Chapter 20
A Transfer Learning Approach for Smart Home Application Based on Evolutionary Algorithms

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ABSTRACT

Building new systems used for indoor sign recognition and indoor wayfinding assistance navigation, especially for blind and visually impaired persons, presents a very important task. Deep learning-based algorithms have revolutionized the computer vision and the artificial intelligence fields. Deep convolutional neural networks (DCNNs) are on the top of state-of-the-art algorithms which makes them very suitable to build new assistive technologies based on these architectures. Especially, the authors will develop a new indoor wayfinding assistance system using aging evolutionary algorithms AmoebaNet-A. The proposed system will be able to recognize a set of landmark signs highly recommended to assist blind and sighted persons to explore their surrounding environments. The experimental results have shown the high recognition performance results obtained by the developed work. The authors obtained a mean recognition rate for the four classes coming up to 93.46%.

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1. INTRODUCTION

Indoor sign recognition and indoor wayfinding assistance present a very crucial assistance task especially for blind and visually impaired persons (VIP) to reach their destinations in a safer way. Blind persons have troubles when navigating in strange environments. They are unable to use the information posted on notice boards and indoor signs. Persons with vision impairments frequently need more help with daily tasks than people with other disabilities. A visual impairment restricts one's capacity for learning, social interaction, and object recognition. By developing new assistive systems, we can widely contribute to help persons presenting visual deficiencies to navigate safely in new unfamiliar indoor environments. Indoor sign identification and detection serve as a fundamental building block for numerous fields. It seeks to determine whether or not an indoor sign is present in the image.

Recently, deep learning architecture and deep convolutional neural networks (DCNNs) have demonstrated huge performances to perform new assistive technologies. DCNN architectures can be applied for different types of artificial intelligence and computer vision tasks. Deep learning-based models have made an outstanding success in computer vision and artificial intelligence areas.

Indoor sign recognition presents one of the most common problems that can affect the blind and the visually impaired (BVI) security. In order to ensure better life conditions for the BVI persons, new innovative and adaptive technologies and new navigational systems are increasingly needed. These new assistive technologies are generally used to ensure better inclusion of this category of persons in the social life.

Indoor wayfinding presents a crucial task for the living independent. It is exceedingly difficult to create an interior navigation system for BVI. Building such systems in indoor environments are extremely challenging due to the complexity of decoration, high occlusion, inter and intra-class class variation and different lighting conditions. Understanding indoor environments is very challenging task. Persons with limited sight face different difficulties to follow visual information in indoor places. Building low cost navigation assistance systems for BVI people is urgently needed. People rely on perception and visual information particularly to identify the surrounding objects, orientations and directions. This challenging task falls under the category of wayfinding, whereas the capacity of identifying objects and avoiding obstacles falls under the category of mobility. Currently, these are few studies or navigational aids for blinds and visually impaired in new unfamiliar environments that include various decorations which make navigation in this category of spaces challenging difficult. The vision problem significantly affects the life of affected persons and makes it difficult to carry-out their daily life activities.

We propose in his work to build a new indoor wayfinding assistance system used for BVI assistance navigation and for better social integration.

The main aim from this work is to build a new wayfinding assistance technology used to support BVI persons to freely navigate in their indoor environments without being dependent to other persons. The proposed work is developed by tacking advantages of aging evolutionary algorithms.

Training and testing experiments have been performed using the proposed indoor signage dataset. The proposed dataset counts 800 images composed of 4 landmark indoor signs. The 4 signs are: WC, exit, confidence zone and disabled exit. We note that the proposed dataset is original as it covers various challenging conditions such as: different objects viewpoints, different lighting conditions, high inter and intra-class variation and so on. We note that the proposed work presents the first work evaluating the evolutionary algorithms in indoor wayfinding assistance. Another strength of the proposed work is that it provides a new indoor sign recognition system that is able to recognize new indoor signs that were not studied before by the state-of-the-art works.