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OCR Training and Simulation for Person Follower Robot in an Indoor Environment

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Authors' contributions

This work was carried out in collaboration between all authors. Authors DS and TSS designed the study. Author DS wrote the first draft of the manuscript. Authors DS and PRK managed literature searches and the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

This paper explores the usage of Optical character recognition (OCR) for a person follower behavior. The character on a person's uniform is captured using a network camera, which is interfaced on a Robotic system. In particular, this paper addresses the training of the characters to be used for the person following behaviour of a Robot, to ensure that the tracking is done properly. The graphical design is developed with LabVIEW software of National Instruments. Simulation results are furnished for the proposed training scheme.

Aim: To train and simulate an OCR for person follower behavior.

Study Design: The study of OCR method, exploring its use for person follower behavior is proposed and a LabVIEW based graphic design is developed.

Place and Duration of Study: Department of Electronics and Communications engineering, B V Raju Institute of Technology, Narasapur, Medak (Dt), Telangana, India, between July 2014 and July 2016.

Methodology: We included different image samples of each character 'L', 'F' and 'R' at various distances from camera which covered maximum scenarios. OCR module present in LabVIEW was used for training samples.

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Results: The screenshots of simulated results of the proposed training scheme are presented.
Conclusion: The training of sample images of the characters is done in various positions and to a maximum field of view of the camera. The test results have been found to be satisfactory.

Keywords: Optical character recognition; person follower; training; template matching.

1. INTRODUCTION

Robots have entered in human day to day affair like automating activities such as caring for elderly, cleaning floor, sharing emotional gaps, entertainment, etc. In recent years, the study on person centered robotics and the problem of tracking-localization has become the most fascinating area of research addressing the social aspect of service robots. There had been an increasing demand for care takers in society for elderly people and hence assistive robot is also seen as an alternative for them. The author of [1] stated that socially assistive robots can be classified in two ways, one as companion type and the other as service type. Both are adhered to provide assistance to the leader. Information about the present position of its leader will help mobile robots to deliver its services more efficiently. Assistive robots are used to evaluate the daily activities of a human being. The authors of [2] presented a thorough analysis of what kind of activities should be assisted by a robot. The prediction of human behavior is a challenging task and various methods with tough restrictions proposed by researchers and also the use of image processing techniques for tracking a person can be found in literature. A survey by [3] was presented on reconfigurable service robots and its applications in restaurants and medical domain.

The survey by [4] showed capabilities of technologies that are going to come in the development of service robots. The companies that develop Care-Robot have future expectations that there would be a shortage of caretakers. A report in the year 2015 by the United Nations on world population ageing stated that the percentage of older people (More than 60 years) with respect to the world's population is 12.3% and projected that by 2050 it would almost double to that of in the year 2015. And in India 116 million people were older in the year 2015 and it is estimated that by 2050 it would rise to 330 million [5]. This statistic depicts that the monitoring of elderly will become essential.

The use of various sensors for identifying the daily activities of elderly people based on the fuzzy logic system can be found in literature. They like the independent life style and hence a pervasive tele-monitoring system for them is required for their safety [6,7]. The functioning of sensors is very important, in case if one of the sensors is malfunctioned then the concept of multisensory data fusion is used. A work on the fusion of multisensory data based on human tracking mobile robot using laser range finder for leg detection was proposed by [8]. An approach to estimate the human trajectories using their activities like opening-closing of doors and stepping up-down based on SLAM framework was proposed by [9]. A grid mapping based hardware efficient scheme for indoor navigation of the robot was presented by the authors of [10]. A survey on the control of mobile robot movement using Bio inspired intelligent algorithms (BIAs) was presented by J.Ni et.al. The authors also proposed a new classification for BIAs from the biomimetic mechanistic point of view [11]. The control design of a intelligent vehicle for moving target following based on computer vision was presented by [12]. The authors also incorporated collision avoidance and colour image processing.

Optical character recognition (OCR) is an open research area for historical documents. Its use is found in digitizing the documents. A degradation model was proposed and analyzed by [13] to recognize the similarity between groups of ruined characters. The authors of [14] proposed a method of reducing word error rate using different OCR engines and the usage of in domain training was explored. An iterative training framework was proposed by [15] which uses OCR without segmentation to reduce the error in character recognition. The authors of [16] proposed an unsupervised learning of OCR and the same was authenticated for five languages. An approach based on neural networks was presented by [17] to decrease the training time of OCR and a high matching rate was maintained. The authors of [18] proposed method using Shannon entropy and wavelet packet technique to recognize handwritten Arabic characters and

the recognition performance were also discussed. A hidden Markov model based character recognition system is presented by [19] for detecting type written characters.

