INTEGRATING IMAGE PROCESSING AND MACHINE LEARNING FOR MATERIAL RECOGNITION ON CONVEYOR BELTS

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AGENDA

- Introduction to material, eddy current separator and the goal
- Sensor’s and awareness system set up
- Problems
- Solutions
- Challenges
- Future work

MATERIAL AND EDDY CURRENT SEPARATOR

Aluminum, Copper, Brass

Eddy current separator machine

- Separates non-ferrous metals (e.g., aluminum, copper, brass) from other materials using magnetic principles.

- Main components:

  - Rotating magnetic drum

  - Conveyor belt

  - Vibration feed

  - Control unit

GOAL

Metal scraps

- Detecting the presence and absence of materials
- Material identification
- Counting the materials
- Reducing errors
- Development of awareness system
- Remote control and monitoring

SENSOR AND AWARENESS SYSTEM SET UP

ELP camera and motion detection sensor

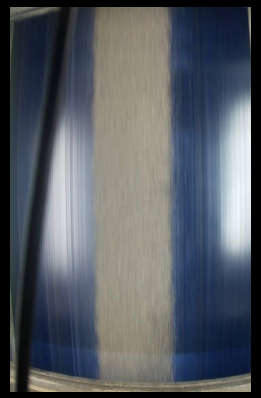
Raspberry Pi + Led lights

- An ELP camera is installed above the conveyor
- The conveyor is transporting materials
- The setup is part of a sorting system

- A control box with three indicators (labeled “IR”,”KA”,”IN”)
- Indicators include green and red lights
- The system integrates motion sensor and camera for monitoring the conveyor belt

PROBLEMS

Absence of material



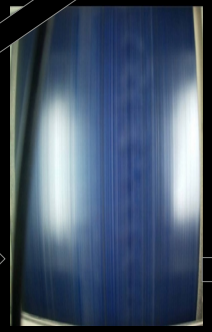
Presence of material

Amount of material

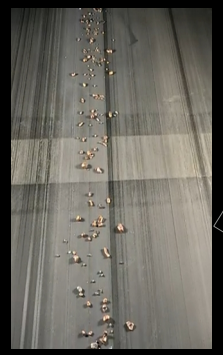
- Dusty and harsh environment
- Human error
- Difficulty in distinguishing materials with similar weight but different colors
- High cost of advanced methods like x-rays imaging
- Inefficient energy use
- Scalability issues

