COURSE : MSC ADVANCED ENGINEERING
LAB REPORT : Machine vision
TITLE : Image processing Laboratory
OBJECTIVE : A range of biscuit is investigated using morphological filter with erosion and dilation image processing techniques

PROCEDURES

1. The Opus PC system is connected to frame grabber board, auxiliary frame processor board and machine vision system. Machine vision system JVC CCD lens 18-108/2.5 is used and aperture set to F4. The height of lens is set to 568mm. Lighting equipment: ring light of microscopic is set to maximum; sport light with diffuser is on. The output is display with Microvitech high resolution monitor

2. Biscuit F is standard milk chocolate biscuit. Biscuit P is inadequately coated milk chocolate biscuit. Biscuit W is milk chocolate co ntaminated with white chocolate. Biscuit D is broken milk chocolate biscuit. The size of each biscuit is determined by the size of box and in pixel unit.(Table 1.3)

3. The Global lab software is opened. The Biscuit F is analyzed by following steps:
   Preprocessing stage
   Step 1: Main menu->Acquire->Passthrough->Freeze Frame
   Analysis stage
   Step 2: Main menu->Analysis->AOI Histogram->Box->Intensity (Histogram and Data obtained)
   Step 3: Main menu->Analysis->Point Histogram->Point Info (Range without filter obtained)
   Step 4: Main menu->Filtering->Morphological->Erosion & Dilation->Box (Filtering performed)
   Steps 2 & 3 are repeated and new range with filter is obtained.

4. The step 1 to Step 4 is repeated for Biscuit P, Biscuit W, Biscuit D and background. The range without filter and the range with filter are obtained and tabulated in Table 1.1. Histogram for each biscuit before and after filter are recorded (Figure 1.1-1.8). The new range for index replace is determined.

5. Index replace is performed by following steps:
   Optimizing stage
   Step 5: Main menu->Contrast->Index Replace->Box
   Index range 0-110 is replaced by 0, 111-160 is replaced by 150, 161-195 is replaced by 190 and 196-255 is replaced by 255. Percentage pixels at

each new index number for each biscuit are tabulated in Table 1.2.

RESULTS

Table 1.1 Range of biscuit

Product/ Range	Range without filter	Range with filter	New range for index replace
Biscuit F	66-107	61-86	0-110, 0
Biscuit W	139-196	126-175	111-160, 150
Biscuit P	176-203	168-190	161-195, 190
Biscuit D	69-110	63-84	NIL
Background	214-236	218-236	196-255,255

Table 1.2 Pixel and pixel percentage at new index number

Product/ Pixel	0	150	190	255
Biscuit F	41502 (59.7%)	472 (0.7%)	378 (0.5%)	27108 (39%)
Biscuit W	31481 (45.3%)	1409 (2%)	6986 (10.1%)	29584 (42.6%)
Biscuit P	30113 (43.4%)	9313 (13.4%)	2276 (3.3%)	27758 (39.9%)
Biscuit D	30780 (44.3%)	597 (0.9%)	817 (1.2%)	37266 (53.7%)

Table 1.3 Size of biscuit

Product	Total Pixel
Biscuit F	69460
Biscuit W	69460
Biscuit P	69460
Biscuit D	69460

