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Hand Cricket Game Using CNN Squeeze Network

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Abstract—The game of Hand cricket is a popular childhood game that involves the use of hands and fingers to simulate a cricket match. In this paper, we propose a novel approach to enhance the game by introducing the use of squeeze sensors and implementing a deep neural network for execution. The squeeze sensors are used to detect the hand gestures of the players and transmit the data to the deep neural network for analysis. The deep neural network then generates the appropriate response for executing the game, such as displaying the score and determining the winner. Our experimental results demonstrate that the use of squeeze sensors and deep neural networks can significantly enhance the game of Hand cricket, providing a more engaging and interactive experience for players.

Keywords— Hand Cricket, CNN, Tensorflow, OpenCV, Keras

I. INTRODUCTION

Hand cricket is a popular game played by children in many countries. It involves the use of hands and fingers to simulate a cricket match. While the game is simple and easy to play, it can be enhanced using modern technologies to provide a more engaging and interactive experience. In this paper, we propose a novel approach to enhance the game of Hand cricket using squeeze sensors and a deep neural network for execution.

Small, inexpensive squeeze sensors that may be fastened to a player's hand allow for the detection of hand motions. They are frequently employed in wearable technology to track health-related metrics and monitor physical activity. In the method we suggest, participants' hand motions while playing hand cricket are detected using squeeze sensors. The deep neural network receives the sensor data and transmits it for processing.

An artificial intelligence system called a deep neural network is made to resemble the structure and operation of the human brain. It is made up of numerous layers of connected nodes, which can learn intricate patterns from big datasets. In the method we suggest, we employ a deep neural network to analyse the squeeze sensor data and produce suitable Hand cricket playback replies.

This study aims to show how deep neural networks and squeeze sensors may dramatically improve the game of hand cricket, giving players a more interesting and involved experience. We offer experimental data. results that show the efficacy of our suggested strategy and talk about the potential uses of this technology in various sports and activities

II. RELATED WORKS

Both traditional methods and automatic methods of machine learning approaches were used to classify breast cancer. Both provided good accuracy, however Extra Tree Classifier fared better than other algorithms [1]. DPIIER, an emotion identification system that can function in many lighting situations and for various head postures, has been proposed. The Model is tested and evaluated using Type III-fold cross validation on a GPU system [2]. In order to reduce the number of filters required for satellite image categorization from the current four bands CNN to two bands, NDVI is used as a stand-alone parameter. According to the findings, this approach provided SAT-4 picture classification with an accuracy rate of 98.01% [3]. On a system with extremely limited power resources, CNN based on thermal picture is proposed to recognise persons. With a 99 percent accuracy rate, it can recognise heads and count the number of people in a given classroom using memory no more than 500kB [4].

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The technique of finding and classifying groups of pixels or vectors inside an image based on predetermined rules is known as image classification. There are many algorithms for classifying images, including SVM, CNN, K-NN, and Decision Tree, among others. Contrary to predictions, CNNs have become the most sophisticated computer vision method. LSTM, ANN, RNN, and other forms of neural networks apart, CNNs are by far the most popular and are frequently utilised in image data applications [5]. CNN is a framework that has the capacity to independently discover features of a given domain. Different uses of the CNN's variations are investigated [6]. From CNN, the feature vectors are transferred to SVM. Pre-Trained CNN as a feature extractor has been demonstrated to be an incredibly reliable method for identifying handwritten numbers [7]. A novel technique is given forth that creates a bypass feature maps input by combining CNN and the SQI (Self Quotient Image) Algorithm. This structure enabled the adding of features with prior knowledge to the CNN [8] with the aid of fundamental image processing.

The analysis of CNN's performance in classifying sports videos has shown that it can do it with perfect accuracy using just one CPU [9]. A CNN with fewer parameters than usual was suggested to address issues with gradient vanishing and overfitting when classifying photos. With the use of this model, the MNIST Dataset's accuracy was increased to 99.467 percent [10]. Image classification has been used in the past to identify colours, classify animals, read handwritten numbers, find breast cancer, identify emotions, classify image and video material, and more. The suggested model focuses on the application of image classification in the gaming industry, specifically the use of CNN squeeze network to build a game of hand cricket while classifying photos of hands.

