetson-agx-xavier-developer-kit
- <u>NVIDIA Jetson AGX Xavier Development Kit</u>. https://my.cytron.io/p-nvidia-jetson-agx-xavier-developer-kit?search=xavier%20agx&description=1

Intel® RealSense™ Tracking Camera T265

- <u>Intel® RealSense™ Tracking Camera T265</u>. https://www.intelrealsense.com/tracking-camera-t265/
- https://store.intelrealsense.com/buy-intel-realsense-tracking-camera-t265.html

Electronic Hydraulic System

- <u>BODAS Controller</u>. https://www.boschrexroth.com/en/jp/products_8/product_groups_8/mobile_hydraulics/mobile-electronics/bodas-hardware/bodas-controllers/rc5-6-40
- <u>Measuring adapter</u>. https://www.boschrexroth.com/en/jp/products_8/product_groups_8/mobile_hydraulics/mobile-electronics/bodas-hardware/accessories/ma
- <u>Universal test box</u>. https://www.boschrexroth.com/en/jp/products_8/product_groups_8/mobile_hydraulics/mobile-electronics/bodas-hardware/accessories/tb3
- <u>Cables and connectors</u>. https://www.boschrexroth.com/en/jp/products_8/product_groups_8/mobile_hydraulics/mobile-electronics/bodas-hardware/accessories/cables-and-connectors

Rotary Absolute Encoder

- <u>Rotary Absolute Encoder</u>. https://ecatalog.dynapar.com/ecatalog/absolute-encoders/en

Linear Absolute Encoder

- <u>Linear Absolute Encoder</u>. https://www.rls.si/eng/la11-linear-absolute-encoder

METHODOLOGY

Vision System

- Vision 1
  - Detection of FFB
  - Outputting the region; left or right and distance
    - Region — decide the grabber arm rotation CW/CCW
    - Distance — decide the grabber arm is within it working environment; arm extension
    - If all the condition meets; arm moving
    - Else — None; HOME position
- Vision 2
  - Detection of FFB
  - Outputting the location of FFB; x, y coordinate — and distance; z coordinate
    - X-coordinate — decide the rotation of the arm
    - Y-coordinate — decide the extension of the arm
    - Z-coordinate — decide the extension of the grabber; collect

Control System — Feedback

- Purposely sending the grabber arm into HOME position
  - If Vision 1 not outputting any condition that Vision 2 required; acceptable region and distance — arm shall then return/stay to/at HOME position; loading bin
  - Or, if Vision 2 completed it tasks; move towards FFB and collect — arm shall then return to HOME position; loading bin

Hydraulic Electrical Control Unit — Controller

- Each of arm movement controlled by electronic hydraulic control unit
  - [Input] Output from Central Processing triggering the electrical controller — based on condition

Central Processing

- Brain of the system
  - [Input] Output from Vision 1, Vision 2 and Control System; Feedback send back to central processing — processed and trigger the electrical hydraulic system
  - Cneter of integration and communication