Response Characteristics of Sensor Array of Fresh Meat Detection Circuit using Conducting Polymer Sensor

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Abstract. Consumption of meat is needed by society. The meat needed is of course fresh and quality meat. However, the quality of meat sold in the community varies greatly. Fresh and quality meat is meat that is odorless, not slimy, does not change color in certain areas. Meat that is not fresh and not of good quality is smelly meat. The odor is described as a fishy smell, a foul smell, contains sulfur and smells like ammonia. Because it is dangerous to consume rotten meat, it is necessary to have an automatic meat detection device so that it can ensure the meat is fresh and of good quality. This tool replaces the human nose with an odor sensor as a bad smell detector.

Keywords: Conductive Polymer Sensor, Odor, Response Chare

1. Introduction

Detection of meat quality is needed by producers, agents and sellers to ensure that the meat offered is quality meat that meets the expectations of its customers. Evaluation of meat is needed because the industry needs to ensure that the meat sold in the market is still fit for consumption or not. The shelf-life of meat is defined as the elapsed time between cutting and rotting time. Damage to meat is a sensory quality which is the occurrence of off-odor meat and off-flavor or changes in meat color (Noureddine El Barbri et al, 2008). The results of bacterial activity determine the shelf life of meat. The initial value of each sensor is shown in Table 1.

\textbf{Table 1. The Initial Value Of Each Sensor}

| Chanel | Sensor | Polimer   | $V_{\text{ref}}$ |
|--------|--------|-----------|------------------|
| 0      | 1      | Silicon DC – 200 | 1,10 V          |
| 1      | 2      | PEG-20M   | 0,00 V          |
| 2      | 3      | 0V-101    | 1,15 V          |
| 3      | 4      | 0V-17     | 1,80 V          |
| 4      | 5      | DEGA      | 0,00 V          |
| 5      | 6      | PEG-200   | 2,60 V          |
| 6      | 7      | PEG-1540  | 0,00 V          |
| 7      | 8      | PEG-6000  | 1,80 V          |
2. Research Methods

The stages carried out in this research are as follows:

a. The first, The sensor chamber is flowed with air which is passed to Silica Gel to clean the remaining steam from odors that previously entered the sensor chamber and reduce humidity. After that, the steam from the meat odor is put into the sensor chamber.

b. The computer program will average the data sent by the microcontroller for 5 seconds or as much as 20 data as the reference voltage value when there is no odor in the sensor room.

c. The steam from the meat odor is introduced into the sensor chamber by entering the air which is passed through the Silica Gel into a closed container of the meat sample.

d. The meat odor vapor is exposed in the sensor chamber and provides measurement results or meat odor identification. The measurement results will be visualized and identified using the Visual Basic program.

The amplifier circuit schematic to be tested is shown in Figure 2.

3. Results Discussion

When the steam from the meat odor hits or is exposed to the sensor array, it will produce a response like Figure 3, 4 and 5 where in Figure 3 it can be seen that the response is table at the 337th data. Figure 4 describes the stable response at the 517th data. Figure 5 describes the stable response at the 125th data. In this condition the training data is taken at the 600th data.
Figure 3. Response of sensor array to vapor exposure from odorless odors.

Figure 4. Sensor array response to vapor Exposure from fresh smell.

Figure 5. The sensor array response to vapor Exposure from bad smell.

Figure 6, 7 and 8 show the pattern of change normalized sensor array voltage when exposed to steam from the odor of meat and it was seen that for Each odor state is odorless, fresh, and rot will give a response pattern of conducting polymer sensor array.
Figure 6. The voltage pattern of the sensor array that has been normalized to vapor exposure from odorless.

Figure 7. The voltage pattern of the sensor array that has been normalized to vapor exposure from bad smell.

Figure 8. The voltage pattern of the sensor array that has been normalized to vapor exposure from bad smell.
The Kohonen network is trained using a normalized voltage pattern. The training process is limited by 2 conditions, namely the maximum number of iterations and no change in weight. Training will stop if one of these conditions is met.

The Kohonen network was trained using 60 normalized stress pattern data from exposure to 2 types of vapor from the odor of chicken meat. The number of iterations is limited to 50 iterations. The weight change is calculated by subtracting the weight in an iteration from the weight in the previous iteration. The average of the difference in weight between iterations is shown in Figure 9.

The Kohonen network training process is completed in 21 iterations. To check whether the weights generated during the training process, the Kohonen network is simulated with the input of all the data used in the training process. If the training is done correctly, then the system is tested after the simulation process shows that the Kohonen network can group all the data used in the process.

4. Conclusion
The conclusions that can be drawn from the results of the study are as follows:

1. The identification error occurs because there is a similar pattern of changes in the stress of each odor. In addition, errors can also occur due to the cleaning process of the sensor series that is not clean.
2. The response to changes in the voltage of the sensor array will start to stabilize after exposure to steam for 1 to 3 minutes, if you want to use it again, the sensor room must first be cleaned using air flow through silica gel or cleaning gas for 12 to 20 minutes or until the sensor series voltage is close to the current voltage value no vapor exposure.

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