CONCEPTS

This paper covers the CNN architecture, which consists of Convolution, Squeeze network, ReLu, and Global Pooling.

A typical ANN requires more processing and is sensitive to image location. This means that it is not advised for image classification [11].

CNN is effective at handling both. It employs filters from the different CNN layers to carry out operations like convolution, pooling, and normalisation. Multiple filters are applied to the input image at the convolutional layer in order to extract various features from it. These filters are capable of spotting simple patterns like corners, edges, and lines in the input image. The subsequent layer receives the output of the convolutional layer and may use additional filters to extract more complicated characteristics. Fig. 1 depicts the standard CNN's architecture.

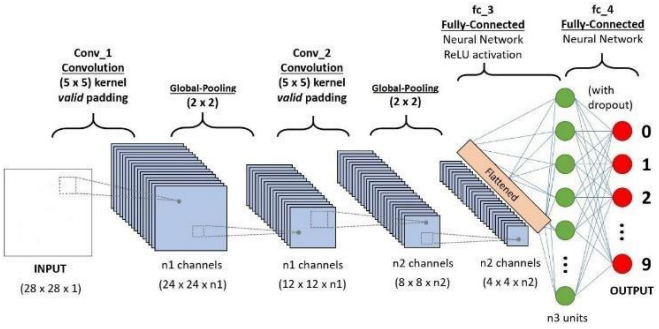

Fig. 1. Diagrammatic Representation of a CNN

A. Convolution:

Consider a hand written number '9' as shown in the Fig. 2.

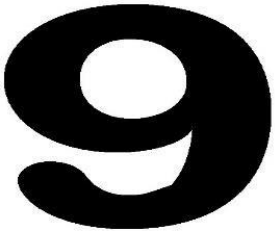

Fig.2. Hand written number

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As depicted in Fig. 3, imagine portraying the image of the number "9" using an 8 by 9 grid that contains intensity values..

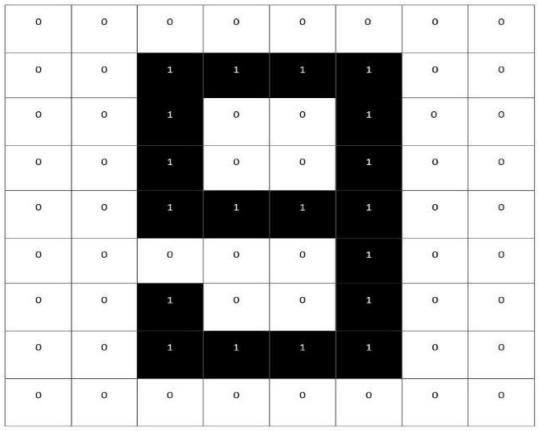

Fig.3. Number “9” in pixel format

To recognise the handwritten alphabet "a," take into consideration three features: the loopy pattern filter shown in Figure 3.a, the curved pattern filter displayed in Figure 3.b, and the diagonal pattern filter shown in Figure 3.c [3].

