Low Cost, User Friendly Embedded Machine Vision System Implementation for High-Speed Industrial Manufacture

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Research Summary:

The future of manufacturing environments is becoming increasingly intelligent. With Industry 4.0, and lean production strategies, many manufacturers are considering investing in intelligent, real time, and non-destructive machine vision (MV) systems for product manufacture fault analysis [2]. This technology is improving rapidly in both the industrial and consumer sectors [3]. This work presents the development of a low cost, user friendly embedded machine vision system for use in industrial snack manufacturing. Previous attempts at using a high cost ~£10000 system failed, due to inadequate knowledge for successful integration. The OpenMV cam M7 was procured as a low cost ~£100, simpler alternative. The system achieved 88% ±1% sensitivity and precision in detecting products on a live production line. Therefore this is a viable prototyping option for machine vision novices, enabling informed decisions thereafter.

OpenMV Camera M7 [4]:

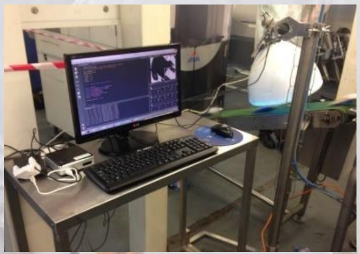
- Low cost "Arduino- like" camera.
- Embedded processor and USB power.
- Has integrated software platform.
- Has MicroPython as a simple software language with example scripts.

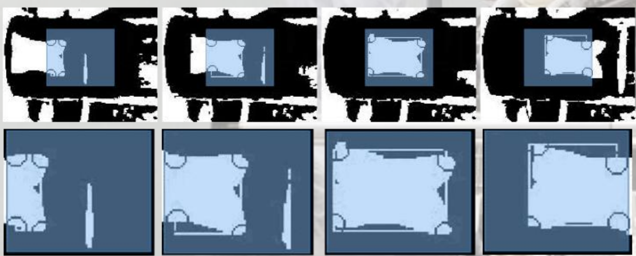
Machine Vision System:

- OpenMV Cam M7 with software.
- Stainless steel mechanical frame.
- Dome diffusion LED lighting shade.
- Intel NUC Windows PC with keyboard and mouse.

Software Development:

Similar to Arduino, the OpenMV cam M7 has a specific software IDE, with image filtering (see right images 3, 6-8) and image feature extraction (see right images 1-2, 4-5, 8) algorithm example scripts. The Hough Transform feature was investigated (1-2 and 4), as well as finding corners (5). OpenMV LLC created a rectangle feature extraction algorithm, which the authors then applied a binary image filter to create the final code output (8). This script, used with the dome light shade, was tested in-vivo.





Factory In-Vivo Test:

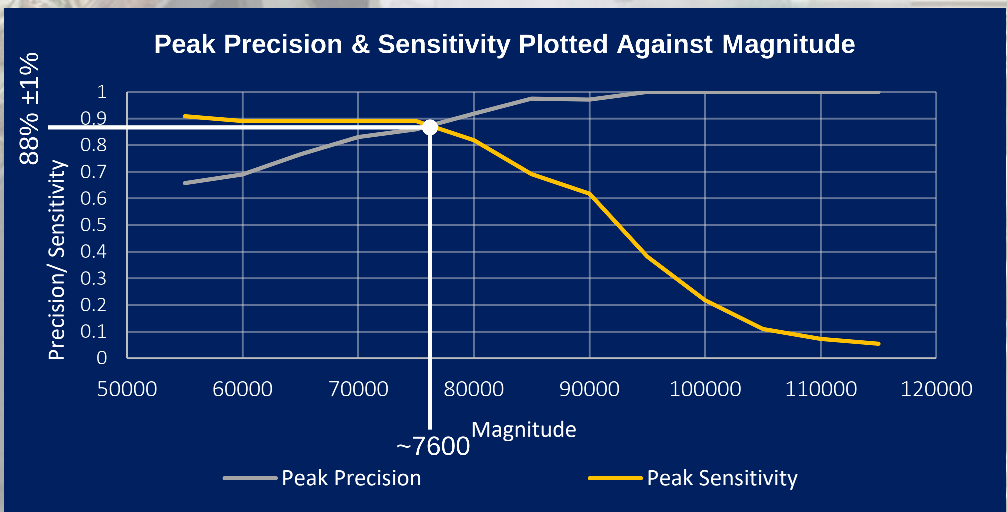
The system was placed in a manufacturing environment. The system was flexible to an unknown assembly line, lighting and product. 55 products were passed under the field of view. 290 rectangles in total were recorded, the majority as partial product recordings in the blue region of interest, shown left.

Results:

Peaks in magnitude for each rectangle (strength of the line quality) were correlated to detecting 50/55 products. Binary statistical analysis was used here to calculate precision and sensitivity of these peaks. These were then plotted below, and a crossover point at ~76000 magnitude for the highest peak precision and sensitivity of 88% ±1% was found, which is 49 products detected.

Acknowledgments:

The authors thank the food manufacturer for all their assistance.



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