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TAKING MEASUREMENTS OF THE DETECTION SENSOR USED IN THE LABELLING PROCESS

WYKONANIE POMIARÓW CZUJNIKA DETEKCJI UŻYWANEGO W PROCESIE ETYKIETOWANIA

Summary: *The present paper is the fourth part in our consideration of the following issue: attempt to compare the work of the detection sensor with the ZFV vision system in the packaging labelling project.*

Keywords: *measurement, detection sensor, ZFV vision system, labelling, packaging*

Streszczenie: *Artykuł jest czwartą częścią w naszym rozpatrywaniu zagadnienia jakim jest próba porównania pracy czujnika detekcji z systemem wizyjnym ZFV w procesie etykietowania opakowań.*

Słowa kluczowe: *pomiar, czujnik detekcji, system wizyjny ZFV, etykietowanie, opakowania*

Introduction

To perform the analysis, with the aim to obtain the answer to the thesis assumed in the title of the present paper, the measurements were in two types of positioning systems A and B. The study A was performed with the use of vision camera while the study B was carried out using photoelectric sensor.

As to make the measurements comparable for the particular labels, the same measuring criteria were employed in all cases. Thus, after performing the series of labelling of 100 pcs of packaging, using the positioning system with vision camera (study A), the switch was changed from position ZFV into KAY position and then , the study B was carried out with the series of 100 pcs of packaging, as well. It was marked on the packaging in what point the beginning of label was to be found. Each sequence was performed for one label at three different speeds of transporter: 10 m/min, 15m/min and 20m/min. In a final stage of the study, the correctness of laying the label was considered. The following criteria were employed:

- correct labelling, i.e. the label is commenced at the correct site;
- defective labelling, i.e. the labels are glued but with the shift in relation to the beginning of the packaging;
- lack of label when the packaging has not been labelled.

Ensuring of a smooth functioning of the machine, that is efficient performance of the tests was possible owing to the help of the additional persons in a role of assistant.

Positioning as performed with the use of camera

Label no 1 has distinct drawings, owing to which camera catches them easily and the packaging is correctly labelled; it may be observed in Table 1 and Figure 1.

Table 1. The results obtained during labelling with label no 1

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	98%	97%	96%
2.	Defectively labelled	2%	3%	4%
3.	Lack of label	0%	0%	0%

Fig. 1. Diagram of labelling with label no 1

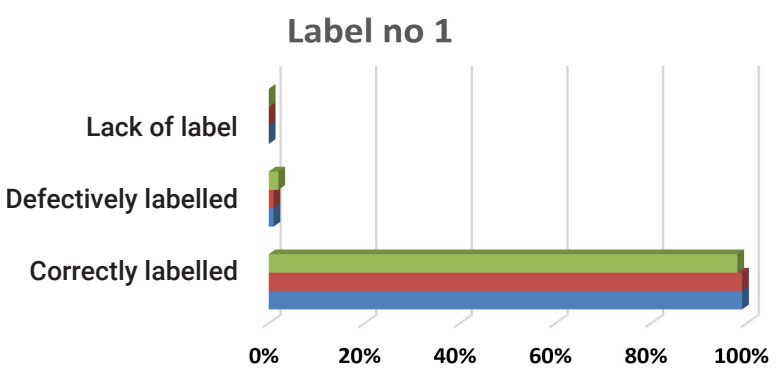

Fig. 2. Diagram of labelling with label no 2

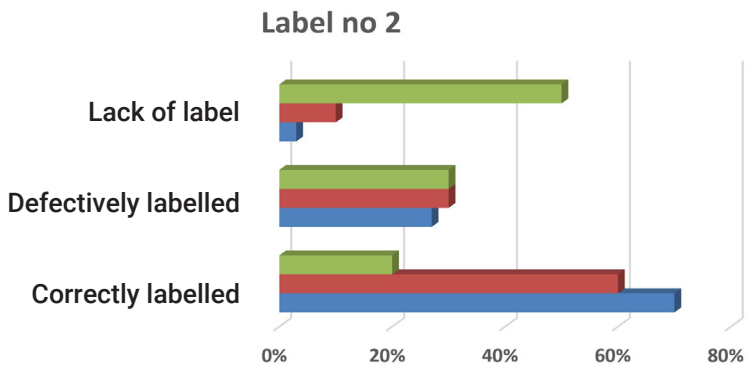

Table 2. The results obtained during labelling with label no 2

No.	V of transporter [m/m/in]	10	15	20
1.	Correctly labelled	70%	60%	20%
2.	Defectively labelled	27%	30%	30%
3.	Lack of label	3%	10%	50%