SOLUTIONS

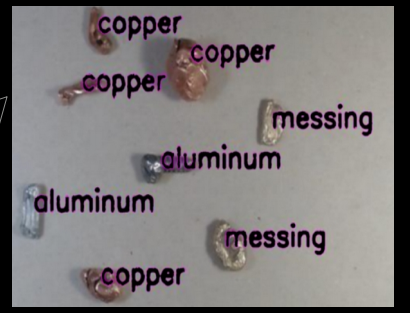
Imaging by ELP camera

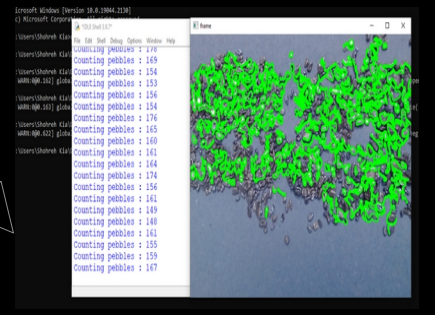


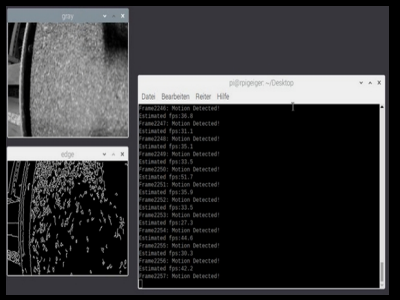
Imaging by ELP camera

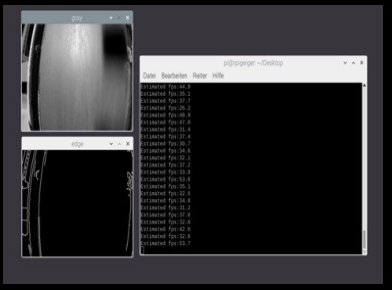


Processing unit



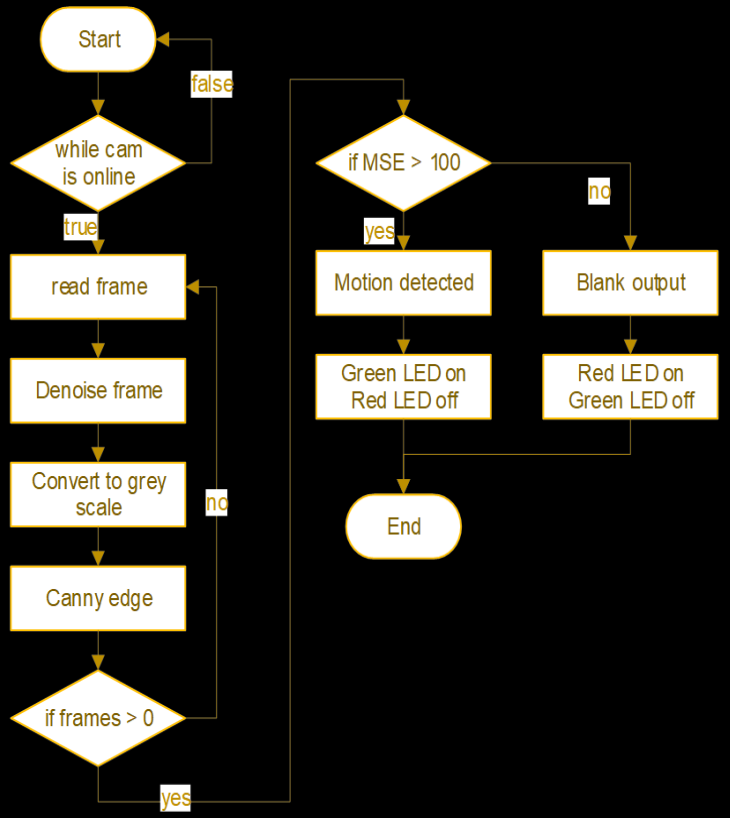




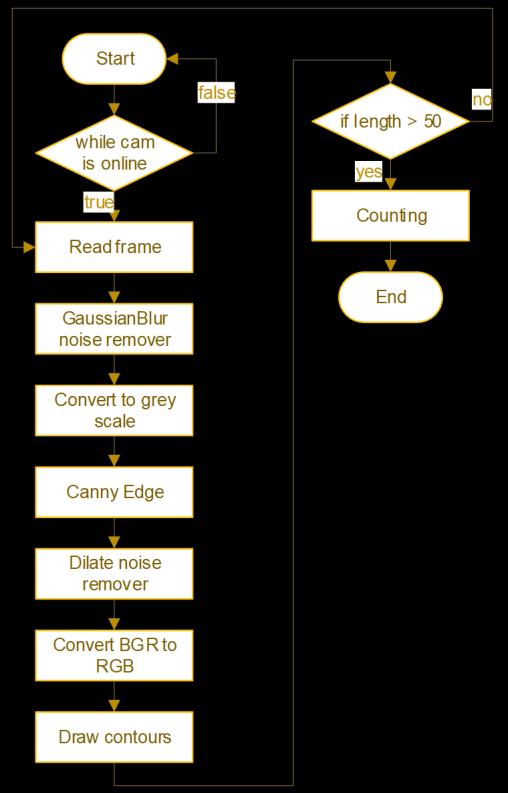


Output

The Overview of Developed System



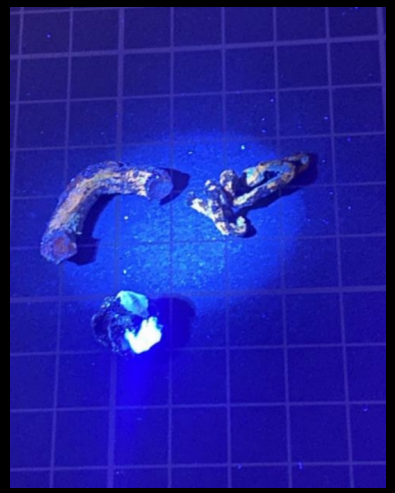
Flowchart of a motion detection system



Flowchart of an object detection and counting system

CHALLENGES

Samples containing mixed materials



Testing the mixed material samples under blue light

- Presence of mixed materials
- Inconsistent surface properties
- Color similarity

Separated samples of mixed materials after the processing stage

CONCLUSION

- Progressive automation strategy: Leveraging image processing and machine learning to improve material recognition and counting on conveyor systems
- Key achievements:
  - Addressed material detection challenges in harsh environments
  - Developed a sensor-integrated awareness system using IoT for monitoring
- Impact:
  - Enhanced sorting accuracy and efficiency
  - Reduced human error and energy inefficiencies

FUTURE WORK

4 mm

3 mm

2 mm

1 mm

- Investigate smaller material sizes
- Enhance material diversity
- Advanced feature extraction
- Optimize separation for size variations

THANK YOU

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