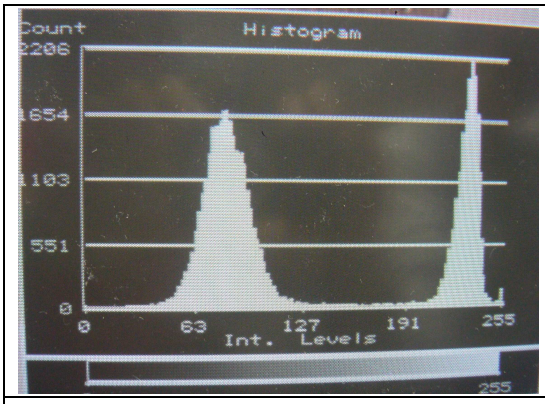

Figure 1.1 Biscuit F before filter histogram

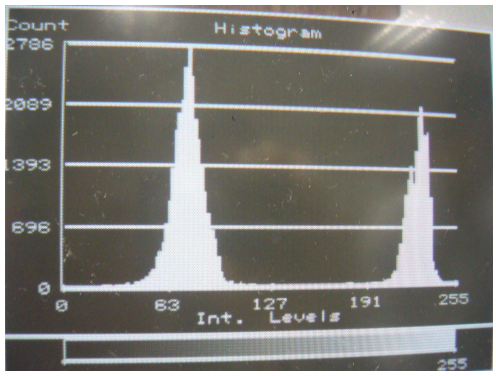

Figure 1.2 Biscuit F after filter histogram

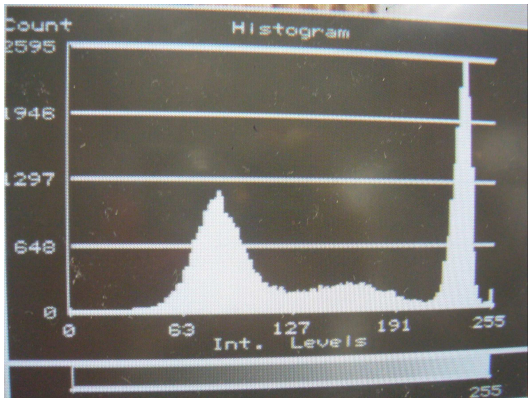

Figure 1.3 Biscuit P before filter histogram

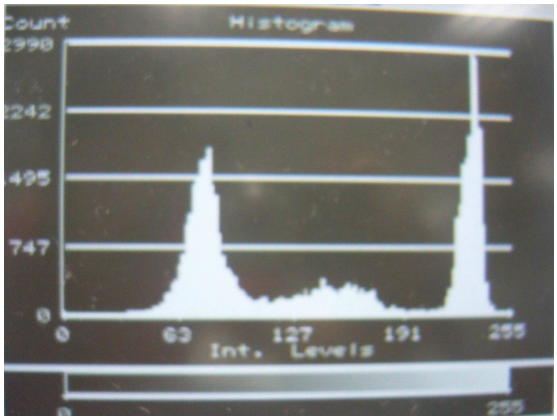

Figure 1.4 Biscuit P after filter histogram

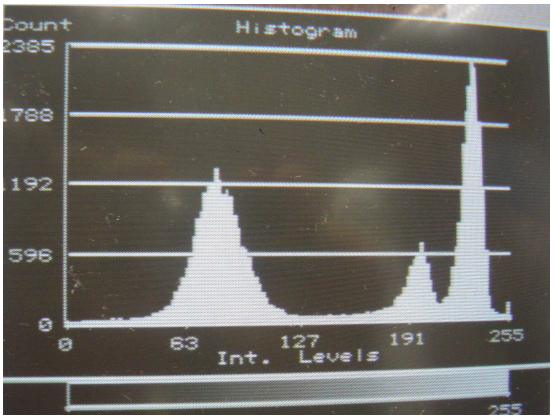

Figure 1.5 Biscuit W before filter histogram

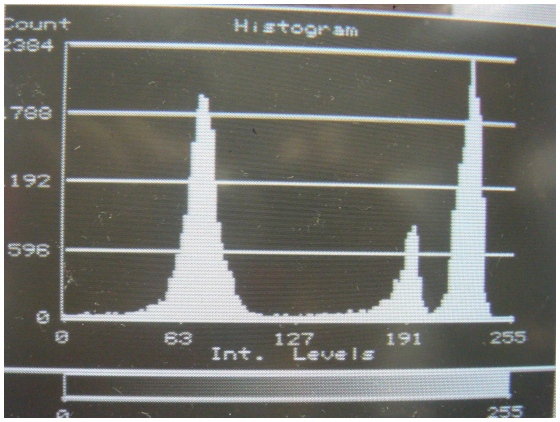

Figure 1.6 Biscuit W after filter histogram

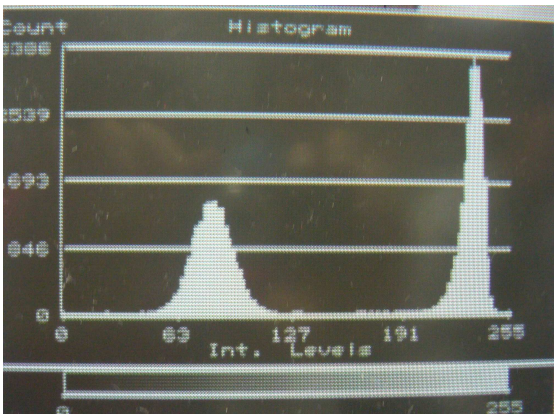

Figure 1.7 Biscuit D before filter histogram

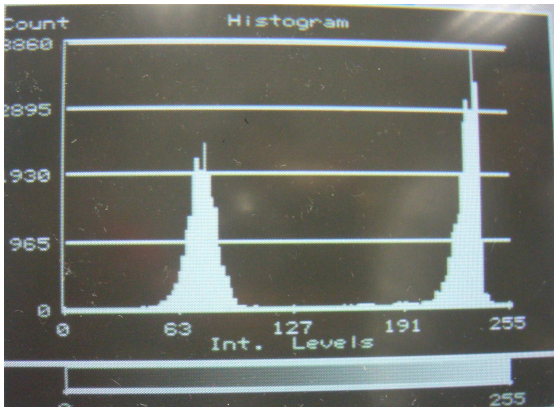

Figure 1.8 Biscuit D after filter histogram

DISCUSSIONS

1. The machine vision setting and configurations are optimized. Spotlights and ⮝ big paper cone are used to provide and collecting light around biscuit area.

2. ⮝s in Table 1.1, it is observed that the value of range with filter is smaller than the value of range without filter. The value is overlap each other but after filtering the overlap is decreased. Therefore, better results are obtained after image filtering by erosion and dilation once.

3. Range of index number is replaced by new index number. Standard milk chocolate biscuit, biscuit F has 59.7% pixel at index number 0 and 39% pixel at index number 255. Index number 0 is black and 255 is white. In biscuit F, 59.7% is chocolate and 39% is due to white background. In biscuit M, the percentage at index number 0 and 255 is 45.3% and 42.6%. The