Our purpose of using OCR engine is to detect isolated characters 'L', 'F' and 'R' only to make important decisions by the robot like to take left turn, move forward or right turn, whenever the above characters were detected. This paper contributes a development of an OCR training scheme which uses sample images captured in the maximum focal view of an IP camera using LabVIEW. This training scheme was used by [20] for a person follower robotic system and developed a fuzzy logic model.

The remainder of the paper is organized as follows. Section 2 presents the methodology of the proposed work. The section 3 gives a block diagram of OCR training in LabVIEW. The section 4 presents the training samples of images used in OCR engine. Section 5 gives the simulation results and finally the section 6 concludes the work.

2. METHODOLOGY OF THE PROPOSED WORK

The work proposed here is about a character recognition based person follower robotic system. The characters, namely 'L', 'F' and 'R' are used on the person's uniform and these characters are required to be tracked continuously. An ultrasonic sensor will also be used for the measurement of distance from the robot. The sensor range is 0.2 to 3 metres. The concept here is that the robot is supposed to take left turn for character 'L', right turn for character 'R' and to move forward whenever the character 'F' is detected. In this scenario the OCR training and the matching will play an important role. Hence the training of the characters in various situations has to be done efficiently.

The camera used for capturing the images is Axis M1013 network camera. As per the data sheet the horizontal angle of view is 67^{o}, so the character presence on the person to be followed may be anywhere in the field of view up to 3 metres as shown in Fig. (1). The OCR training of the three characters is done in all positions in the field of view by capturing images with uniform steps taken by the person in area of the vicinity.

The method used for character recognition involves reading the captured frame image and then applying thresholding. This will convert the captured color image into Binary image.The particle analysis is performed on the binary image to recognize the character presence. Here the character recognition module of NI Vision assistant is used for training the characters.

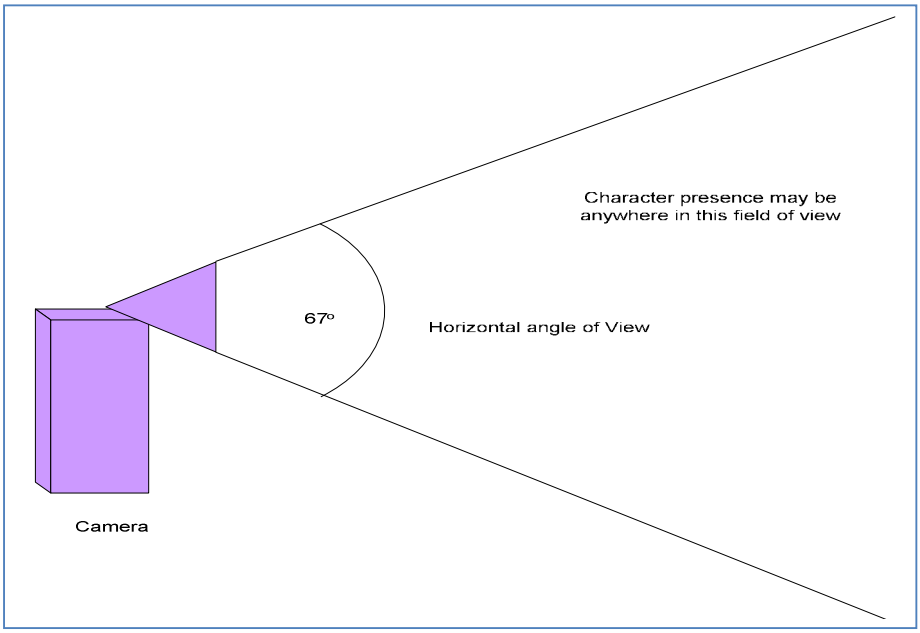

Fig. 1. Camera horizontal angle of view

3. BLOCK DIAGRAM OF OCR TRAINING

The block diagram of OCR training and the step by step block level explanation for character Training using Vision Assistant is shown in Fig. 2. The terminology and the modules shown are as per the NI LabVIEW..The OCR function using vision assistant offers to train the image characters by virtue of selecting the new character set file. A bound box is used to create a ROI (Region of Interest) area around the characters to train the image it will automatically separate each character from image background. As a result, there will be small rectangles that will indicate the location of the matched character in the image. The character sets are selected individually and accordingly the training is performed for all characters. After selecting the training data then the string characters are selected. For example 1-a 2-b 3-c, Here a, b, c is string and 1 2 3 character. Select train, to train the characters in the ROI. It can be the case that the text characters to be recognized are of different fonts.

