

New Era for Educational Robotics: Replacing Teachers with a Robotic System to Teach Alphabet Writing

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Abstract. Usage of robotic systems has been always centre of interest of educational organizations. Due to the structure and behaviour of robot, new learners feel comfortable to interact with robot while they are learning. In this paper, a new educational robotic system is proposed which is used in order to teach new learners how to write the alphabets correctly. The system is using advance computer vision algorithms such as singular value decomposition based illumination enhancement, multi-diagonal matrix filter based edge detection, and part-based tree-structured character recognition to detect the written characters.

Keywords: Educational robotic system, image processing, character recognition

1 Introduction

Routes of educational robotics are from 1960's when Seymour Papert together with Marvin Minsky developed a floor robot called Turtle [1]. Turtle was programmed with programming language LOGO. Turtle was able to drive on the floor and draw it's trajectory with pencil. Nowadays there are many robotic hardware solutions available for educational institutions [2].

There are not many studies that give good cause to use one or another approach with pupils. All of educational technology is based on Papert's theory of constructionism [3]. As educational robotics (ER) has been used mostly in extracurricular activities, students attend based on their beliefs and assumptions about robotics. Effect of ER in learning only affects those attending. ER is not considering robotics as an object but rather a tool to learn with. Learning with robots enhances learner's cognition. Authors believe learning effect is the same when robot is in role of a teacher or learning aid instead of being built by the pupils [4].

Robots are so far used mostly in education for construction and implementation of constructionism. There are few studies on improving handwriting with the help of robots. Character recognition is one of the most essential steps in many image processing applications [5]. There exist many techniques in recognition of the characters based on their orientations and shapes [6]. Palsbo and Hood-Szivek made a study in 2012 where they tried to evaluate the safety and efficacy of a small gaming console, the Falcon, in delivering training to children with poor hand writing [7].

2 Proposed Educational Robotic System

In this work the proposed ER system is aiming to help new alphabet learners, mainly young children, to write the characters correctly. This task is being done by firstly enhancing the illumination of the captured sequences using singular value equalization [8] and then detecting the edges of the characters by using multi-diagonal matrix filter [9] followed by detection of characters by using part-based tree-structured algorithm [10]. Fig. 1 is representing the general block diagram of the proposed method.

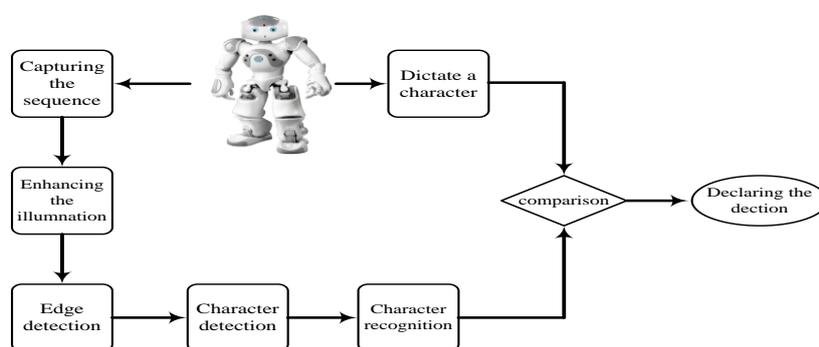


Fig. 1: The block diagram of the proposed educational robotic system

In order to enhance the illumination of each frame of the sequence, singular value equalization based illumination enhancement is being implemented [8]. The enhanced frame will be converted into binary form and the edges of the characters will be extracted by using multi-diagonal matrix filter [8]. The extracted edges are used as an input of part-based tree-structured character detection [9]. Each character is represented by a tree consisting of nodes and topological relations of nodes. In the detection stage histogram of oriented gradients (HOG) is being used as a descriptor of the characters [11]. The recognized character will be checked by the dictated character that the robot has dictated earlier. If both of them are same, the robot will congratulate the learner, otherwise the robot will encourage the learner to try again. In case of not being able to recognize the character the robot will ask the learner to re-write the alphabet.

Robot is being used as teacher aid similarly to You et al. [12] in contact free concept. That means robot is not in contact with pupils physically, but can help learning in distance. Study carried out by You involved physical humanoid robot placed in classroom as an assistant of teacher to teach English. In handwriting recognition system, robot is performing autonomously. In case of close communication with the robot, children are led to a point where they want to write clear enough to make the robot to understand their handwriting or write fast to meet requirements set by the robot.

3 Conclusion

In this research work we have proposed a new educational robotic system is proposed which is used in order to teach new learners how to write the alphabets correctly. The system was benefiting from advanced computer vision algorithms in order to detect the written characters. Due to the structure and behaviour of the proposed educational robotic system the learners can boost their learning skills.

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