TEAM 045

Automated Package Sorting System

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ICS 4 ISE EE ME

Problem Statement

- Warehouses and logistics companies face a problem with inefficiencies and errors in manual package sorting. So, for logistics centers, who need a fast and accurate way to categorize shipments, the Automated Package Sorting System is a smart sorting solution that automates package classification based on size and damage detection, reducing errors and costs. the product integrates AI-driven package analysis with a dual-function sorting mechanism, ensuring both accuracy and damage detection in one streamlined process.

Constraints

The operational time should be around 8 hours	Ensuring the system processes data within 100 milliseconds
The power should be supplied with Saudi Arabia Standard of 220 Volt	Stay under Budget of 5400

Specifications

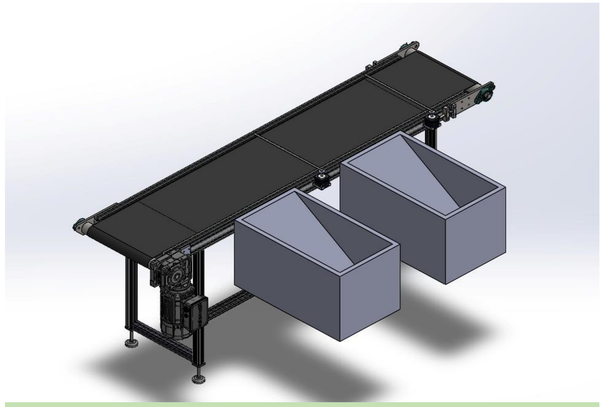
	Major-specific specifications
1	Power Consumption should not exceed 0.4 KWh
2	Sensor Refresh Rate should be at least 50 Hz
3	Operational Area should be around (1.6 x 0.9)m^2
4	Each package should be sorted in less than 10 sec
5	Accuracy Percentage should be at least 95%
6	Package Weight should not exceed 10 Kg
7	Conveyer Belt Speed should be at least 0.15 m/s
8	Real-time dashboard with refresh rate of less than 10 seconds
	Integrated specifications
9	overall system efficiency should be at least 90%
10	Overall system weight should be around 25Kg
11	Average package processing time is about 7.5 seconds

Prototype Design

1. Frame: the frame has a slot for the belt motor. It also has the package baskets and a place for the pushing arms motors. It flips the package through a metal bump to allow the algorithm to classify the state of the glass in the package.
2. Sensors: An ultrasonic sensor that will detect package presence, a camera to check package size and a microphone that will record audio of the package during flipping. Signals are controlled and procced with the Microcomputer Raspberry Pi.
3. Pushing arm: The design was achieved using a stepper motor that is connected to a metal arm and is controlled by the Microcomputer to push packages in the basket.
4. Power system: the power is achieved using an AC to DC converters with appropriate wire gauge rating and a speed controller for the belt motor and a logic level shifter to connect the sensor with the Microcomputer.
5. Classification algorithm: ML-algorithm allows Microcomputer to determine package size and glass state using camera input and FFT of the audio respectively.

Testing / Validation

- Power consumption validation was done using multimeter.
- Package and system weight was validated using scales.
- Accuracy and efficiency was validated by running full operational tests.
- Dashboard refresh rate was validated using a Timer.
- Package processing time, belt speed and package sorting time was validated using a stopwatch.
- Refresh rate feasibility was ensured by finding maximum sensor frequency based on sound speed and distance.



conclusion

In conclusion, our prototype will reduce sorting time drastically and improve customer satisfaction by detecting defects before delivery, thereby reducing overall cost.