Fig. 3. Diagram of labelling with label no 3

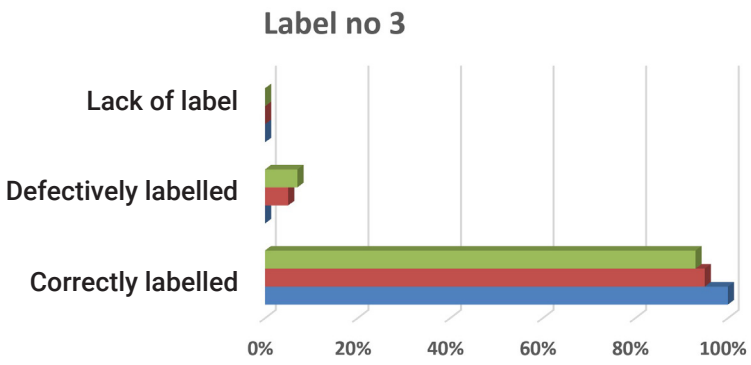

Table 3. The results obtained during labelling with label no 3

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	100%	95%	93%
2.	Defectively labelled	0%	5%	7%
3.	Lack of label	0%	0%	0%

Fig. 4. Diagram of labelling with label no 4

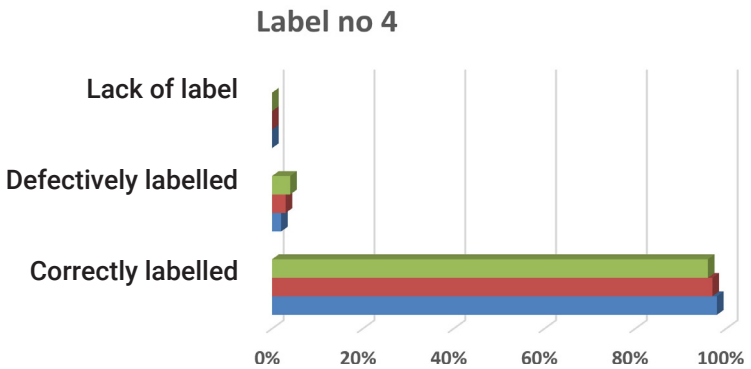

Table 4. The results obtained during labelling with label no 4

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	98%	97%	96%
2.	Defectively labelled	2%	3%	4%
3.	Lack of label	0%	0%	0%

Defectively labelled single pieces were treated as casual error because the measurements were not carried out under strictly controlled laboratory conditions, but only in the manufacturing hall.

Label no 2 has no distinct symbol in overprint, so it is difficult to be calibrated by camera. The obtained results have been presented in Table 2 and Figure 2.

For low speed values, the camera is still able to catch a signal but together with the increase of the speed, it "looses", in a certain way, the packaging, causing a big number of non-labelled packaging pieces.

Label no 3 contains a characteristic image owing to which the camera catches its position very well. It has been illustrated in Table 3 and Figure 3.

The length of a single label prolongs the cycle of labelling of a single packaging but it has no impact on the correctness of the labelling process itself.

Label no 4 is performed in 3D printing technology; it is, however, equipped with the characteristics symbols which the camera was tuned to. It has been reflected in the results shown in Table 4 and Figure 4.

