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Detection of position and posture of occupants using low resolution sensor

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ABSTRACT

There has been an active development toward the extraction of human image by measuring heat sources with infrared rays. This is because infrared rays are more effective at detecting human than visible light. Detection of position and posture of occupants using low resolution sensor is proposed. The proposed system can measure the position and posture of occupants from data using a sensor. Other applications are: The surface temperature behavior of a steel specimen is done by obtaining the endurance state of the specimen by use of thermal images. This study presents a system for recognizing an armored vehicle by distinguishing marks and contours. This study presents an effective method for choosing features and processing images.

A thermal image processing system consists of a thermal image sensor, an image pre-processor, and a neural network. The thermal image sensor is a pyroelectric type infrared image sensor, which does not require cooling and measures the thermal environment and extracts information of occupants.

The improvement in the positional precision of the neural network by structuralization is examined. 1. One large neural network without structured.2. One posture-estimating neural network and two position-estimating neural networks where output is selected by the output of posture-estimating neural network 3. One posture-estimating neural networks and two position-estimating neural network where output is calculated from each two outputs (distance of sanding posture and sitting posture) and the outputs of the posture-estimating neural network.

Key Words: Detection, isolator, occupants, position, posture, sensor, shape.

1. INTRODUCTION

A infra-red image processing system consists of a pre-processor to extract feature data and a structured multi-layer perception to detect precisely the position and posture of an occupant. It uses a low-resolution infra-red image that can be obtained from a small, lightweight non-cooled infra-red sensor. Figure 1 shows the configuration of the infra-red image processing system used for this experiment [7]. The system consists of a infra-red image sensor, an image pre-processor, and a neural network. The infra-red image sensor is a pyroelectric:-type infrared image sensor, which does not require cooling and measures the infra-red environment and extracts information of occupants [2]. This sensing device consists of an array of eight sensing elements aligned vertically that mechanically rotates horizontally when scanning. Therefore, the infra-red image, detected by this sensor, has distortion in the polar coordinate system. Then, using image pre-processor, the area corresponding to the human image (human block) is distinguished from a infra-red image, and the feature data is calculated from this area. The neural network extracts the valid information on occupants from the feature data. The number of persons is determined by the number of the human block. The neural network is trained with the feature data on the image pre-processing and the measured position and posture prior to implementation, thus allowing it to estimate the position and posture of any occupants.

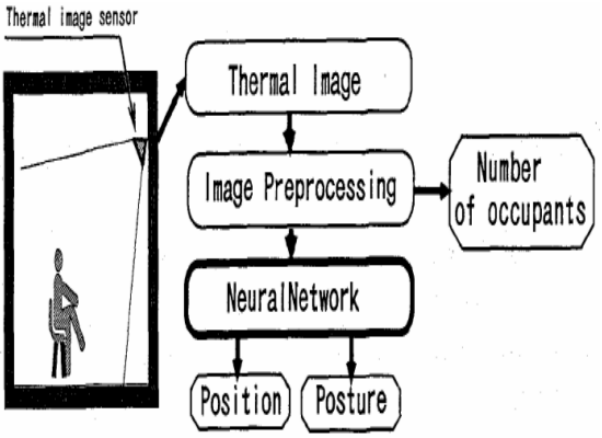

Figure 1: Infra-red image processing system

The neural network consists of three multi-layer perceptions that estimate the posture and distance of an occupant from the sensor for each posture (standing or sitting), and select an optimum output value from two outputs of position-estimating neural network. The infrared sensor in this system outputs the low-resolution infra-red image in the polar coordinate system. Therefore, if the position of an occupant is calculated from the key pixel number of human block, an error will occur about from 30 cm to 3 m. Therefore, the neural network is taught the relationship between the distance from the human sensor, the temperature of a human block, and the background temperature from large learning data. It is difficult to train the distance from the sensor for both postures (sitting and

standing) in one neural network, so the distance is taught for each posture in separate neural networks [8]. The output of two position-estimating neural networks is controlled by the posture-estimating neural network.