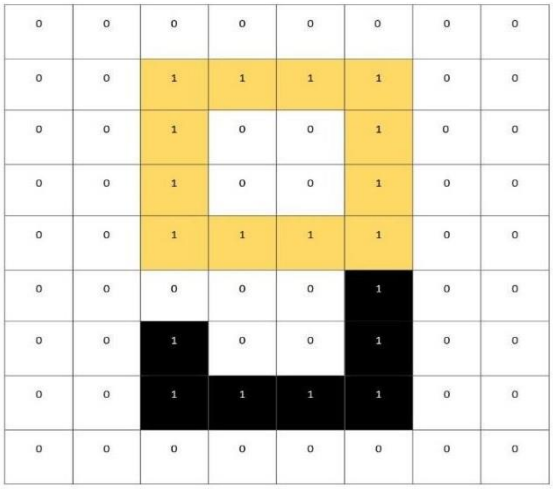

Fig.3.a: Loopy Pattern Filter

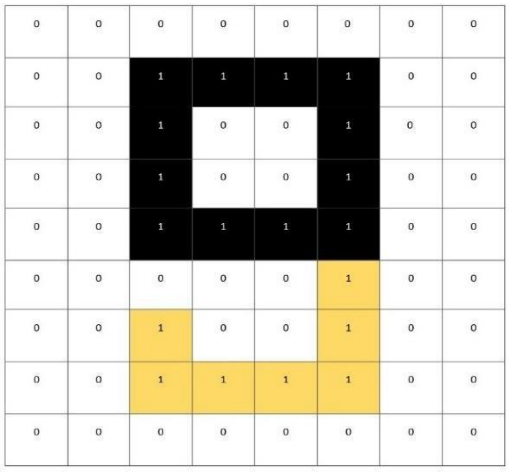

Fig.3.b: Curved Pattern Filter

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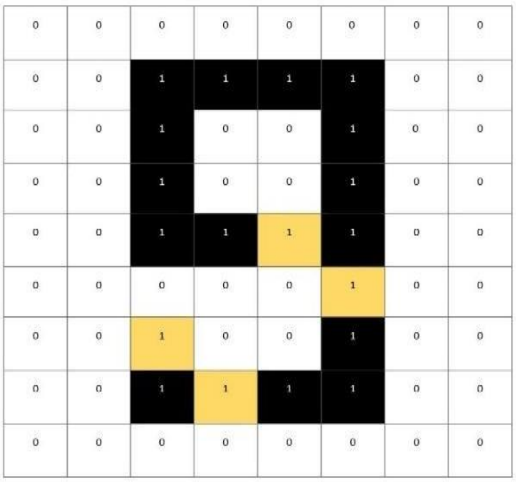

An n x n matrix is taken into consideration if the filter is n x n, and individual elements are multiplied, averaged, and inserted into a new matrix known as the feature map because it maps all the features.
Example:

For Loopy Pattern Filter:

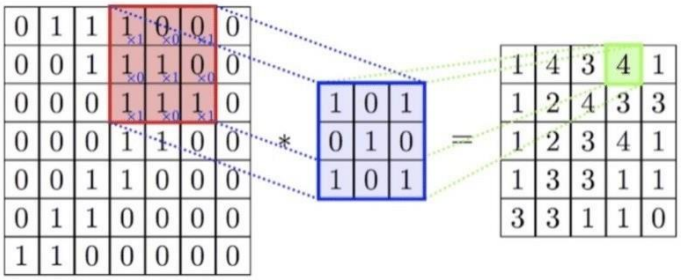

Fig.4.: Working of Convolution with filter with an example

C. Pooling:

The feature map's dimensions are decreased through pooling. In Fig. 6, the next example is a maximum pooling with a 2 x 2 filter and stride "2". The maximum number will be selected during maximum pooling.

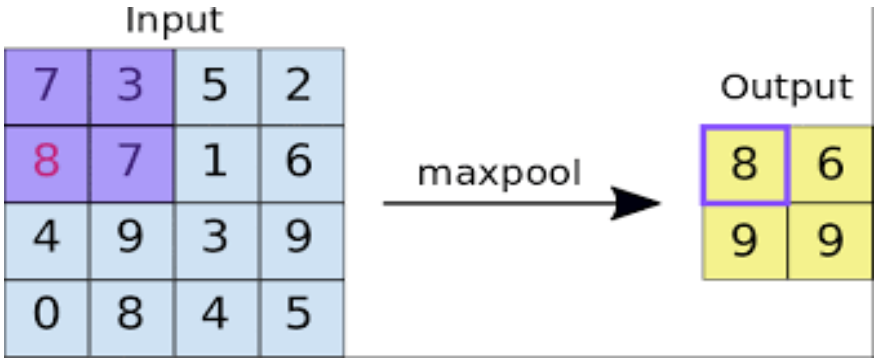

Fig.6. Working of Max Pooling with an example

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D. Thresholding:

- • Thresholding, in which pixels with equal grey scale (or any

The process of convolution of an image with a filter is shown in Fig. 4.a and b. As an example, the first element of the 3 x

3 grid of the entire matrix is multiplied with the first element
of the filter, the second element of the grid is multiplied with the second element of the filter, and so on. All values obtained are then added up, and the result is divided by the number of elements in the filter.And so, on up to the last possible 3 x 3 grid.