Fig. 5. Diagram of labelling with label no 5

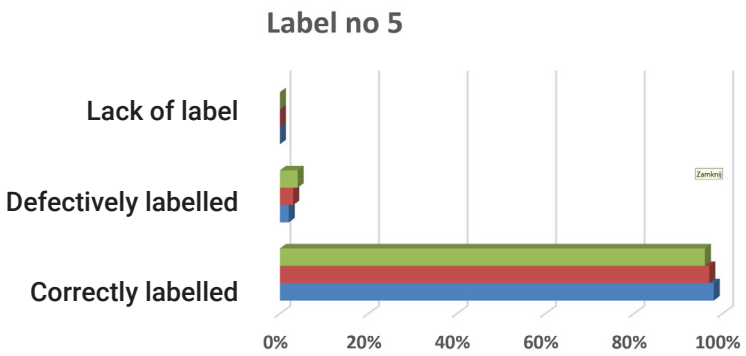

Table 5. The results obtained during labelling with label no 5

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	98%	97%	96%
2.	Defectively labelled	2%	3%	4%
3.	Lack of label	0%	0%	0%

Fig. 6. Diagram of labelling with label no 6

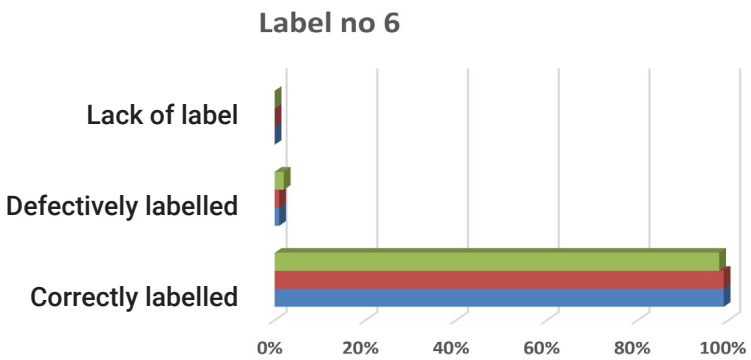

Table 6. The results obtained during labelling with label no 6

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	99%	99%	98%
2.	Defectively labelled	1%	1%	2%
3.	Lack of label	0%	0%	0%

As it can be seen from the obtained results, camera coped very well with the discussed innovative solution in relation to labels.

The successive label marked with number 5 was performed on film substratum and besides it, on transparent film. In spite of this fact, the code bar is visible; it served as a symbol for camera. The obtained results are found in Table 5 and Figure 5.

In spite of its appearance and material of the label, the camera had no problem with detection and positioning of the label on packaging.

The shape of label no 6 was irregular but it had characteristic symbol facilitating calibration of camera what was reflected in the results contained in Table 6 and Figure 6.

Camera was tuned to a square with flag, what facilitated its correct work. On the ground of this fact, it may be stated that the shape of label did not affect the yield of the vision system during positioning. The labelling process ran correctly, irrespectively of the employed velocity of transporter.

Positioning with the use of sensor

The sensor was calibrated on the field of a wide square in label no 1. The obtained results are found in Table 7 and Figure 7.

The sensor performed positioning correctly for low speed values. Together with the rise of velocity, the number of defectively labelled packaging was increasing.

Fig. 7. Diagram of labelling with label no 1

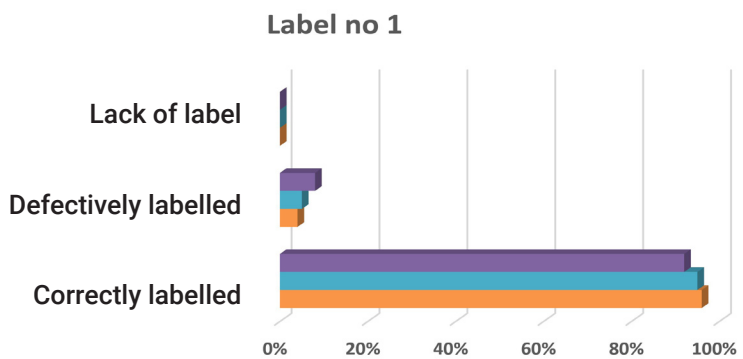

Table 7. The results obtained during labelling with label no 1

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	96%	95%	92%
2.	Defectively labelled	4%	5%	8%
3.	Lack of label	0%	0%	0%