2. LOW RESOLUTION INFRA-RED SENSOR AND IMAGE PRE-PROCESSOR

The infra-red image sensor of the system has the following features [9]:

- Pyroelectric thin film element which can operate continuously at room temperature
- The vertical visual field (70 deg.) and a horizontal visual field (150 deg) as a infra-red image (64 x 8 pixel elements), using a super wide angle infrared lens.

With the infra-red image obtained from this sensor, the human block is detected by image preprocessing. A flexible area detection method is developed by making the best use of the sensing method features. In this pre processing, the method of connecting or erasing isolated points is performed by matching the features of the infra-red image and noise reduction and area partition are executed in order to correctly detect the human block

3. NEURAL NETWORK CONFIGURATIONS

A Neural network consists of two multi layer Perception's to estimate the distance of an occupant from the sensor for the standing and sitting posture, and one multi layer Perception's to estimate posture and to select the optimum output value from the output of above two positions estimating neural network [3]. Figure 2 shows the neural network configuration of the system. As shown in the following formula, distance estimate Y is determined using selective output Z (2) & Z (3) from the selective neural network and the output value (standing: Yr, sitting: Yz) of the position-estimating neural network.

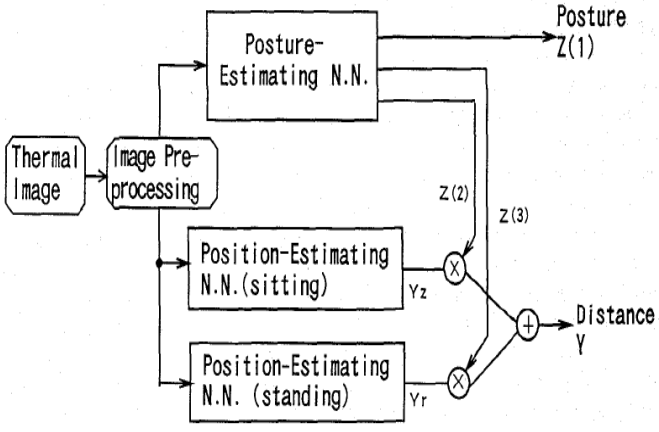

Figure 2 : Neural Network configurations

$$Y = Z(2) * Yr + Z(3) * Y z$$

3.1. Position-estimating neural network

This processing of the position-estimating neural network determines the correct position of an occupant, using a human block detected by the pre-processing and the ambient temperature in the neural network [3]. Then it gets the center of infra-red gravity of the human block, These factors are used for input: the temperature of lowest point (A) in the human block (used as the center of gravity) , point (B) above A, point (C) below A and point (D) beside C, and the background temperature obtained from the average temperature of infra-red image except for the human blocks and the number of A (vertical key pixel number of human block) and the sensor reference temperature. The input condition mostly depends on the posture. The position-estimating neural network has two kinds of multi layer Perception's for each posture to improve position estimation precision. Figure 3 shows the configuration of the position-estimating neural network. The neural network consists of one input layer with eight elements, two sets of hidden layers with ten neurons, and one output layer including one neuron.

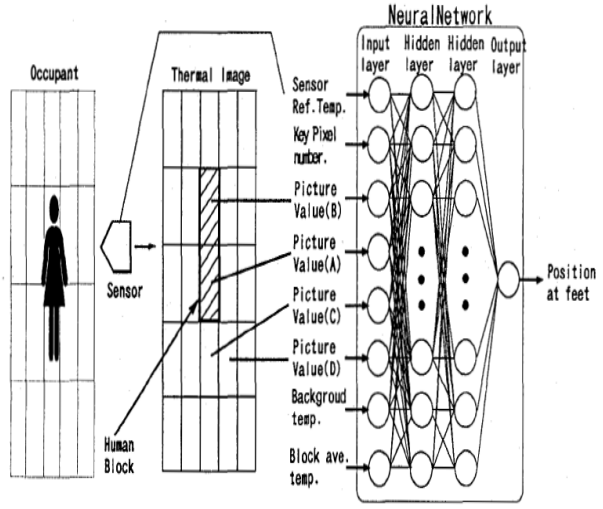

Figure 3 : The Position-estimating Neural Network

3.2. Posture-estimating neural network

This processing of the posture-estimating neural network distinguishes the posture (standing or sitting) of human in the human block detected by the pre-processing [3]. In this processing, the form and size of the human block is used to determinate the posture of an occupant. However, the form and size of the human block depends on the position of the occupant. Therefore, this processing detects rectangular areas which interpolates the human block detected by the pre-processing, and extracts the feature data of a 3 x 3 block to