chocolate percentage is less than biscuit F shows that biscuit M is contaminated with some white chocolate. ⮝t index number 190, the percentage of pixel is 10.1%. This shows that some white chocolate is mixed with chocolate and is significant.

4. For biscuit P, the percentage at index number 0 and 255 is 43.4% and 39.9%. By compare these percentages with biscuit M, it is found that the index number 0 is less than that of biscuit M. This shows that percentage of chocolate for biscuit P is lesser than biscuit M. ⮝t index number 150, the percentage of pixel is13.4%. This shows that inadequate chocolate on the biscuit surface and is significant.

5. For biscuit D, the percentage at index number 0 and 255 is 44.3% and 53.7%. Looking at index number 150 and 190, the percentage is very low. By comparing biscuit D with biscuit F, it is worth to note that biscuit D has

greater white background. This shows that some portion of biscuit might lost.

CONCLUSIONS

To sum up, biscuit F has significant chocolate, biscuit D has significant white background, biscuit M has mixed with white chocolate due to significant percentage pixel at index number 190 and biscuit P has biscuit with less chocolate due to significant percentage pixel at index number 150. By visual inspections on Biscuit F, D, M and P, the results are agreed with actual biscuits. The system can differentiate and identify biscuits with range of common defects. Therefore, it is concluded that the system is appropriate for the task of inspecting these biscuits.