Fig. 8. Diagram of labelling with label no 2

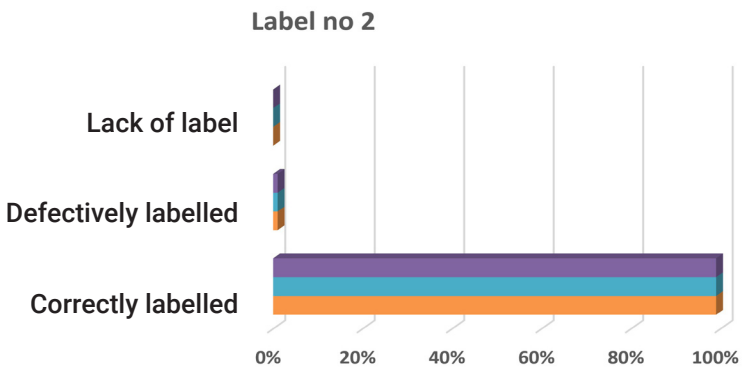

Table 8. The results obtained during labelling with label no 2

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	99%	99%	99%
2.	Defectively labelled	1%	1%	1%
3.	Lack of label	0%	0%	0%

Fig. 9. Diagram of labelling with label no 3

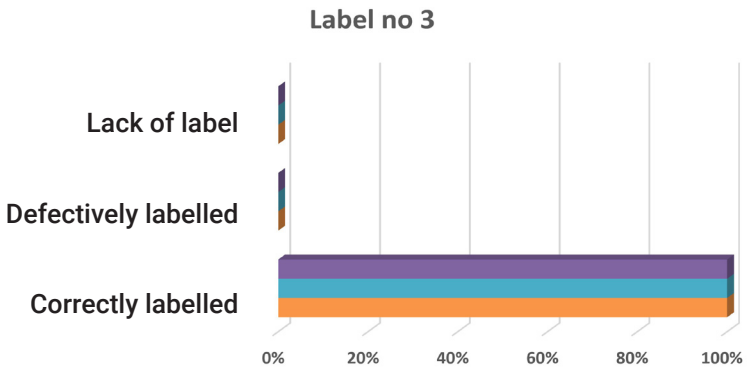

Table 9. The results obtained during labelling with label no 3

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	100%	100%	100%
2.	Defectively labelled	0%	0%	0%
3.	Lack of label	0%	0%	0%

Fig. 10. Diagram of labelling with label no 4

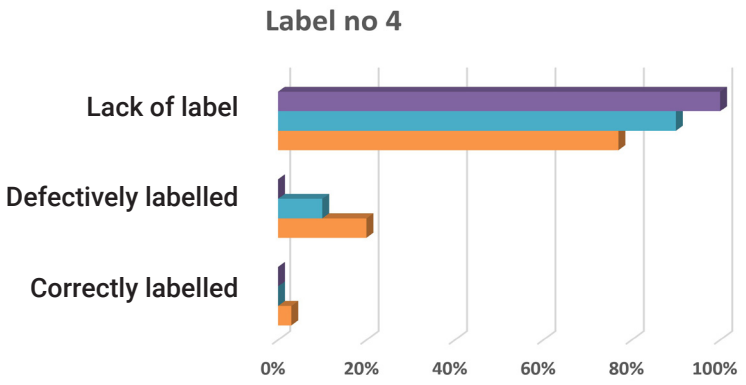

Table 10. The results obtained during labelling with label no 4

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	3%	0%	0%
2.	Defectively labelled	20%	10%	0%
3.	Lack of label	77%	90%	100%

In label no 2, we can see a characteristic black line which is in a strong contrast with the remaining graphic of the label. The results of positioning with the use of the sensor are given in Table 8 and Figure 8.

In the discussed above case, the sensor caught easily the mentioned difference what allowed his correct work, even at the increased velocity.

Label no 3 has a black rectangle in its graphical form; it is very suitable for catching by the sensor; it is well visible in Table 9 and Figure 9.

When taking the obtained results into consideration, it was found that the length of the label has a favourable impact on the work of the sensor because even at the high velocity values labelling was correct.