Convolution has the following advantages: • Sparse networks, where not every node is connected to every other node, reduce overfitting.

- A location invariant feature detection is produced by convolution and pooling.

- Parameter sharing, where one filter can share a parameter that it has learned with another filter.

B. ReLu:

It is an activation function that keeps the positive numbers unchanged while changing the negative numbers to '0'. Fig. 5 conveys the operation of a ReLu activation function quite clearly.

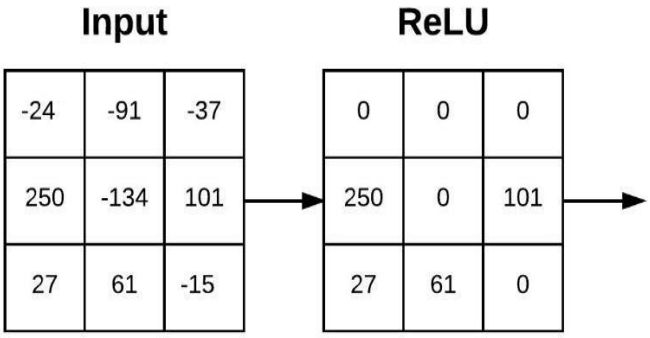

Fig.5. Working of ReLu Activation Function with an example

Benefits of ReLu:

It is an activation function that keeps the positive numbers unchanged while changing the negative numbers to '0'. Fig. 5 conveys the operation of a ReLu activation function quite clearly.

other property) are clustered or grouped together, is one of the most crucial techniques for segmenting images.

- The most effective threshold setting (s) can often be found using an image histogram.
- Since some images (such scanned text) are bimodal, just one threshold should be used [2,4,7-9,11].

Grey-level Thresholding:

Let, 'T' be the Threshold Value

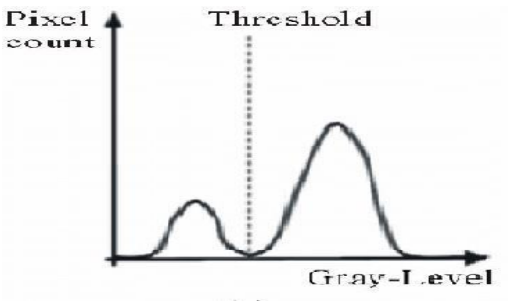

Fig.7. Gray Level Thresholding

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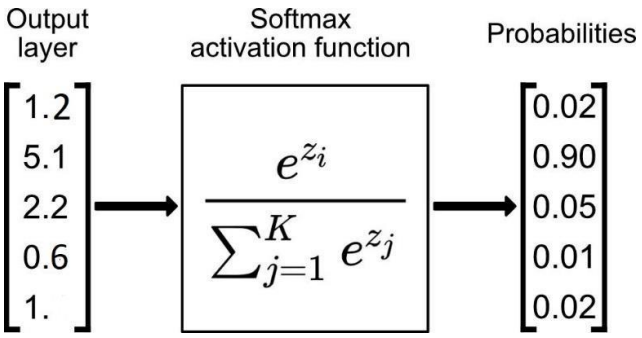
Grey level thresholding algorithm works as follows: – If (pixel p's grey level = T):
"Pixel p is an object pixel" Alternatively,
The statement "Pixel p is a background pixel"
Every threshold, as shown in Fig. 7, causes the histogram to be divided into two groups, each with their own statistics (mean, variance).

