

MAKERERE UNIVERSITY

CONVOLUTION NEURAL NETWORKS FOR MICROCONTROLLERS AND CONSTRAINED HARDWARE

DEPARTMENT OF COMPUTER SCIENCE

SCHOOL OF COMPUTING AND INFORMATICS TECHNOLOGY

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**Abstract**

Though recent advanced convolution neural networks have been improving the image recognition accuracy, the models are getting more complex and time consuming. For real-world applications in industrial and commercial scenarios, engineers and developers are often faced with the requirement of constrained time budget. [5, 6] We investigate the accuracy of convolution neural networks under constrained time cost. Under this constraint, the designs of the network architectures should exhibit as trade-offs among the factors like depth, numbers of filters, filter sizes, etc. With a series of controlled comparisons, we progressively modify a baseline model while preserving its time complexity. This is also helpful for understanding the importance of the factors in network designs. We present an architecture that achieves very competitive accuracy in the Image Net dataset

1. **Introduction**

Convolutional neural networks (CNNs) have recently brought in revolutions to the computer vision area. Deep CNNs not only have been continuously advancing the image classification accuracy but also play as generic feature extractors for various recognition tasks such as object detection, semantic segmentation and image retrieval. [1]

**1.1 Background**

Convolution is a mathematical concept used heavily in Digital signal processing when dealing with signals that take the form of a times series.

In machine learning, a convolutional neural network is a type of feed-forward artificial neural network in which the connectivity pattern between its neurons is inspired by the organization of the animal visual cortex.[2] Convolution Neural Networks stand out for their ubiquity of use, expanding the ANN of applicability from feature vectors to variable-length inputs. [3]

Over the past few years Artificial Neural Networks (ANN) have received major attention due to breakthroughs in several fields, such as computer vision [1], voice recognition [2] and natural language processing [3]. With statistical methods [4] these networks are able to approximate underlying functions and patterns in large amounts of data without any prior knowledge or assumptions about it.

The Markup Language (ML) has been witnessing a “Neural Revolution” since the mid 2000’s as the Artificial Neural Networks (ANNs) found application in tools and technologies such as search engines, automatic translation, or video classification. [4]

* 1. **Problem Statement**

The problem this project will address the imbalanced distribution and loss of data in image classification performance. This will give insight the underperformance of the CNN or possibly it increase. It will also investigate how the different distributions affect the CNN performance in the data training.

* 1. **Objectives**
     1. **Main Objective**

To develop a system that will present an approach to explore the deployment of trained convolution networks in microcontrollers and constrained hardware that will demonstrate useful image processing on low devices.

* + 1. **Specific Objectives**

To review the existing system and the processes that have been undertaken to come up with the system

To obtain requirements of the new system as regards to the loopholes in the current systems.

To provide an application which enables each and every user to monitor and supervise their homes.

To test whether the mobile phone application addresses the stated objectives and implement it.

* 1. **Scope**

The scope provides for the boundary of the research in terms of depth of investigation, content, and sample size, geographical and theoretical coverage. The geographical scope of this research will be carried out around the homes.

**References**

[1] A. Krizhevsky, I. Sutskever, and G. Hinton. Imagenet classification with deep convolutional neural networks. In NIPS, 2012.

[2] Wikipedia, the free encyclopedia <https://en.wikipedia.org/wiki/Convolutional_neural_network>

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[4]   Andrey Kurenkov, “A brief History of Neural Nets and Deep Learning”. [<http://www.andreykurenkov.com/writing/a-brief-history-of-neural-nets-and-deep-learning/>]

[5] Cornell University Library, <https://arxiv.org/abs/1506.03648>

[6] [Weisstein, Eric W.](http://mathworld.wolfram.com/about/author.html) “Convolution.” From [MathWorld](http://mathworld.wolfram.com/) — A Wolfram Web Resource. [H[ttp://mathworld.wolfram.com/Convolution.html](http://mathworld.wolfram.com/Convolution.html)]