Label no 4 was performed in 3 D printing technology and due to this fact, the sensor has big problems with the receipt of return signal. It was reflected in the results found in Table 10 and Figure 10.

The results have confirmed that the discussed type of label excludes the application of the described system of positioning.

Fig. 11. Diagram of labelling with label no 5

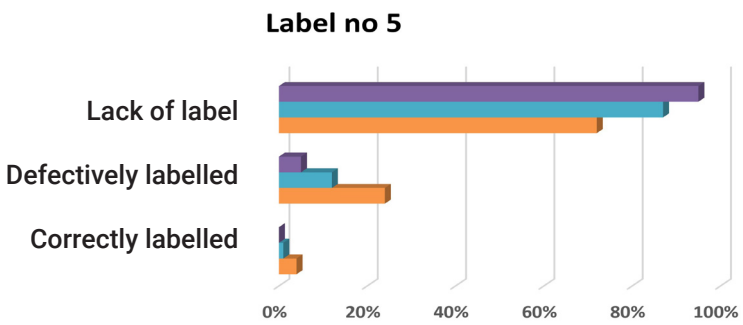

Table 11. The results obtained during labelling with label no 5

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	4%	1%	0%
2.	Defectively labelled	24%	12%	5%
3.	Lack of label	72%	87%	95%

Fig. 12. Diagram of labelling with label no 6

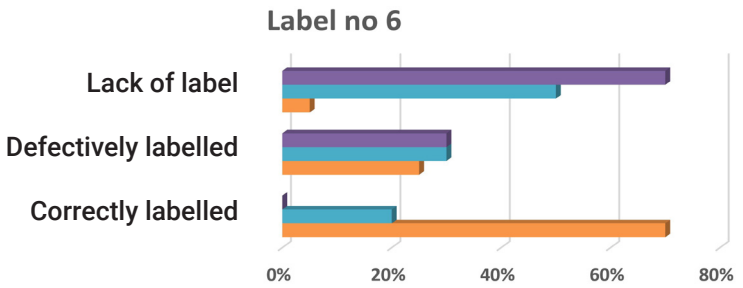

Table 12. The results obtained during labelling with label no 6

No.	V of transporter [m/min]	10	15	20
1.	Correctly labelled	70%	20%	0%
2.	Defectively labelled	25%	30%	30%
3.	Lack of label	5%	50%	70%

Label no 5 has not any contrast fields on its surface, therefore, the sensor had big problems with its catching. It resulted in a low effectiveness what was demonstrated in the results given in Table 11 and Figure 11.

The application of the sensors in the discussed type of label did not work.

For multi-colour label (i.e. number 6), at low veolocity values, the sensor was not capable of catching every packaging. It is well visible in the obtained results given in Table 12 and Figure 12.

Together with the increase of the velocity, the sensor had the troubles with finding the contrast fields what can be well demonstrated in Figure 12.

Conclusions

When taking into account the obtained results, it can be concluded that the vision system at a high speed value makes more errors, which results from the speed of the camera processing the image into an impulse. The camera, as having the comparative image in its memory, compares it each time with the one obtained during the current work. This takes a certain amount of the time needed for the image processing by the camera system, and therefore, it increases the time needed to send the pulse to the labelling head.

Based on the research, it can be concluded that the photoelectric sensor was very good at such situations, because it immediately obtained an impulse that controlled the head. However, many models of labels made in new technologies, such as 3D or transparent are currently entering the market. The sensor evidently failed to cope with these during the research carried out in this study.

The industry also employs the labels that do not have clearly contrasting elements. This causes the sensor to have trouble recognizing the end and start of the label. Comparing the size of the labels, it can be seen that this parameter has no major impact on the effectiveness of labelling. Based on the experience gained during the performed measurements, it can be seen that the way of matching the components with each other has a significant impact on the accuracy of labelling.

Sensor systems are currently the most widely used in the market, but they are gradually being replaced by advanced vision systems. This change is not very dynamic as vision systems are still an expensive investment. For these reasons, when designing a labelling machine, each designer needs to know which labels the labelling line is intended for.

Thus, it should be recognized that the packaging positioning system in labellers depends on the type of labels used.

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