Training the OCR software with all Characters including tilted fonts is performed in order to recognize the characters in various positions, so that this will produce a more accurate and reliable results. The acceptance level is set to 700 for recognizing the characters and the Threshold level of image is set to 10 for the characters F, L, R during training. The live video image acquisition is done using 25 frames per second. The OCR Training Interface F, L, R creates an OCR session file. The IMAQ clear overlay stores the character string. This information of Image and character string is read by Read text block, which can also read the selected Region of Interest (ROI). The region of interest is chosen of length 600 and breadth 300. The IMAQ overlay ROI block is to make the bound box layout color red. The dispose block to destroy the image, which is generally present at the end of the design and also after the while loop. An Error handling block displays "?????????" when no character is detected. The next step is matching the pattern.

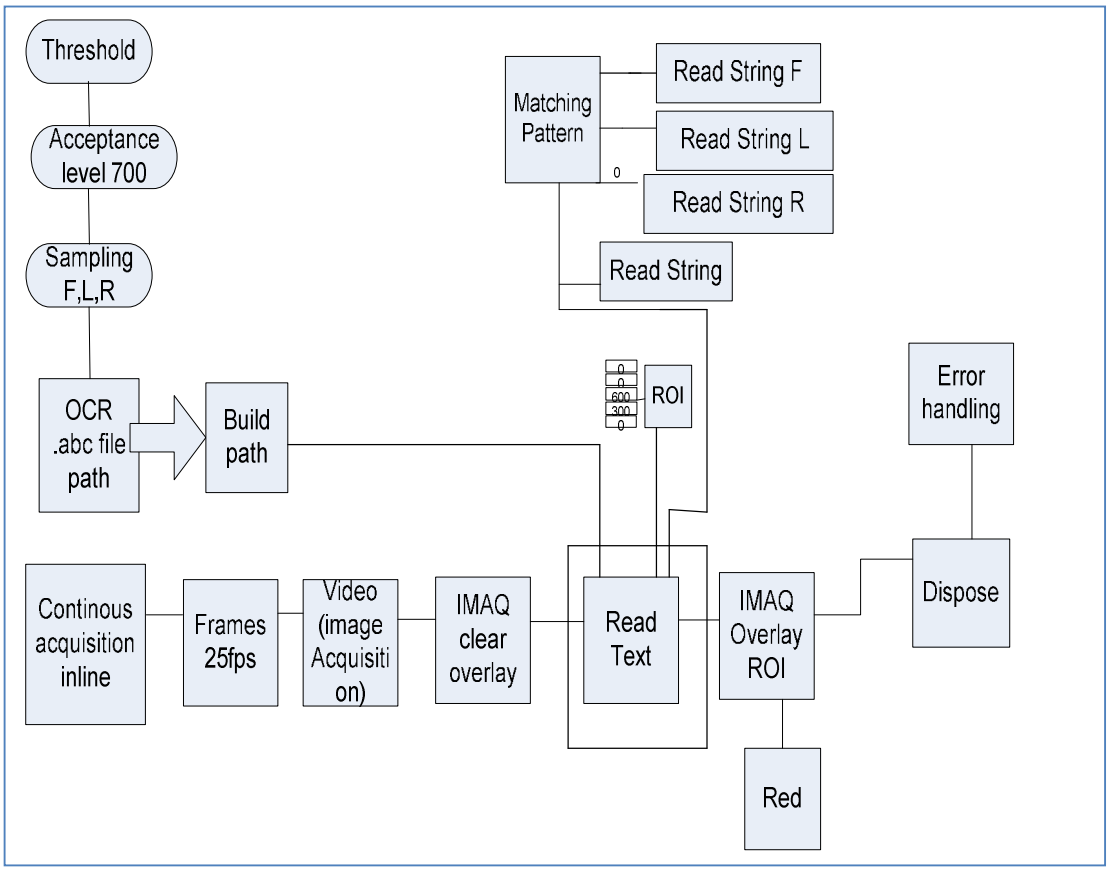

Fig. 2. Block level diagram for OCR training

4. SAMPLE OF IMAGES USED FOR OCR TRAINING

Each character is trained separately. So based on the various positions of character the sample count is different. This was chosen because the path that would be taken by the person is a random path in an indoor environment. As most of the time the robot act as a follower when compared to left and right turn which seldom occur unless there is an obstacle, hence more sample images were taken for training the character 'F'. The few sample images used for training the OCR are shown in Fig. 3.