average, supplement, or expand this rectangle area. This feature data are then input to the neural network. In addition the vertical key pixel element number of human block, a size of human block and the average temperature in the human block are inputs to the neural network. This neural network generates three outputs which estimate the posture of an occupant, and select the optimum output value from the output of the above two position-estimating neural networks [2]. Figure 4 shows the neural network configuration for this processing.

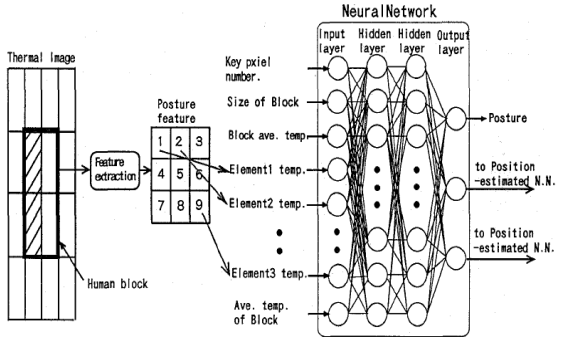

Figure 4 : posture-estimating Neural Network

4. RESULTS

In the experiment, the sensor was installed at a height of 2 m with a sensing area, 2 m by 3 m. In order to train the neural network, it is necessary for the neural network to be provided with data on many factors, such as body shape, direction, and clothing of the person, and the background temperature of the sensor [4]. In this experiment, 992 patterns of learning data were collected on background temperature, and on various direction and posture of the person. For the positional precision of the neural network, the positional precision of the person depended on the detection of the human area through the pre-processing [1]. In this experiment, the improvement in the positional precision of the neural network by structuralization was mostly examined as shown in Figure 2.

The following three items, in this experiment, were examined for the neural network configuration [5]:

1. One large neural network without structured.
2. One posture-estimating neural network and two position-estimating neural network where output is selected by the output of posture-estimating neural network.
3. One posture-estimating neural networks and two position-estimating neural networks where output is calculated from each two outputs and the outputs of the posture-estimating neural network.

Table 1: Average errors of distance-estimating by three different neural networks

ALOGORITHM	STEP 1	STEP 2	STEP 3
N.N. CODING	1	2	3
AVERAGE DISTANCE ERROR (CM)	19.4	17.5	14.0

Table 1 lists the three distance-estimating average errors. As a result, it could be confirmed that the structured configuration in 3 had the fewest errors. Errors occurred in 10 out of the 992 patterns for postural precision.

5. CONCLUSION

Detection of position and posture of occupants using low resolution sensor is proposed. The proposed system can measure the position and posture of occupants from feature data using a low resolution sensor. Infra-red image processing will develop into an image processing system that will be built in various household electric appliances that utilize the information on the occupants of a room.

REFERENCES

1. Robert J. Schilling & Sandra L. Harris. **Fundamentals of Digital Signal Processing using Matlab**, Thomson Learning, 2007.
2. Rafael C. Gonzalez & Richard E. Woods. **Digital Image Processing,** Second Edition, 2002, Pearson Education
3. Laurene Fausett. **Fundamentals of Neural Networks Architecture, Algorithms, and Applications**, 2005, Pearson Education.
4. Anil K. Jain, **Fundamental of Image Processing**, Prentice Hall of India.
5. Ballard and Brown, **Computer Vision**, Prentice Hall, 1982
6. Hirose, Yutaka, **Extraction of Human Image in Scene y IR and Visible View**,in Annual Conf. IEICE(Autumn).
7. Imai, Takayuki. **Infrared Image Processing using Neural net**, Annual Conf. IEICE (Spring).
8. Deguchi, Takashi. **Infrared Image Sensor System for Air Conditioners**, Sensor Technology, Vol. 13, No.4, 1994