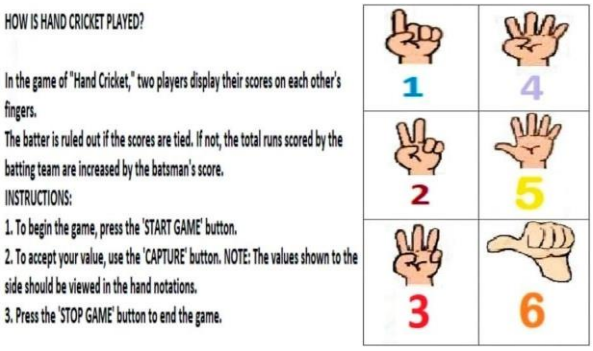
The homogeneity of each group is assessed using the variance within each group. The best threshold is one that satisfies all of the aforementioned criteria [1,6].

A.SoftMax Function:
Softmax broadens this idea to include a number of classes. Softmax does this in a multi-class problem by assigning decimal probabilities to each class. Their combined decimal probability have to equal 1.0.

An array of numbers is transformed into an array of probabilities by the mathematical function SoftMax, where each value's likelihood is inversely associated with its location in the vector [5].

Example:





IMPLEMENTATION

Using CNN:

This approach makes advantage of a unique data collection that was created in-house. Open-CV was used in its production. Using the coordinates of the ROI, the hand region that is the ROI is extracted. "The hand gestures dataset" is 6300 by 6 categories, 1, 2, 3, 4, and 5, with 1000 photos in each category for training and 50 images in each category for testing.
.
The Pytorch Module is used to build the neural network. The CNN is made up of two convolution layers, each with 32 3 x 3 filters, ReLu Activation (which speeds up computation and makes the neural network non-linear), a Max Pooling Layer (which downscales the image and helps extract the most crucial features), and a Dense Layer with a Hidden Layer and SoftMax function at the end. As assessment criteria, the CNN classifier used accuracy, categorical cross entropy loss function, and Adam optimizer (Adam is the best performing optimizer that performs well with sparse data).

Before training the model, the images are converted to black and white using grey level thresholding, which helps to divide the image into two portions with the hand being turned into black and the rest of the image into white. There are ten training epochs employed.

The validation set consists of the model and the testing data set. The GUI is developed using PyQt5. The game's instructions can be accessed by selecting the directions button in the home menu (see Fig. 9 below for an illustration). The user can go back and start the game from the home screen once they've read the instructions.

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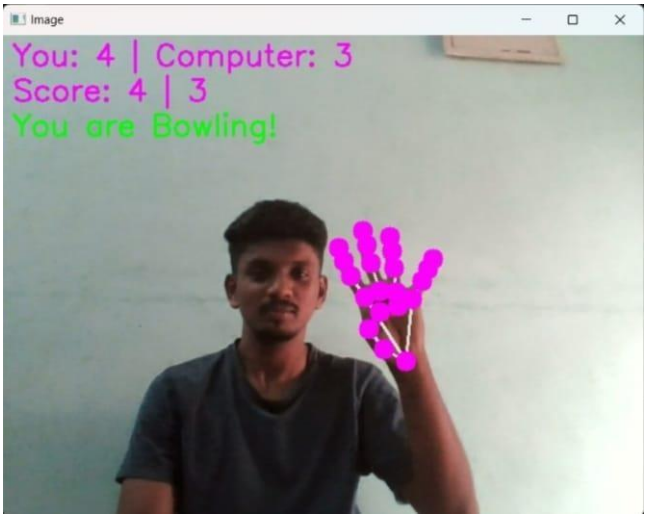

Fig. Playing Hand Cricket Game

Fig. Displaing Winner

Fig. Playing Hand Cricket game (2)

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CONCLUSION AND FUTURE SCOPE

In this work, a CNN for hand cricket game was constructed using Python, and a different implementation was created using MediaPipe. Using the unique home-made data set, the CNN model was trained, and it showed good accuracy. The player should only use his left hand when playing because the custom-built dataset was made utilising left hand photos. In the future, the dataset might be expanded to include photos of the right hand as well, allowing the game to be developed as a two-player game with players other than the computer..

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