Table 1. Number of trained samples per character

Character	Number of trained samples
F	27
L	18
R	18

The Table 1 shows the number of trained samples taken for each character, namely F, 'L' and 'R'. Hence a total of 63 sample images were trained in various positions at different distances from the camera.

5. RESULTS AND DISCUSSION

The complete design is done in LabVIEW and the simulation results are shown in figure (4). After the Matching of character is done, we create the substring eg. F, L and R character and is given to an arithmetic function equal to symbol. During matching if the Camera captured image has 'F', it compares with substring character F and then checks the arithmetic operation equal to symbol, if the condition is satisfied the result is shown through a green color led in the Fig. 4.

The recognition efficiency for the three characters is shown in the Table 2. The testing was done manually by capturing the frames at various positions of the person. However, the capturing is done at the rate of 25 frames per second in real time so if the character is not recognized for one or two times will not affect the tracking of the person.

Fig. 3. Few sample images used for training the characters F',' L' and 'R'

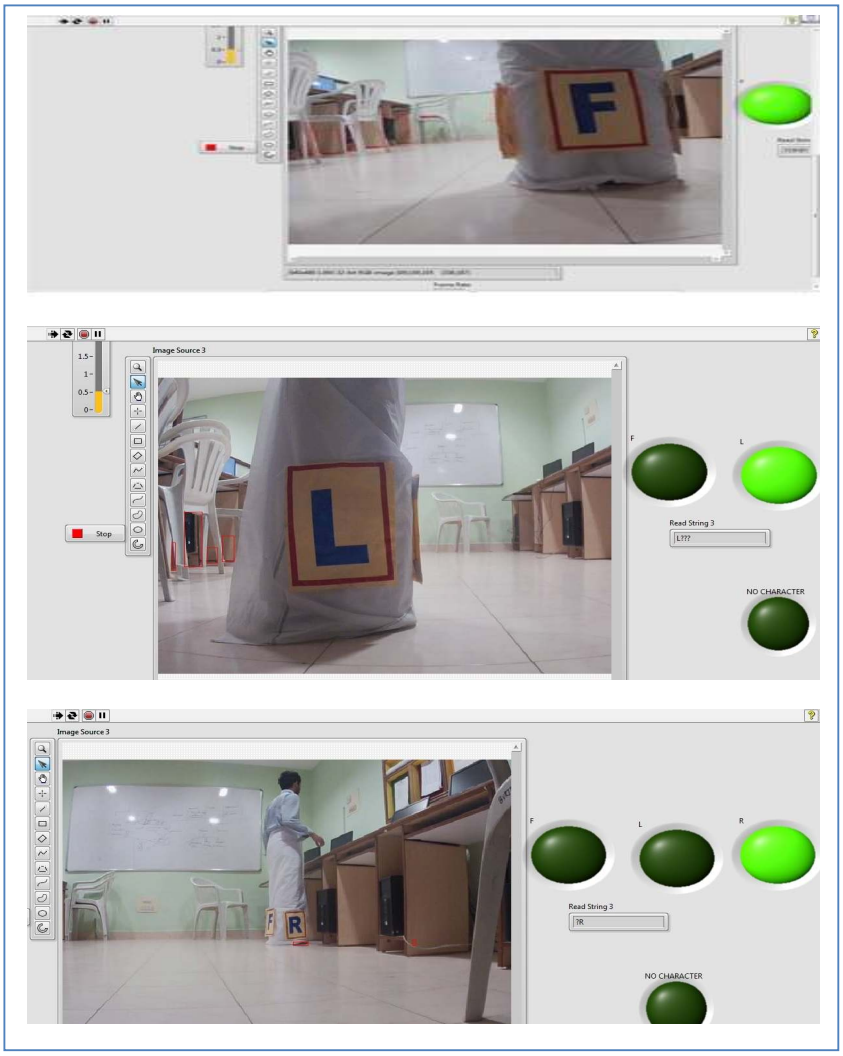

Fig. 4. Simulation results when the characters F',' L' and 'R' are detected by OCR engine

Table 2. Recognition efficiency for the testing sample images

Character	Number of trained sample images	Number of testing dataset	Recognized character	Recognition efficiency
F	27	20	19	95%
L	18	12	11	91%
R	18	12	10	83%

6. CONCLUSION

This paper presented the training of an OCR engine in particular for a person follower robot. The processing time for character matching will be less as compared to other complex tracking methods. A total of 63 sample images were trained in different positions. This paper contributed a training scheme of OCR and developed a sample database for person tracking using character recognition. The performance of the OCR engine was tested for the three characters in various positions of the person.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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